VEX Robotics Electronic Challenge

Team 3204C

Introduction

We will be disassembling the following devices:

- VEX PIC Robot Microcontroller
- VEX ARM Cortex
- VEX IQ Robot Controller
- VEX V5 Robot Brain

Introduction (Continued)

We chose to disassemble these devices because we believe that they accurately portray VEX's history. Because this is a series of devices, we can compare them, seeing how the VEX Robotics Platform has evolved, as well as predicting what the future of VEX Products look like. They are also a likely place to find multiple Texas instruments components, as this is even listed on the challenge website!

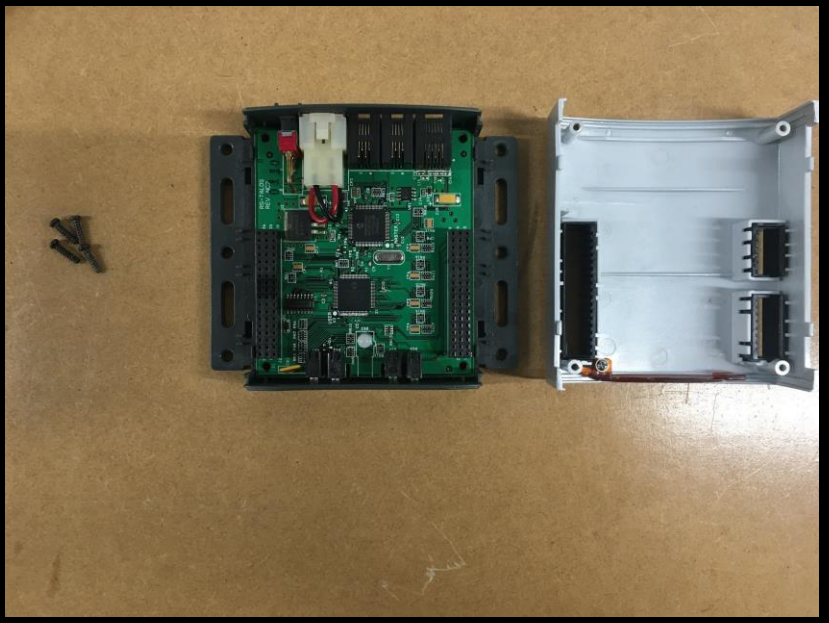
Part One

