

DISASSEMBLY AND ANALYSIS OF VEX V5 WIRELESS CONTROLLER

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Introduction:

The VEX V5 Wireless Controller (SKU#: 276-4820) was used for the purposes of this online challenge. Originally we planned to disassemble the TI-15 Explorer™ Elementary Calculator, however we decided to change devices after finding that the TI-15 used a proprietary chip-on-board that was covered with a black epoxy. We were inspired by team 10C, Exothermic Robotics, in their disassembly of a VEX Transmitter and Receiver (SKU#: 276-2153). They reported that they were able to find uncovered IC's with part numbers which made us hope that we could do the same with the VEX V5 Wireless Controller.

Components

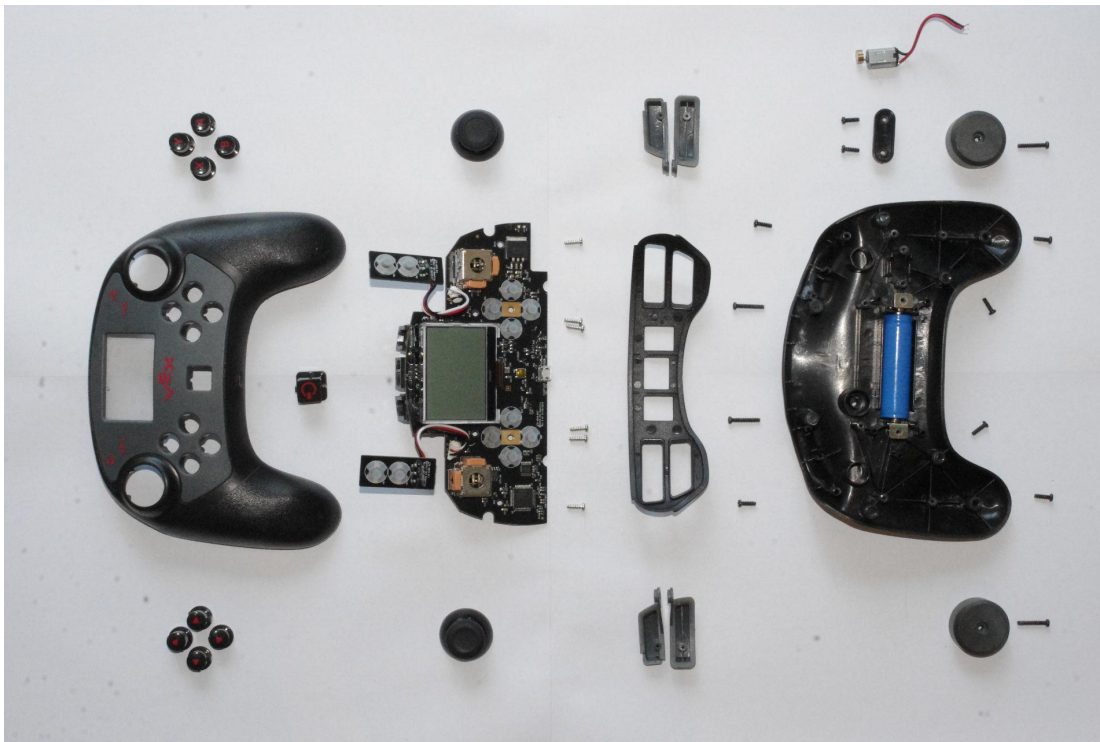







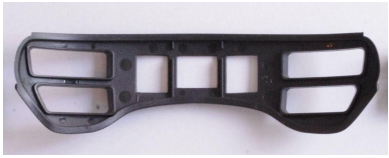

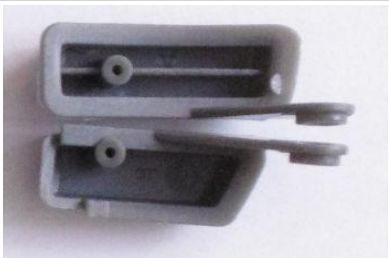





Fig 1. Full view of all components in the VEX V5 Wireless Controller.

