

# Yellowjacket Pro Transmitter



## TECHNICAL MANUAL

Version 1.4

Provided by:

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**RFHERO™**  
**Industrial Controls**

# YellowJacket Pro

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Revision	Date	Updated Sections	Rev. Init.	Approval	Comment
1.0	10/10/2013	All	ECN	EN	First Issue
1.1	1/30/2014	1	ECN	EN	Updated General Information
1.2	4/5/2016	1,2,4,5	KS, ECN	EN	Updated for FCC , IC Cert.
1.3	4/27/2016	1	ECN	EN	Update to FCC label
1.4	4/30/2016	6	KS,ECN	EN	User Guide

## FCC Notice:

The following notification is required for all YellowJacket Pro transmitters. The device is certified to operate within FCC RF power control limits for unlicensed transmitters. The notification is located on the back of the transmitter.

FCC ID: QIA-YJPRO  
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.



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## **1: General Information:**

The YellowJacket Pro transmitter is a low powered FM radio sending device designed to operate a variety of electrical systems by allowing a remote operator to provide control via an industrial pushbutton interface. Using the selected radio band of 434 MHz and utilizing low power yet highly accurate digital and radio microprocessors coupled with industrial grade hardware the YellowJacket has proven to provide exceptional range, utility and effectiveness in the use of wireless controls for machinery and safety.

Primary uses for the YellowJacket Pro include mining, material handling, safety alerts, lighting controls and an extensive use for switchable relays that compliment operating from a short to medium distance less than 500 feet (~ 130 meters). The unit is completely self contained and the operator does not have to do any programming, antenna placement or configuration prior to operation. All critical functions have been preset by the factory and the antenna is internal to the high impact plastic case. Simplified operation for most control systems has been proven to be accomplished by the use of either on or two buttons to turn the unit on and off. When coupled with the YellowJacket receiving system the paired system has shown to have extensive industrial capacity to operate in extreme environments for temperature as well as heavy obstructions such as walls, fences and other terrain obstacle.

## **2.0 Transmitter Design and Specifications:**

Nichols Electronics has extensive experience working with mobile industrial controls in the material handling and mining industries in particular. Throughout the years the single most necessary factor for a remote transmitter was reliability when needed. Secondly the demands for size, weight and a non snagging type of antenna were most requested.

Often these devices are employed to such a great extent that they become integrated in to the operation to the extent they are required by either production managers to increase work flow or safety managers to extend the safe operating distance for personnel to avoid dangerous obstacles or processes. To address the concerns the design team found the following high level key parameters were essential to success:

- Highly reliable communications within 100 meter (~300 ft) range
- Small handheld profile– can fit in a pocket if needed
- Hardened case that is impact resistant and tolerant to harsh chemicals
- Battery operated by standard off-the-shelf AA batteries
- Non-snap antenna– internal preferable
- Industrial buttons with good tactile feedback
- Button protection from inadvertent actuation
- Low battery indication, easy to identify
- Operating LED to acknowledge unit is sending

To address these issues it was decided to high impact plastic case along with industrial pushbuttons that has already proven to be a highly capable combination. This also allows optimum radio communication without sacrifice of ruggedness. The radio system is completely organic to the main processor PCB which allows comprehensive digital signal processing while maintaining complete control over the RF signal. The RF signal is emanated from an internal wire type antenna that is matched to operate within the frequency and other dynamics of handheld communications.

Primarily the design team was challenged to provide a simplex control system, low cost yet with high reliability thru multiple temperature ranges while providing the operator nearly zero latency with command once a button is depressed. To accomplish the goals a proven combination of using a microchip series processor and integrating a low power Infineon TDA7100 FM transmitter chip provided a clean and optimized system that has virtually no tuning and completely integrated within a single PCB.

## YellowJacket Pro Radio Control System Specifications:

### Transmitter:

- ◆ Size: 4.5 x 2.75 x 1.4 in.
- ◆ Weight: 4.25 oz
- ◆ Frequency: 434 MHz
- ◆ RF Power: 4-10mW
- ◆ RF Range: 300—500 ft. LOS
- ◆ Operating Temperature: -30 to +70 Deg. C
- ◆ Battery Life: 100+ Hours on single charge
- ◆ Antenna: Internal PCB or Whip
- ◆ Controls: 3 industrial grade pushbuttons
- ◆ Battery Power: AA standard or rechargeable
- ◆ Enclosure material: High impact resistant ABS Plastic

Image 1 below shows the face and pushbutton locations.