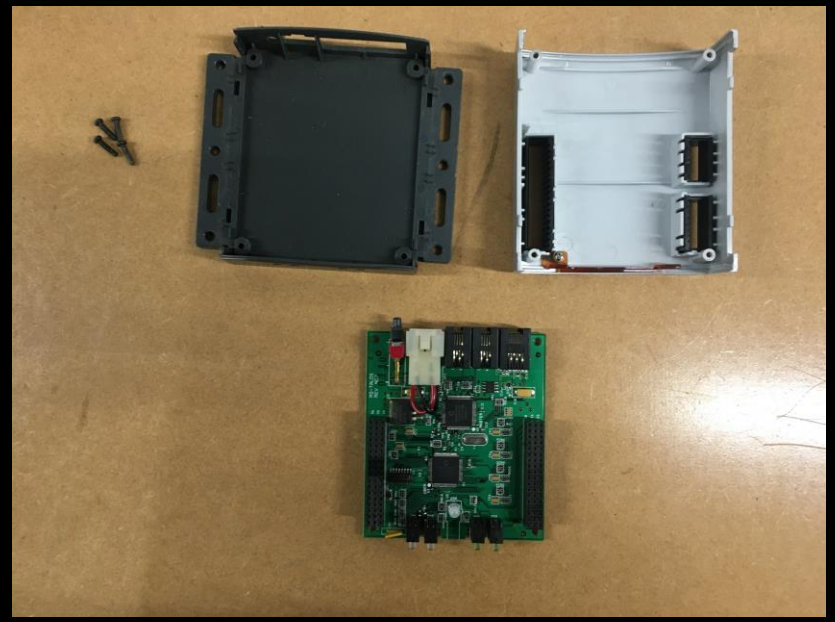
VEX PIC Microcontroller

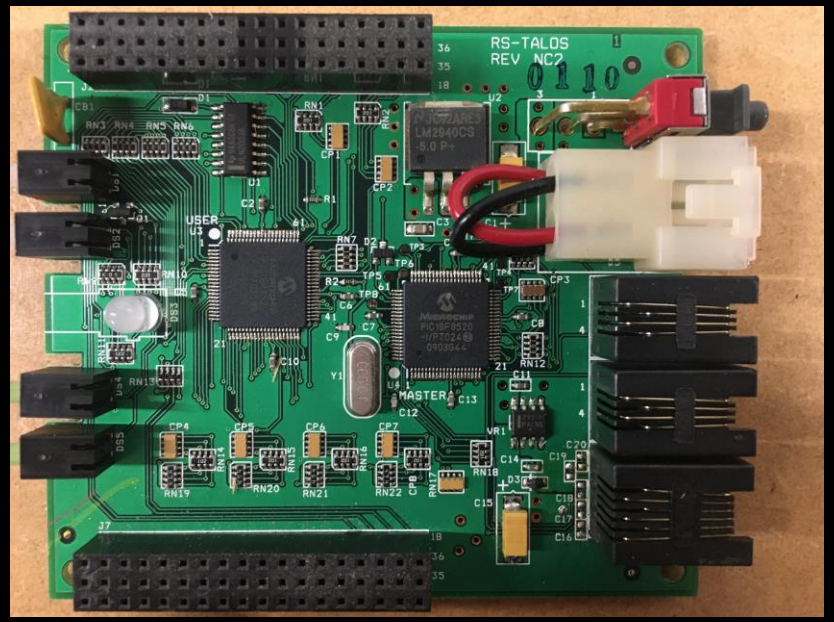
Disassembly

Disassembly of the device was easy, due to its components being covered in a reasonably small plastic shroud. Here are the images that we took of the disassembly process:

Research







Research (Continued)

Here the list of components we found inside, as well as each of their functions, features, and whether they were made by Texas Instruments:

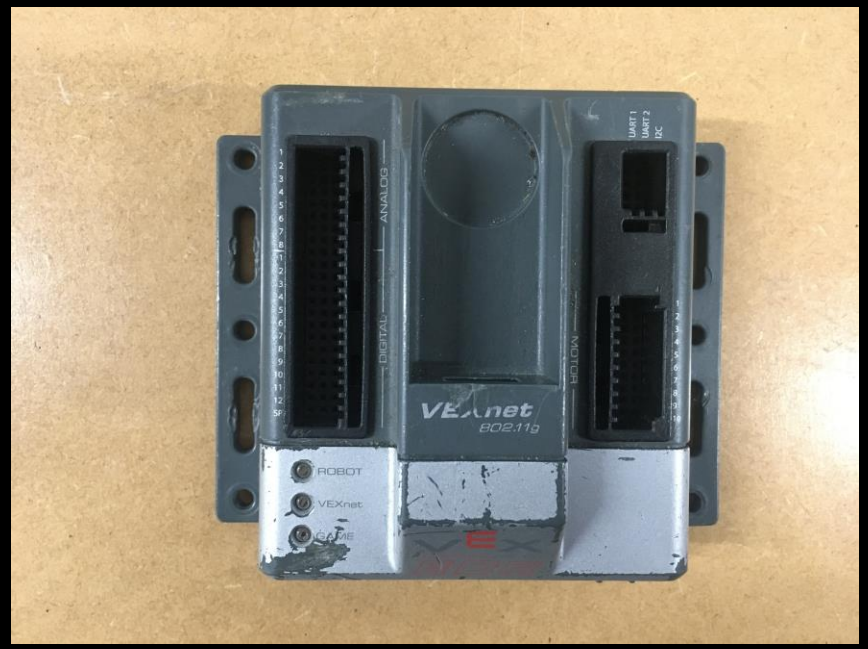
Part no.	Function	Features
PIC18F8520 (1)	System Mode Processor	32 KB Storage, Low Power Consumption
PIC18F8520 (2)	User Mode Processor	32 KB Storage, Low Power Consumption
9AAQC6K	Unknown	Unknown

