XBOX ADAPTIVE CONTROLLER INPUT DEVICE SPECIFICATION

INPUT CONNECTOR SPECIFICATIONS FOR ACCESSIBILITY BUTTONS, TRIGGERS, AND THUMBSTICKS FOR USE WITH THE XBOX ONE ADAPTIVE CONTROLLER (v1.5)

Note: This document provides input device makers with technical specifications of the Xbox Adaptive Controller. Microsoft does not provide consumer technical support for input device makers. To engage with other input device makers, post your questions in the Xbox Forums. For consumer support, go to All about the Xbox Adaptive Controller.

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2 REVISION HISTORY

Revision	Engr Version	ECO#	Date	Description
	0.1	N/A	9/7/17	Initial creation of the input specification document
	0.1.1		9/25/17	Updated with a lexicon section and added updates from Gaylon
	1.0		10/29/17	Updated analog jack requirements.
	1.1		06 Nov 2017	Added ADC joystick graphs
A	1.2		12 Dec 2017	Added CI Information on ferrites
B	1.3		13 Dec 2017	Updated Graphs
C	1.4		17 Dec 2017	Updates for firmware support
D	1.5		30 Mar 2018	Updated electrical specs and USB-A compatible devices

Table 1 Revision History

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6   LEXICON

Word	Meaning
USB	Universal Serial Bus – a standards-based interface for a majority of computer equipment connectivity. Both power and signaling are provided through the USB connector. Device behavior is specified via profiles defined per the standard.
Controller	A device that provides various inputs to a user to control activity on a computer, console, or mobile device. A controller can have both digital (e.g. open or closed) buttons as well as analog (e.g. thumbsticks or triggers) inputs.
Xbox Adaptive Controller	A controller designed to enable custom gaming experiences for gamers with disabilities. The device exposes an electrical interface that allows users to easily connect their necessary sensors and controls to the controller.

Table 2 Definitions

7   PURPOSE

The purpose of this document is to describe the input devices that are compatible with the Xbox Adaptive Controller. The description will include the types of input devices allowed, mechanical connector requirements, electrical requirements, and application information for the creation of such devices.

The intended audience for this document is the development, test, and manufacturing engineers responsible for creating peripherals for the Xbox Adaptive Controller. This specification describes the following:

- Electrical specification of the various input plugs on the Xbox Adaptive Controller
- Mechanical descriptions of the various input plugs on the Xbox Adaptive Controller
- Application notes for creation of devices, including device expected wiring

8 OVERVIEW

This document reviews the input structures of the Xbox Adaptive Controller, including the electrical and mechanical requirements.   It also specifies the requirements for input accessories that can be used with the various input jacks on this device. Lastly, it describes requirements for compatible USB HID joysticks.

9 INPUT JACKS

The Xbox Adaptive Controller accepts control input through several 3.5mm audio jacks. In the marketplace, there are many types of 3.5mm jacks. This section is intended to help clarify for the user the types of headphones jacks available and what is recommended for operation with the Xbox Adaptive Controller.

Note the following terminology is used with connectors of this style:

-   The tip of the connector is labelled T; this stands for Tip.
-   The next ring (if it exists) is labelled R1; this stands for Ring.
-   The next ring (if it exists) is labelled R2; this also stands for Ring.
-   The last ring is labelled S; this stands for Sleeve.

The following styles of 3.5mm headphone plugs are supported by the Xbox Adaptive Controller:

Name	Configuration	Function
Mono Headphone Jack	S　　　T	T: Audio signal S: Ground return
Stereo Headphone Jack	S　　R　T	T: Left audio channel R1: Right audio channel S: Ground return
Stereo Headphone Jack with Microphone **(CTIA standard)**	S　R2　R1　T	T: Left audio channel R1: Right audio channel R2: Ground return S: Microphone

Figure 1 3.5MM HEADPHONE JACKS STYLES

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9.1 DIGITAL INPUT JACKS

The digital input jacks are meant to allow buttons to be plugged in that perform the function of the digital buttons used on the typical Xbox One controller. These include the A/B/X/Y, D-pad, Bumpers, Thumbstick switches, View, Menu, and Xbox buttons.

The Xbox button jack is uniquely designed to support powering the controller on and off, in the same manner as the on-board Xbox button (a.k.a. Nexus button).