Image 2 below show the FCC ID Label and the battery compartment.



Image 1:  
Transmitter  
front view

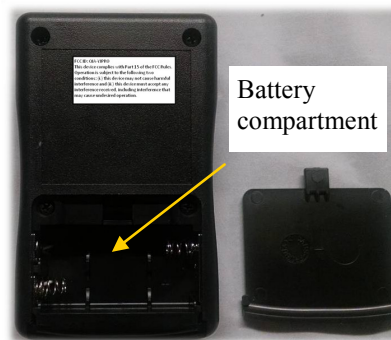


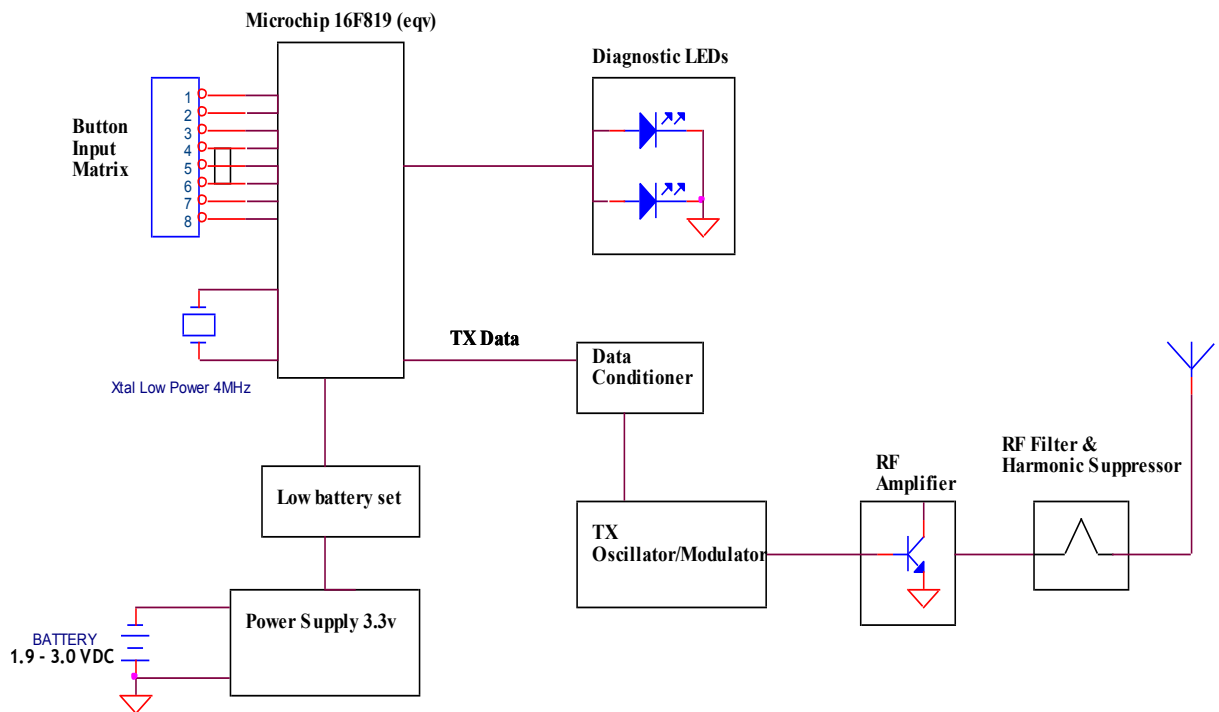
Image 2: Transmitter rear view

### 3.0 Block Diagram and Theory of operation:

The YellowJacket transmitter system is comprised of 6 main areas of functionality. A block diagram and schematic are attached to allow better understanding of the system and its functionality.