Part Two

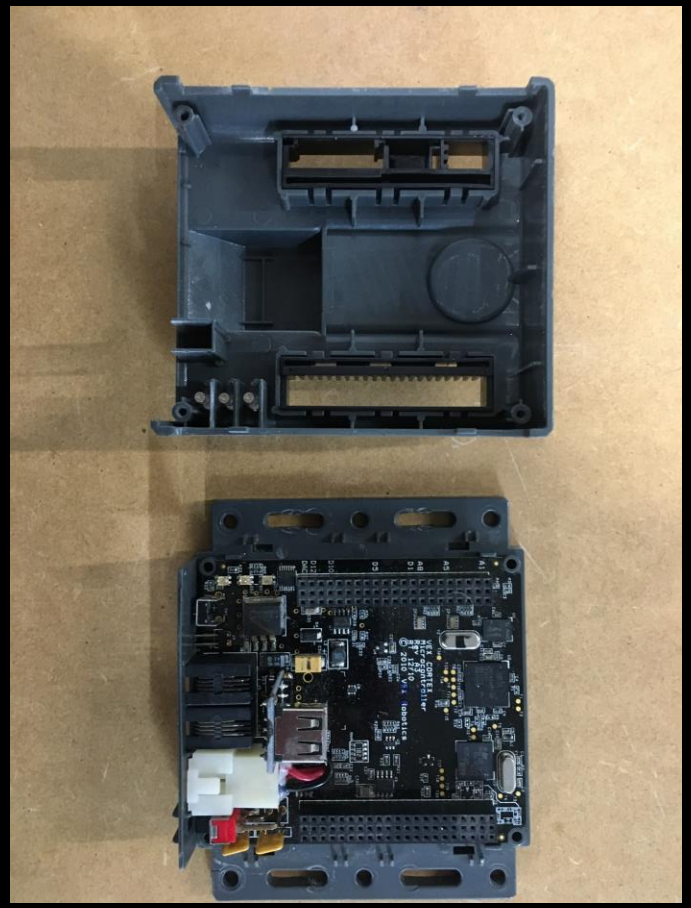
VEX ARM Cortex Microcontroller

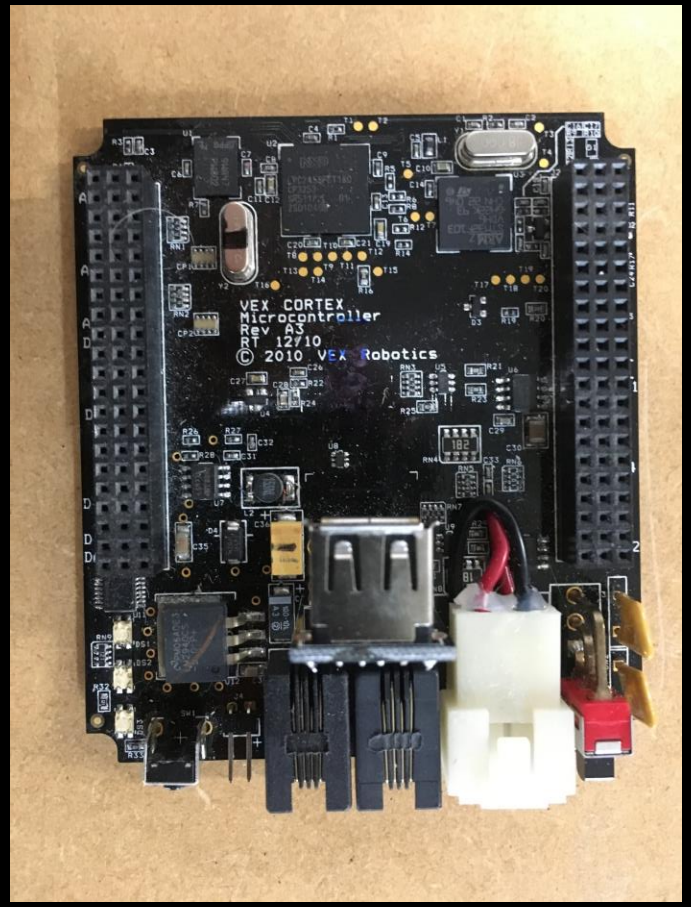
Disassembly

Disassembly of this device was similar to the VEX PIC Microcontroller, as this is effectively just a more refined version. Here are the images that we took of the disassembly process:



Research




VEX CORTEX
Microcontroller
Rev A3
RT 12710