9.1.1 INPUT CONNECTOR

The input connector pinout is shown below:

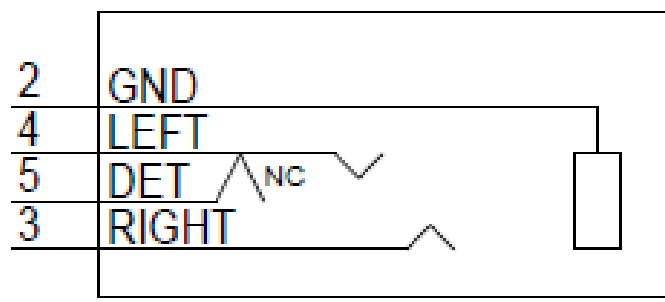**Figure 2 DIGITAL INPUT CONNECTOR**

These signals are connected internally as follows:

Signal	Direction	Function	Electrical Connection
LEFT (T)	Input	Button State	3.3 V pull-up via 10K resistor
RIGHT (R1)	N/A	Ground	0 V
GND (R2)			
MIC (S)			
DET	N/A	Internal to PCBA	N/A

Table 3 DIGITAL INPUT PINOUT

9.1.2 BUTTON DEVICES

The digital jacks are intended to be used with passive, normally open, momentary switches.

Here is an example of the wiring of switches that are to be used with these inputs.

Note: The use of an EMI Ferrite bead on the cable near the device is recommended to minimize conducted noise into the circuit.

Figure 3 DIGITAL INPUT PASSIVE SWITCH

Electrical Requirements	Range	Notes
Switch Resistance (closed)	< 10 Ohms	
Switch Resistance (open)	>15 kOhms	
Max Input Voltage	≤ 3.3 V	
Input HIGH Signal Level	> 2.0 V	Button is unpressed
Input LOW Signal Level	< 0.8 V	Button is pressed

Table 4 DIGITAL INPUT PASSIVE ELECTRICAL SPECS

9.2 ANALOG INPUT JACKS

The analog input jacks are meant to allow analog devices to be plugged in that perform the functions of the thumbsticks and triggers. These jacks are also compatible with digital button devices.

There are two types of analog input jacks:

- **Triggers**: Two jacks (labelled LT and RT) are intended for devices with only a single channel of analog data, such as triggers, throttles, or bite-switches. (Digital button devices will function just like single channel analog devices when connected to LT or RT on the Xbox Adaptive Controller.)
- **Thumbsticks**: Two jacks (labelled X1 and X2) are intended for potentiometer-based devices with two channels of analog data, such as the X and Y axes of a thumbstick or joystick. (Digital button devices will be interpreted as alternate digital buttons when connected to X1 or X2 on the Xbox Adaptive Controller.)

9.2.1 INPUT CONNECTOR

The input connector pinout is shown below:
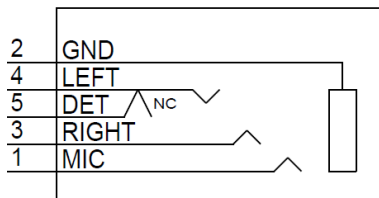
Figure 4 ANALOG INPUT CONNECTOR

These signals are connected internally as follows:

Signal	Direction	Function	Electrical Connection
LEFT (T)	Input	Button state -or- Trigger position -or- Thumbstick X axis position	0 V pull-down via a 100K resistor
RIGHT (R1)	Input	Thumbstick Y axis position	NC on trigger jacks
GND (R2)	N/A	Ground	0 V pull-down via a 1K resistor
MIC (S)	N/A	Reference Voltage	1.8 V pull-up via a 1K resistor
DET	N/A	Internal to PCBA	N/A

Table 5 ANALOG INPUT PINOUT

Note that TRS plugs will function as digital inputs when connected to thumbstick jacks.

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9.2.2 BUTTON DEVICES

The analog jacks may be used with passive, normally open, momentary switches. The trigger jacks will interpret digital switch input as normal trigger input. The thumbstick jacks will interpret digital inputs as alternate digital buttons.

Here is an example of the wiring of switches that are to be used with these inputs.