1. **Microprocessor-** The Microchip <sup>TM</sup> 16F819 series processor using a 4 MHz crystal oscillator is responsible for all housekeeping functions such as: battery management, sleep times, button input wake up and validation, Transmit data format and timing. The 16F819 has a long history of exceptional reliability, low power and industrialized capacity to work through harsh environmental conditions while being able to maintain the radio control, data serial number, and diagnostic LEDs.
2. **Power Supply-** Using a Diodes, Inc. <sup>TM</sup> AP1603 series power boost system the YellowJacket power control is always a steady 3.3V. The unit can operate from 3.3V down to 1.9V at which time a low battery warning will be issued by the processor in the form of a slow beat of red pulses.
3. **Data Conditioner-** This circuit is a simple set of RC components that removes the square edges on the data train to allow a more smooth and exacting FM transition in the TDA7100 transmitter chip. Data going into the conditioner is nominally 9600 baud and simply is just slightly delayed to allow the FM circuitry to properly shift key.
4. **RF Amplifier-** A Class C type of RF transistor suited to the low power demands of the Yellow-Jacket system is used to provide a buffer and power control between the TDA 7100 and the RF Filter circuitry. By biasing the signal properly along with associated balance component the harmonics and other noise factors are significantly reduced by applying the RF Transistor in the manner shown.
5. **RF Filter and Harmonic Suppressor-** A ceramic filter specifically designed for this application was chosen to optimize center frequency response while diminishing any unwanted signals.
6. **Antenna-** The simple wire type antenna was chose for its ease of manufacturing and ability to be folded in the same pattern each time the unit is manufactured. Testing has shown that proper antenna length, type of wire and good solder practices will yield a superior integrated antenna in this design.