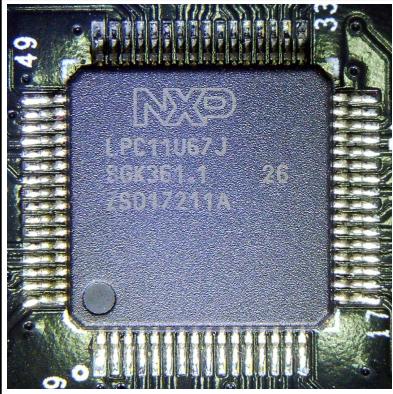
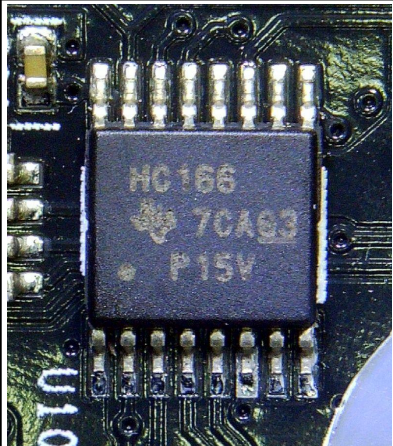
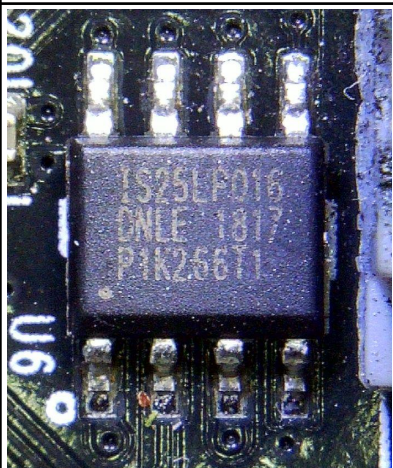
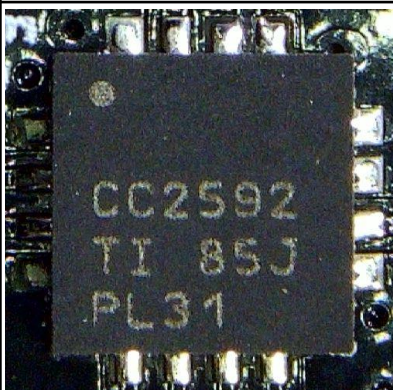
LIST OF EXTERNAL COMPONENTS			
IMAGE	QTY	NAME	DESCRIPTION
	1	Top Housing	The Xbox controller style housing is familiar to most users and makes it easy to grip.

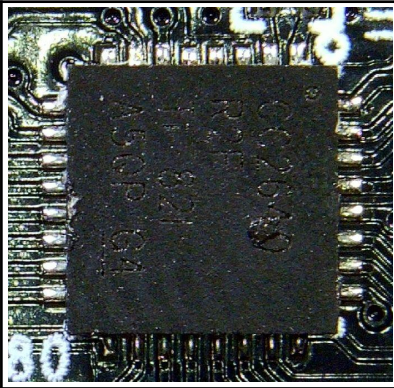
	1	Bottom Housing w/ 14500 Battery	We were unable to find a way to remove the 14500 Lithium Ion battery from the bottom housing safely due to the adhesive. Power is transmitted to the main PCB through large metal contacts, a design choice we enjoyed seeing.
	2	53g Weight	These weights make the controller feel nice in the hands.
	4	ABXY buttons	Drawing inspiration from the Xbox controller, these buttons should be familiar to any driver.
	4	Directional buttons	For any mechanisms that require directional control these buttons come in handy with their arrows.
	1	Power button	Used to power on the controller. Serves a double purpose as
	2	Plastic Joystick	Commonly used to input directional commands to steer the robot. The analog joysticks allow for precise inputs.

	1	Front Plate	This is used to house the shoulder buttons and also to cover the front of the controller.
	2	Left Shoulder Buttons	Extra buttons located on the front of the controller allow for greater control over the robot as more inputs can be sent using only one hand.
	2	Right Shoulder Buttons	
	6	Silver 7mm M3 Plastic Screws	Used to keep everything together. Without these the controller would just fall apart.
	6	Black 7mm M3 Plastic Screws	
	4	Black 15mm M3 Plastic Screws	
	1	Vibration Motor	Used as haptic feedback for the controller software. Makes using the controller easier.
	1	Vibration Motor Mount	Used to keep the vibration motor in place.