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Research (Continued)

Here the list of components we found inside, as well as each of their functions, features, and whether they were made by Texas Instruments:

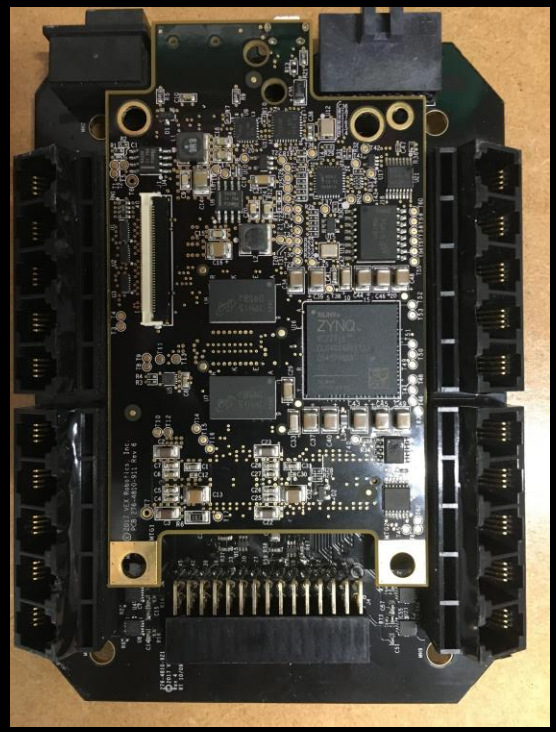
Part no.	Function	Features
NXP LPC2458FET180	System Processor	74 MHz, 512 kb flash
ARM7 STM32F103	User Processor	74 MHz, 384 kb flash
MT 9WA47	Unknown	Unknown