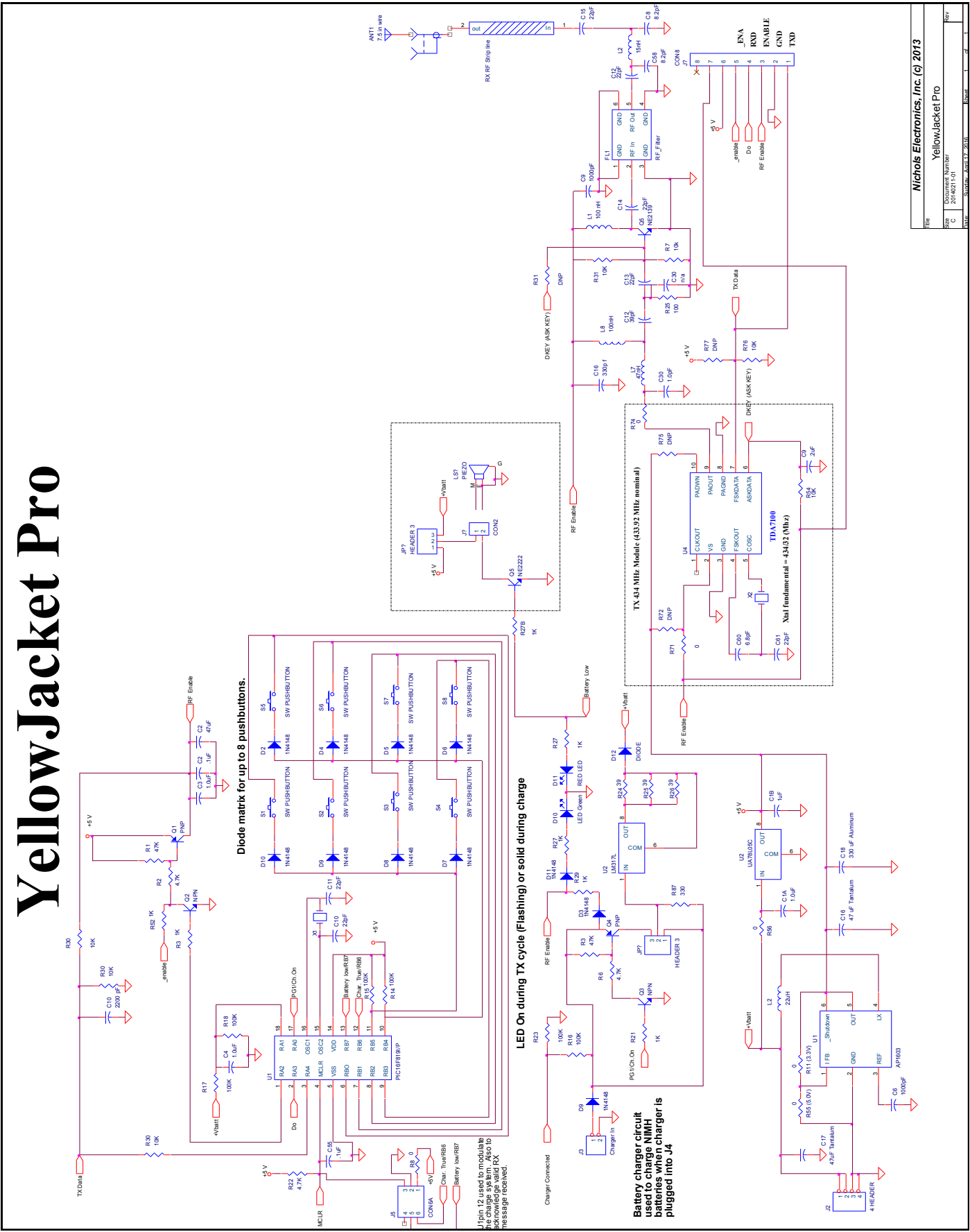
# YellowJacket Pro



Nichols Electronics, Inc. / RFHero (c) 2013		
Title		
YellowJacket Pro Diagram		
Size A	Document Number 20131030-01	Rev A
Date: Sunday, April 17, 2016 Sheet 1 of 1		