LIST OF INTERNAL COMPONENTS

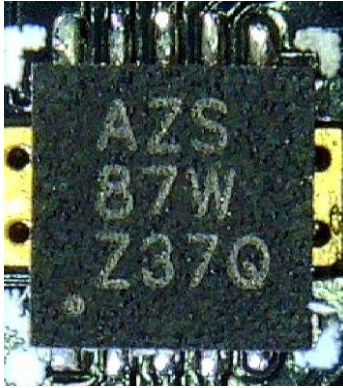
IMAGE	QTY	NAME	DESCRIPTION
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 <p>A close-up photograph of a square microcontroller chip mounted on a green PCB. The chip is labeled with 'NXP', 'LPC11U67J', '86K361.1', '26', and '75017211A'.</p>	1	NXP LPC11U67J	The 'brain' of the VEX V5 Wireless Controller. ARM Cortex-M0+ based 32-bit microcontroller with support for USB and a variety of busses.
 <p>A close-up photograph of a square shift register chip mounted on a green PCB. The chip is labeled with 'HC166', '7CA93', and 'P15V'.</p>	1	SN74HC166	This is a 8-Bit parallel load shift register. What it does is it takes 8 bits as an input and outputs the 8 bits through one output. It achieves this by sending each bit from the 8-bit input individually per each clock cycle. We were unable to discern the input for this shift register, however.
 <p>A close-up photograph of a square chip mounted on a green PCB. The chip is labeled with 'IS25LP016', 'DNLE 1817', and 'P1K2.56T1'.</p>	1	Unable to find a part number combination that yielded data about this chip	
 <p>A close-up photograph of a square radio IC chip mounted on a green PCB. The chip is labeled with 'CC2592', 'TI 85J', and 'PL31'.</p>	1	Texas Instruments CC2592	2.4 GHz radio IC. Output power of 22-dBM. Used on the VEX V5 Wireless Radio to communicate with the VEX V5 Robot Radio.



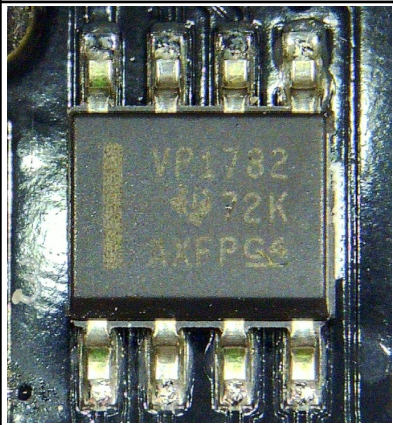
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Unable to find a part number combination that yielded data about this chip



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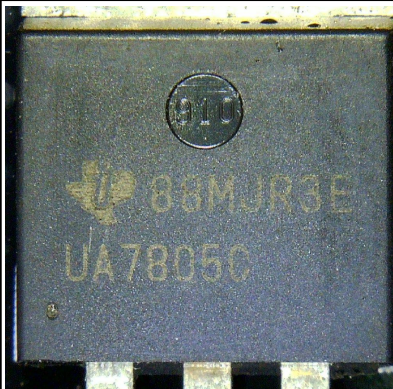
Unable to find a part number combination that yielded data about this chip



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Unable to find a part number combination that yielded data about this chip

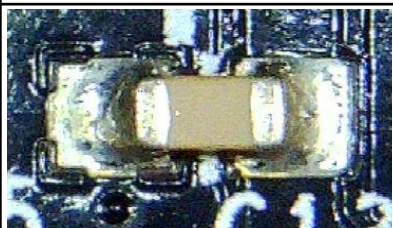
Most likely used to convert the analog input from the joysticks into a digital output. There are two of these chips located near each joystick, meaning that they must be related in some way.



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Texas Instruments UA7805C


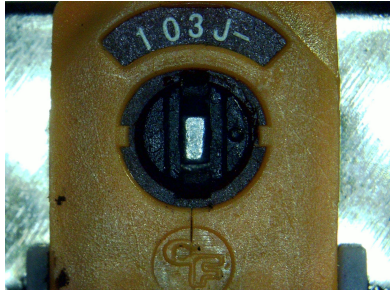
5V linear regulator that supplies power for the entire controller. Takes the battery voltage as input and boosts it to 5V. Linear regulators provide clean power with no switching noise and also can quickly respond to changes in load voltage.



97

SMD Capacitors

Most likely used to decouple power to the various IC's.

	71	SMD Resistors	Most likely used to set configuration modes for the various IC's.
	2	CF Analog Joystick	Analog joysticks that are used for input

Conclusion

Conducting research on the various components found in the VEX V5 Wireless Controller, I learned what a 8-Bit Parallel-Load Shift Registers is.