Part Three

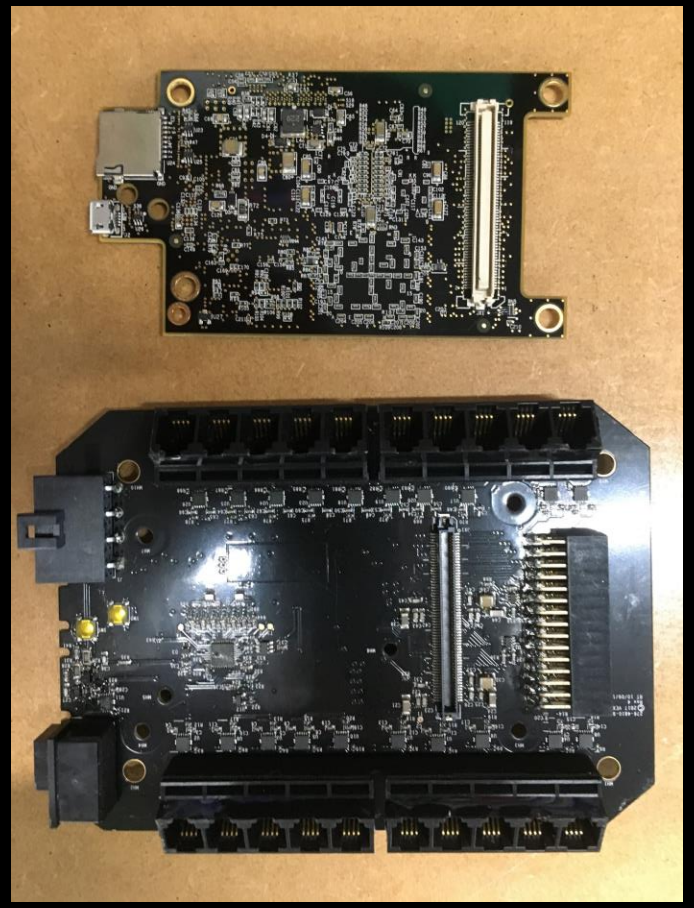
VEX V5 Robot Brain

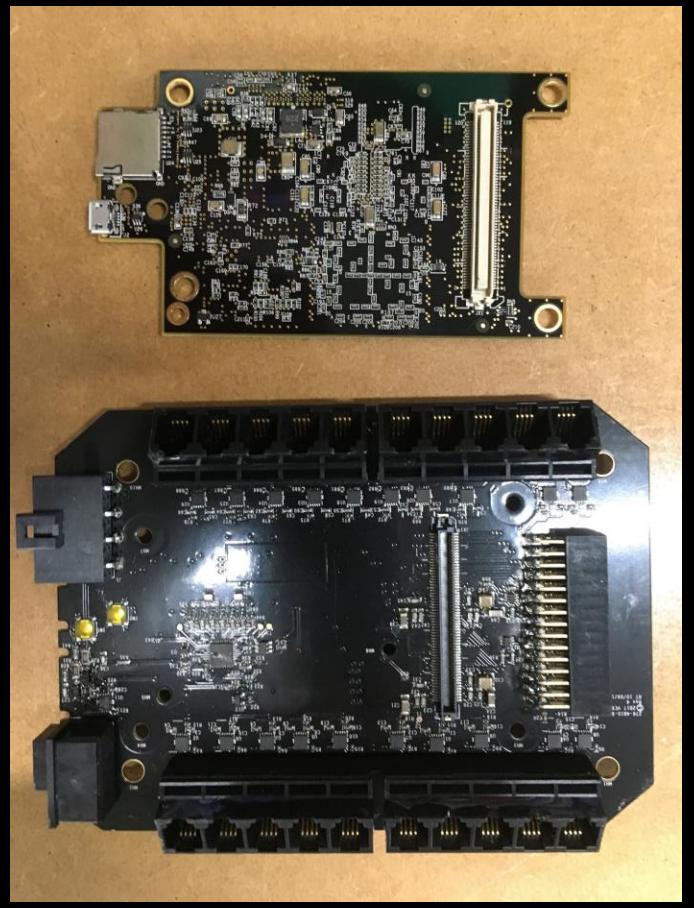
Disassembly

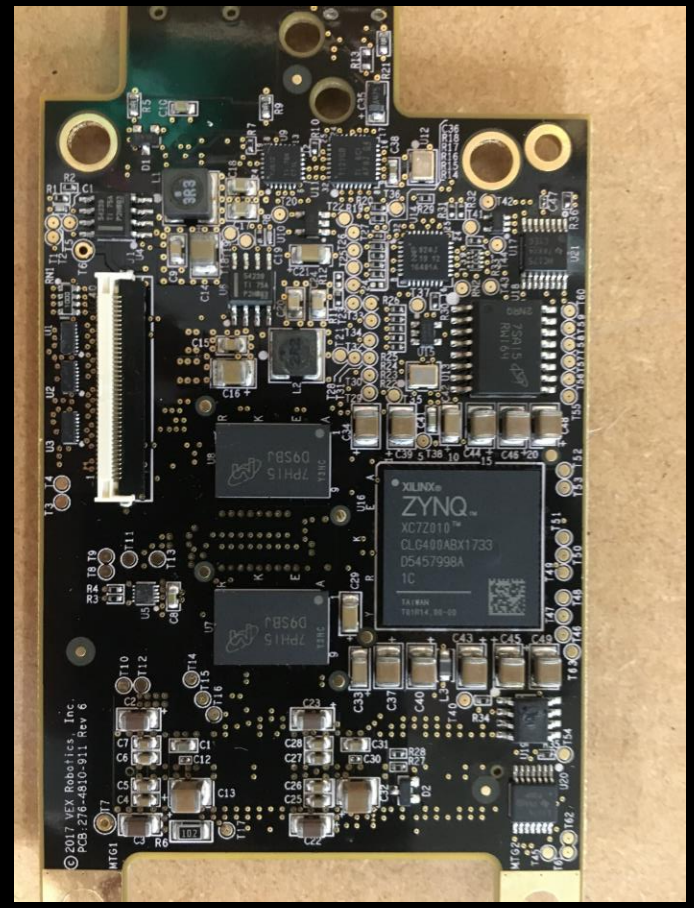
This was by far the hardest device to open because of its touchscreen, button and plethora of ports on all sides. Here are the images that we took of the disassembly process:



Research






XILINX
ZYNQ
XC7Z010
CLG400ABX1733
D5457998A
1C
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PCB 276-4810-911 Rev 6

Research (Continued)

Here the list of components we found inside, as well as each of their functions, features, and whether they were made by Texas Instruments:

Part no.	Function	Features
XILINX ZYNQ XC7Z010	Main Soc	Dual ARM® Cortex®-A9 MPCore™ (667 MHz)
Micron 7PHI5 (x2)	Suspected to RAM	Unknown
Micron 75A15	Suspected to be NAND Flash	Unknown
Texas Instruments HC175	High Speed CMOS Logic	Quad D-type Flip-Flops, Reset, Texas Instruments Component
Texas Instruments LCO7A	Unknown	Texas Instruments Component

Research (Continued)

Part no.	Function	Features
(Unknown Brand) 824J (x2)	Unknown (Possibly FPGA?)	Unknown
WE-HCI 7443251600 High Current Inductor	Inductor (High Current)	Magnetically shielded Flat wire coil for low losses at high frequency
(Unknown Brand) PKJ21B23	Unknown	Unknown
Texas Instruments SN65HVD178x RS-485 Transceiver (x21)	RS-485 Transceiver	Texas Instruments Component, 70-V, Fault-Protected
Texas Instruments TPS25927 4.5-V to 18-V, 1-5A eFuse	4.5-V to 18-V eFuse	Texas Instruments Component
WE-HCI 7443550101 High Current Inductor	Inductor (High Current)	Magnetically shielded Flat wire coil for low losses at high frequency
Texas Instruments TPS54239 (x2)	4.5V to 23V Input Step-Down Converter	D-CAP2 Mode, Texas Instruments Component

Part Four

VEX IQ Robot Controller

Disassembly

Unfortunately, we did not have access to a damaged VEX IQ Brain. We did not want to give up just yet, so we decided to use a VEX IQ Controller instead. Disassembly of this device was much harder than the previous devices, due it's strong outer cover, multiple buttons and general hardness to open. Here are the images that we took of the disassembly process:

Research

Research (Continued)