Diagram 1: YellowJacket transmitter block diagram

# YellowJacket Pro



# YellowJacket Pro Nichols Electronics, Inc.

Item	Qty.	Location	Description	Manufacturer	Man. Part No.	Notes
1	4	R1, R2, R3,R23	47.5K Ohm 0805 SMT resistor 1%	Panasonic	ERJ-6ENF4752V	
2	3	R5,R6, R22	4.75K Ohm 0805 SMT resistor 1%	Panasonic	ERJ-6ENF4751V	
3	7	R8, R9, R11, L7, R74, R70, R71 ( R55*, R56*,)	0 Ohm 0805 SMT Resistor 5%	Panasonic	9C08052A0R00JLHFT	R55*, R56* DNP
4	4	R14,R15, R16, R17 (R18*)	100K Ohm 0805 SMT Resistor 5%	Panasonic	9C08052A1003JLHFT	R18*
5	1	R27A	RES 330 OHM 1/8W 5% 0805 SMD	Panasonic	9C08052A3300JLHFT	
6	6	R30, R7, R31, R76, R75, R54	RES 10K OHM 1/8W 5% 0805 SMD	Vishay/Dale	CRCW080510K0JNEA	
7	4	C1, C2, C3, C4, C20*	1.0 uF Cap. 0805 SMT	Panasonic	ECJ-2VF1C105Z	C20* DNP
8	1	C6	.1 uF Cap 0805 SMT	Panasonic	ECJ-2VF1C104Z	
9	0	C8*	1pF Cap, 0805	Kemet	80-C0805C109C5G	C8* DNP
10	3	C9, C71, C73	1000pF 0805 SMT	Kemet	C0805C102K1RACTU	
11	6	D1, D2, D3, D4*, D5*, D6*, D7*, D8*, D9, D10,D11	DIODE 75V 500MW FAST SWITCHING (1N4148)	Fairchild Diodes, Inc.	FDLL4148	D4*, D5*, D6*, D7*, D8* DNP
12	1	HAWKTX12A5F	Hawkeye TX Card	NEI	HAWKTX12A5F	
13	7	R4, R52, R29, R27, R21, R61	RES 1.0K OHM 1/8W 5% 0805 SMD	Panasonic	9C08052A1001JLHFT	
14	5	C10, C11, C12, C13, C15	22pF 5% 50V NPO CAPACITOR 0805 smt	KEMET	C0805C220J5GAC	
15	1	X1	4MHz CRYSTAL	FOX	FOXS040	
16	0	DNP	18 PIN DIP SOCKET	Assmann	TBD	Direct solder chip to U3 board
17	2	L1, L8	.1uH (100nH) SMT Inductor	Vishay	IMC0805ERR10J01	
18	3	Q1, Q3, Q6	TRANS NPN 40V SMD SOT-23	Zetex	FMMT3904TA	
19	2	Q2, Q4	TRAN 100V 1A PNP SPR SOT SOT-23	Zetex	FMMT723TA	
20	1	Q5	TRANSISTOR NPN 1GHZ SOT-143	CEL	NE68139-T1-A	
21	4	R24, R25, R26, R25A	39 Ohm, 0805 SMT	Vishay/Dale	CRCW080539R0JNEB	
22	1	U1	Switching converter	Diodes, Inc.	AP1603WL-7	
23	1	L2	INDUCTOR 22uH	TDK	VLCF5020T-220MR58	
24	2	C16, C17	47uF 10 Volt Tantalum Capacitor	Vishay	293D476X9010C2TE3	
25	1	LED1	T1-3/4 RED/GREEN BI-COLOR LED	FAIRCHILD	MV5437	
26	1	U3	LM317LZX	FAIRCHILD	LM317LZX	
27	0	C18	330uF, 25V	Mouser	UVR1E331MPD1TD	C18** only on Fal- con
28	1	U2	PICF819I/P, Microprocessor	Microchip	PIC16F819I/P	
29	1	C60	CAP CER 10PF 50V NP0 NP0 0805	TDK CORPORATION (VA)	C2012C0G1H100D	
30	1	X2	13.5625 MHz TX Xtal	RFHERO		
31	1	C61	CAP CER 6.8PF 50V NP0 0805	KEMET (VA)	C0805C689D5GACTU	
32	1	C30	CAP CER 3.3PF 50V NP0 0805	KEMET (VA)	C0805C339D5GACTU	
33	1	C31	CAP CER 330PF 50V 5% NP0 0805	KEMET (VA)	C0805C331J5GACTU	
34	1	U5	IC TX ASK/FSK 434MHZ 10-TSSOP	INFINEON TECH- NOLOGIES (VA)	TDA7100	
35	1	R70	0 Ohm 0805 SMT Resistor 5%	Panasonic	9C08052A0R00JLHFT	
36	1	R71	DNP- for future design			DNP
37	1	C70	DNP- for future design			DNP
38	1	U7	DNP- for future design			DNP
39	1	FL1	434MHz RF Filter		B39431B3710U410	

## YellowJacket Pro Transmitter Test Procedure:

### General information:

The YJ Pro transmitter is designed with **no active or passive tuning elements**. Properly assembled with quality components or approved alternates will result in proper operation each time the unit is manufactured. Should any unit fail the appropriate Quality Control steps it should be removed from the production line and tagged with a white failure tag. On the tag stage/step of failure and technicians notes should be made clearly in black ink.

### Step 1 Transmitter preparation:

1. A properly assembled transmitter ready for testing will look like the image below to left. The test technician is to verify all components are correctly placed, soldered and ready for final testing.



Transmitter open and ready for testing

Transmitter back with battery compartment open



2. Basic operating of the unit is done by inserting batteries (2 AA) into the battery compartment. Make sure the polarity of the batteries is correct by following the indicators inside the compartment. Image above to the right shows the battery compartment. The coil type end clip is always the negative battery terminal.
3. When the batteries are installed the LED at the top of the unit will blink 3 times indicating startup and processor readiness.
  - Check the 3.3V supply by using a multimeter and checking across the pads for C16. The white stripe on the capacitor is positive. Alternatively you can use the pads for C18. The square pad on C18 is ground.
4. Press any button and the Green LED at top of the unit will flash quickly indicating processor is working.
5. Test all three buttons for same as # 4 above to verify all buttons are functioning.
6. Switch to power supply and insert 3.3V to the unit and verify the unit blinks 3 times again.
7. Slowly lower the power supply to 1.9V and verify that between 1.9 and 2.0 V the low battery alert is working. This is noticed by the unit now showing slow blinking red indications when any button is pressed.
8. This completes the basic testing the next steps will provide for the RF testing and verification. Annotate in QC log the test steps completed above
9. Replace the batteries in the unit and verify the RF range by doing a 300 ft. range test. Annotate in QC log the test step completed for RF Range Test at test site.
10. Final testing is done when the unit is operated with the paired receiver. The unit is now ready for stocking.