Note: The use of an EMI Ferrite bead on the cable near the device is recommended to minimize conducted noise into the circuit.
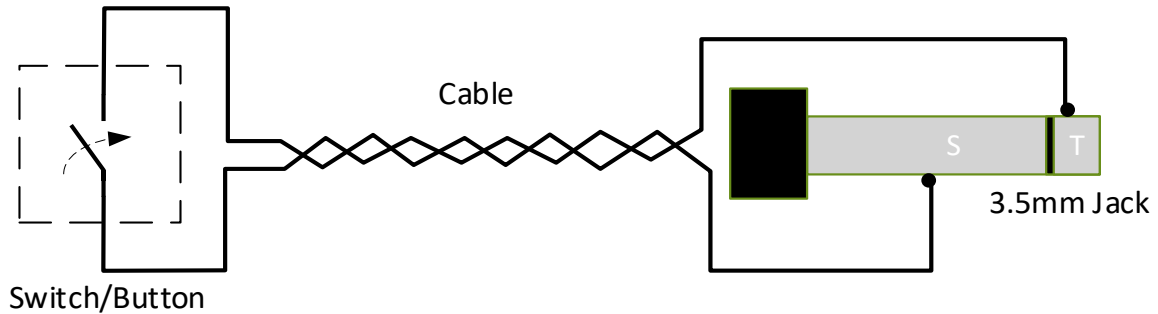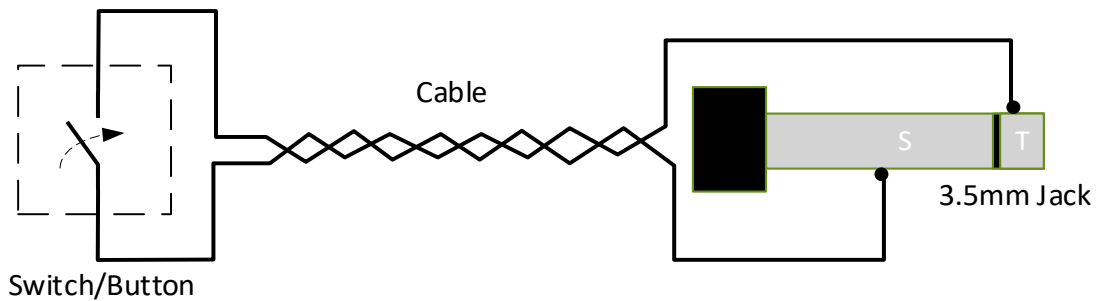

Figure 5 DIGITAL INPUT PASSIVE SWITCH

Electrical Requirements	Range	Notes
Switch Resistance (closed)	< 10 Ohms	
Switch Resistance (open)	> 15 kOhms	
Max Input Voltage	≤ 1.8 V	
Input HIGH Signal Level	> 0.6 V	Button is pressed
Input LOW Signal Level	< 0.3 V	Button is unpressed

Table 6 DIGITAL INPUT PASSIVE ELECTRICAL SPECS

9.2.3 TRIGGER DEVICES

Trigger devices are intended to be used with a single potentiometer to represent position along one axis.

Here is an example of the wiring of triggers that are to be used with these inputs.

Note: The use of an EMI Ferrite bead on the cable near the device is recommended to minimize conducted noise into the circuit.
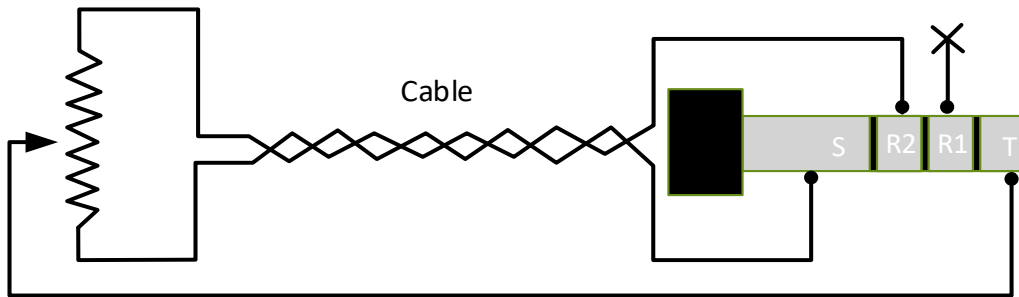

Figure 6 TRIGGER STYLE PASSIVE DEVICE

Alternatively, the trigger inputs could be driven by active circuitry. Input requirements for active drivers are the same as for passive potentiometer-based devices.

Electrical Requirements	Range	Notes
Potentiometer Resistance	10±3 kOhms	As measured from top to bottom
Max Input Voltage	≤ 1.8 V	
Input Resistance to Ground	1 kOhm	Min Voltage 0.15V w/ 10 kOhm Pot
Input Resistance to VDD	1 kOhm	Min Voltage 1.65V w/ 10 kOhm Pot
Max Iout w/ 0 Ohms to GND	≤ 1.8 mA	
Max Iin w/ Vin@1.8V	≤ 1.8 mA	
Vin Clamp Voltage (pos/neg)	-0.6 V ≤ Vin ≤ 2.4 V	
Minimum Voltage Threshold (Fully Unactuated)	≤ 650 mV	Trigger dynamic range will adapt to any minimum threshold in this range

Maximum Voltage Threshold **(Fully Actuated)**	≥ 650 mV	Trigger dynamic range will adapt to any maximum threshold in this range

<div align="center">Table 7 TRIGGER ELECTRICAL REQUIREMENTS</div>

9.2.4 JOYSTICK DEVICES

The thumbstick jacks are intended to be used with two three-terminal potentiometers. Each potentiometer represents one axis of movement in the thumbstick.

Here is an example of the wiring of triggers that are to be used with these inputs.