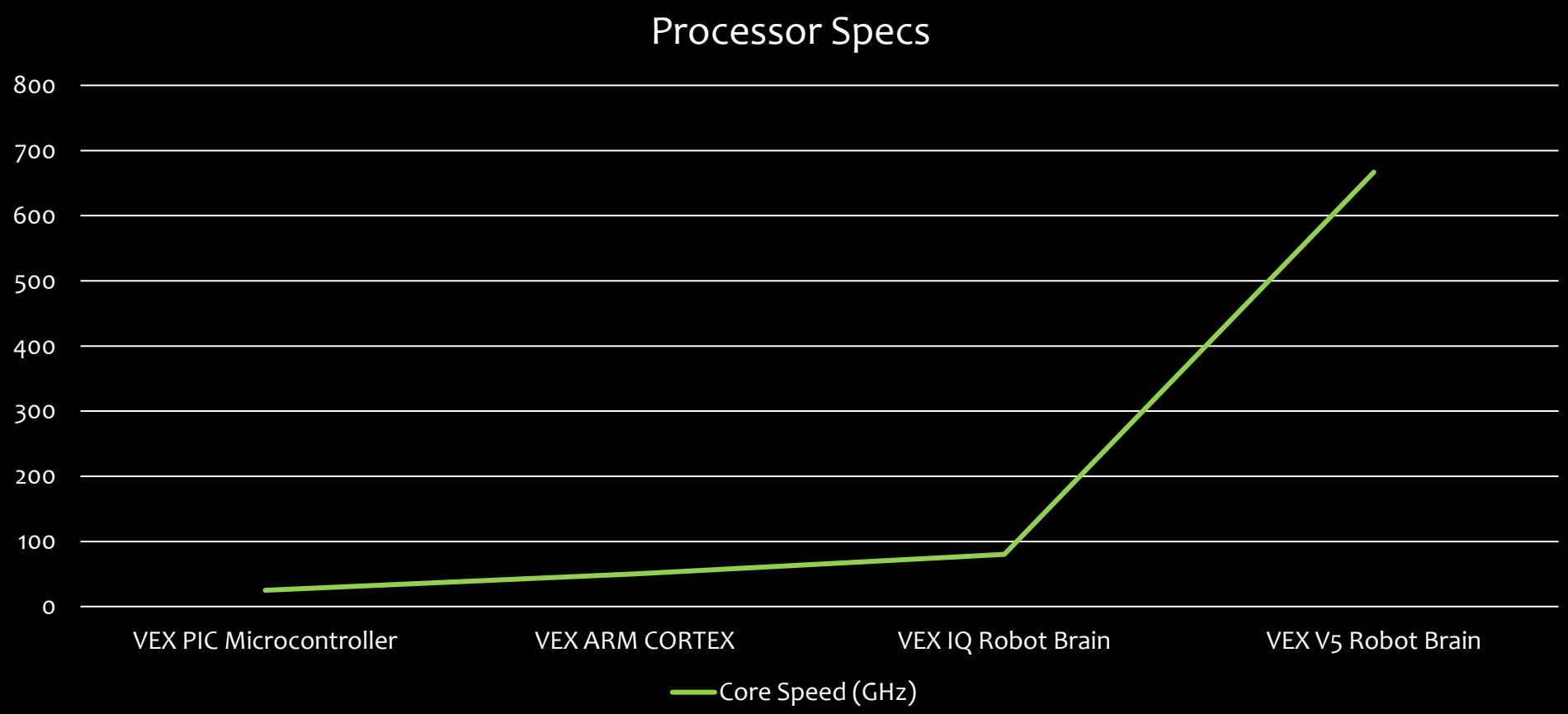
Here the list of components we found inside, as well as each of their functions, features, and whether they were made by Texas Instruments:

Part no.	Function	Features
Texas Instruments SN54HC166	Shift Registers	Parallel-Load, 8-Bit
Texas Instruments MSP430FR5739-EP	microcontroller	24 MHz, 16 KB FRAM, 1 KB SRAM, 32 IO, 10-bit ADC & comparator

Data

Past, Present, and Future

CPU Speed


Processor Specs
800
700
600
500
400
300
200
100
0
VEX PIC Microcontroller
VEX ARM CORTEX
VEX IQ Robot Brain
VEX V5 Robot Brain
Core Speed (GHz)

Data

From the previous graph, we can estimate that the next VEX product will have a CPU speed of at least 1.25 GHz. If we take the previous advances in flash memory size as a guideline, it can be assumed that the next device will have about 1.2 GB of storage. Similarly, the amount of RAM can be calculated using the same formula. This would mean that the next vex product would theoretically have about 2 GB of RAM.