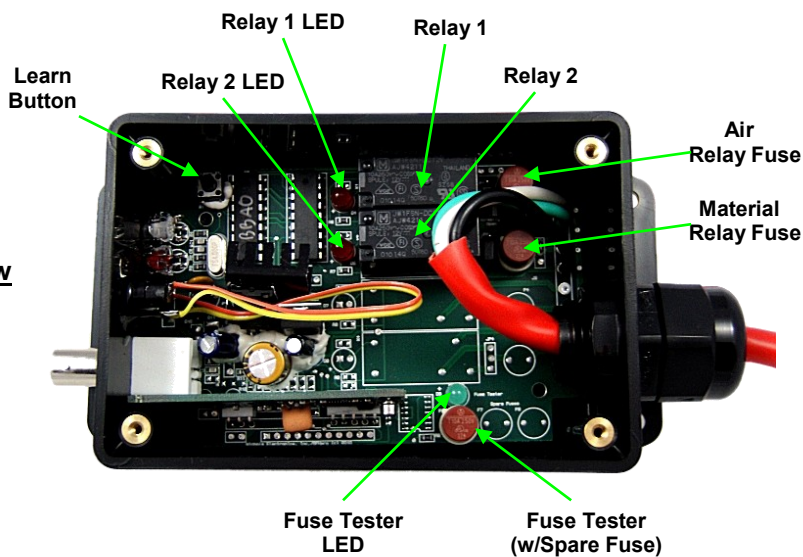
# YJPRO USERS GUIDE

## YellowJacket Pro Receiver

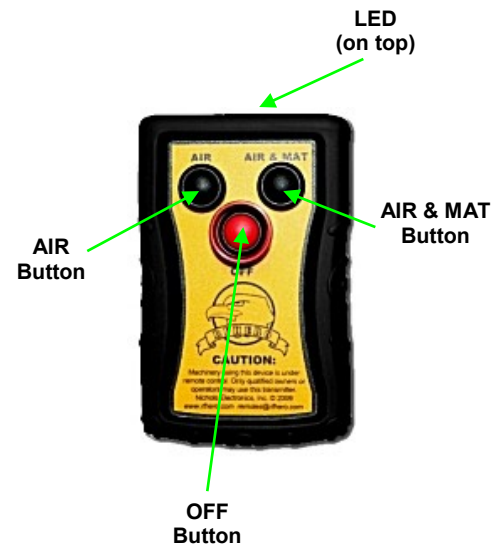
Front View



Top View



## Transmitter



## Pairing the YellowJacket Pro Receiver and Transmitter (Learn Mode)

### **ATTENTION!**

*This section contains the pairing instructions for REPLACING or ADDING an additional remote transmitter. Your new transmitter and receiver are already paired from the factory and this procedure is unnecessary for a new YellowJacket Pro kit.*

1. Remove the lid on the YellowJacket Pro receiver by unscrewing the four (4) Philips head screws (one in each corner).
2. Un-power the receiver by removing the power-plug from the jack next to the antenna connection. Wait 10 seconds. Re-power the receiver by reinserting power plug into it's jack. You have 60 seconds to complete the Learn Mode procedure.
3. After the Communications LED flashes three (3) times, press and hold the Off button on the transmitter.
4. Press and hold the Learn button on the YellowJacket Pro receiver.
5. Release the Off button on the transmitter for five (5) seconds.
6. Press the Off button on the transmitter again.
7. Release the Off button on the transmitter and the Learn button on the YellowJacket Pro receiver.
8. The Communications LED on the YellowJacket Pro receiver should now flash green/red (may appear orange) when a button on the transmitter is pressed.
9. Replace the lid and screws on the YellowJacket Pro receiver.
10. The transmitter and YellowJacket Pro receiver are now paired together and ready to operate as a system.



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