Note: The use of an EMI Ferrite bead on the cable near the device is reccomended to minimize conducted noise into the circuit.
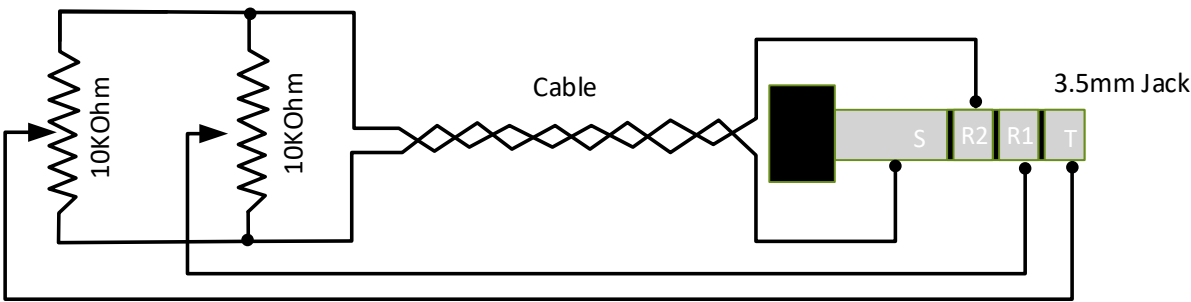

<div align="center">Figure 7 PASSIVE JOYSTICK DEVICE</div>

Alternatively, the thumbstick inputs could be driven by active circuitry. Input requirements for active drivers are the same as for passive potentiometer-based devices.

Electrical Requirements	Range	Notes
Potentiometer Resistance	10±3 kOhms	As measured from top to bottom
Max Input Voltage	≤ 1.8 V	
Input Resistance to Ground	1 kOhm	Min Voltage 0.15V w/ 10 kOhm Pot
Input Resistance to VDD	1 kOhm	Min Voltage 1.65V w/ 10 kOhm Pot
Max Iout w/ 0 Ohms to GND	≤ 1.8 mA	
Max Iin w/ Vin@1.8V	≤ 1.8 mA	

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Vin Clamp Voltage (pos/neg)	-0.6 V ≤ Vin ≤ 2.4 V	
Minimum Voltage Threshold **(Axis Minimum)**	< 750 mV	Thumbstick dynamic range will adapt to any minimum threshold in this range
Maximum Voltage Threshold **(Axis Maximum)**	> 950 mV	Thumbstick dynamic range will adapt to any maximum threshold in this range
Center Voltage Offset	- 130/0/130 mV	Maximum allowed voltage deviation from midpoint of min and max thresholds for return-to-center

Table 8 THUMBSTICK ELECTRICAL REQUIREMENTS

An example of a compatible device is the Alps ThumbPointer™ (Stick Controller) RKJXK/RKJXV Series. Note: Only the dual potentiometer function is supported through the analog jack. Switch function is supported only through the separate dedicated digital jacks.

9.2.5 CALIBRATION

The Xbox Adaptive Controller will automatically calibrate voltage thresholds for minimum, maximum, and center locations for analog controls, subject to the ranges listed in each section above. The device will apply deadzones of 5% of full stroke at each minimum and maximum threshold, to ensure that the control can reliably reach the extreme in either direction. Center deadzone for thumbstick varies by application or game title.

10 USB JACKS

The Xbox Adaptive Controller has two USB Type-A ports, each assigned to either the left or right thumbstick. Each port is compliant to the USB 2.0 Full Speed signaling and electrical interface. The USB interface is limited in compatibility and is designed to only operate with USB HID joysticks that report either a HID Joystick or HID Gamepad Usage Page. Unsupported or incompatible devices will remain powered but will be ignored by the controller. Input from the USB HID joystick will be normalized and reported as the thumbstick position that corresponds to the respective USB port in use.

USB HID joysticks may optionally expose digital buttons through the HID interface. The Xbox Adaptive controller will map the first 8 buttons to X1/X2/ThumbBtnL/BumperL/A/B/View/Menu for Left USB port, and View/Menu/ThumbBtnR/BumperR/X/Y/X1/X2 for Right USB port. Any additional buttons will be ignored. If the mapped buttons are reconfigured using the Xbox Accessories App, the new configurations will be applied to USB HID joystick buttons, too.

If both a USB joystick and an analog joystick are attached for the same thumbstick input, the USB joystick input will be accepted by the controller, and the analog joystick will be ignored.

10.1 POWER LIMITS

The Adaptive controller will provide power through the USB jacks as follows:

DC Jack State	Range	Notes
Unplugged	≤ 100 mA	
Plugged	≤ 500 mA	

<div align="center">Table 9 USB Joystick Power Delivery</div>

Exceeding these limits may result in a fault condition, which will result in the respective USB-A port being disabled until the fault condition is cleared.

10.2 COMPATIBLE DEVICES

Full compatibility is only guaranteed for devices approved by Microsoft/Xbox. If you're looking to design and produce accessories for Xbox, get started at Designed for Xbox.