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JED 443 USB three-channel switcher: Rev V01 software release

(Ed Schoell 25th Aug. 2011)

Introduction

The JED 443 device is a manual or remote controlled USB switcher designed particularly to handle USB interface switching between three computers connected via this device to an Electronic White-Board in a school or university classroom.

In such a classroom setup, there is typically one “Main” computer (called USB Device A) which is normally connected to the whiteboard USB connection and receives pen position information from it. When a lecturer brings in a laptop which is to take over the whiteboard USB connection, the cable from the laptop connects into USB port B on the 443 and can then be switched to the whiteboard under control of the projector or A/V system controller (a JED T430/T440/T460 or some other device.) Typically this is done at the same time the projector controller switches the projector from RGB1 to RGB2 to display the laptop’s VGA output rather than the “main” VGA signal.

(The JED 443 differs from the older JED 439 in that a third channel provided, allowing use in a “teaching of teachers” environment where a student laptop can also be selected. This is also applicable in boardrooms where several laptops need to sequentially control a whiteboard in a conference setting.)



Control modes

There are a number of ways in which the A/V control system can control which USB device is switched to the whiteboard (and also command a complete disconnect from the whiteboard so that non-electronic drawing, (e.g. with a felt pen), or watching a video, does not generate erroneous signals to the computers.) In summary, these are:

- Manual channel selection via a front panel push-button switch teamed with four LEDs allows the operator to select between the three USB channels (A, B and C) and an Idle (or Off) state. Front panel LEDs indicate the currently selected channel or idle state;
- Three contact closure inputs to ground, one input each for Device A, B and C, with disconnection if all contacts are open;
- RS232 command input from an A/V controller, with simple ASCII commands to select Device A, B or C on command, or to disconnect all three lines; and
- “Auto” mode, where the JED 443 senses the 5-volt supply line on the three USB cables. If no USB cables are powered by a computer on the other end then there is no connection through the JED 443 device. If any cable is

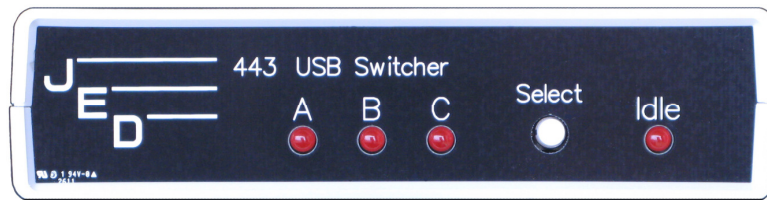
powered individually, then that cable is connected through the device. If all three cables are powered, then connections are prioritised, with Device C having the highest priority, and is connected through, and Device A has the lowest, and is only connected if Device C and Device B are both disconnected or powered down.

Modes are selected via a link on the back as part of the wiring to the JED 443, and certain modes co-exist.

Switching technique

All switching is done by small, gold-contact mechanical relays, and no electronic connection is made to the signal lines of the USB lines: they are just switched. An internal microprocessor controls the six internal relays, sequences them to properly disconnect the data lines then the power line 0.5 of a second later, and when connecting, the connect the power line and then the data line 0.5 of a second later. (Power connections pass through relays rated at 4 amps.)

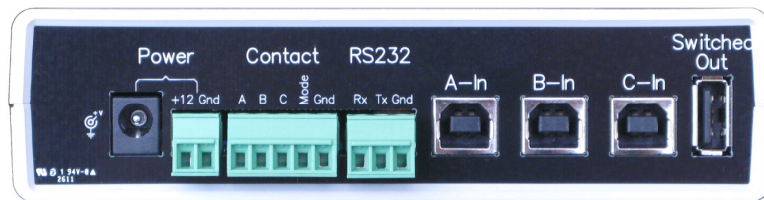
This simulates the offset connections used in USB connectors where pins of varying length connect power before data, when plugging in, and disconnect data before power when unplugging. Printed track wiring in the JED 443 device uses impedance and length matched traces.



Signal Connections

The USB input connections from Device A, B and C to the JED 443 are USB-B type. This allows three Type A to Type B cables to connect the three computers into the JED 443.

The USB output socket on the JED 443 is a vertical Type A, allowing a fourth Type A to Type B cable to connect into the whiteboard.



Power connections

Power inputs to the JED 443 are duplicated:

- A coaxial power connector for 12 volts DC input matches the 12V 1A power pack type SX2R-120-1000 which JED offers as part number PAK12-1A; and
- A two-terminal plug-in Phoenix screw terminal connector wired in parallel with the coaxial connector.

Thus a plug pack can be plugged into the JED 443 directly and power drawn off via the two-terminal plug-in connector to run a JED T430/T440/T460. Alternatively plus 12 volts can be drawn from other sources (such as the JED T461 audio system) and wired into the two-terminal connector. Polarity is indicated alongside the connectors.

Power input requirements are +12v +/- 5% at under 100mA.

Control connections

Control inputs to the JED 443 are via rear Phoenix screw terminals:

- A five-pin "Contact" connector has a ground, three channel selection signal inputs and a "Mode" control input; and
- A three-pin RS232 connector with ground, Rx and Tx.

Again, connections are shown alongside the connectors.

Operational modes

Default / Absolute mode: Three select inputs/commands

Mode selected by: No link on mode pin to ground.

Channel selection can be done in three different ways:

- Manual channel selection is done by the front panel switch rolling the selection between Device A, B or C as shown on the LEDs, in sequence, or we can have complete disconnect by leaving state in the “Idle” position.
- Inputs on the back “Contact” select channel A, B or C by grounding via a relay contact or a FET on a controller output port (driving it LOW). If no line is low, the USB lines are disconnected. The front-panel LEDs show the current channel;
- RS232 commands can turn individual channels on or off. Again the front-panel LEDs show the current channel. Separate commands are provided for ON or OFF on all channels. (The OFF commands are not needed if one just wants to switch directly from channel A to channel B or C. Sending an OFF command without a quickly following ON command will leave the output disconnected in the Idle state.) (See later for the RS232 protocol.)

All three control methods in this mode can be used at the same time, but holding a contact LOW will have priority.

Application: This mode is used where an RS232 channel or three control lines are available, and there is the requirement to switch absolutely from the A/V controller to select between three devices, but also have a “disconnect” mode. This might be an installation where three computers need to actively use the whiteboard, but in “disconnect” mode the whiteboard is used as a passive screen while a video plays.

The JED 443 can be driven by a T460 via RS232 or via relays from a T462R, T462R-4 or T461.

Auto control mode: USB power sensing

Mode selected by: Link on Mode pin to Ground.

Application: In this mode no external control lines are used, and automatic switching to a teacher’s laptop or student’s laptop occurs when that device’s USB cable is plugged in and powered up. Otherwise the connection defaults to the room computer. (Note: Auto mode may not work when USB extension cables are used from the laptop, which are powered from hubs which provide power on the cable when NOT actually plugged into an active laptop.)

Channel selection can be done in three different ways:

- USB power line priority sensing logic selects Device A or B or C by detecting an active USB cable plugged into the JED 443. If no connected USB cables are powered, no channel is selected. If two or three USB cables are powered, Device C has highest priority, then Device B. The front panel LEDs show which channel is selected. If no inputs are active, it shows “Idle”;
- Manual channel selection is done by the front panel switch forcing selection of Device A, B, C or “Idle” directly. The front panel switch over-rides the Vcc connection detection prioritisation, and the switch can then continue manually selecting the desired channels (or Idle) without prioritisation.

Note: Only channels with active Vcc connections are stopped on. Unconnected or un-powered channels are skipped.

Any cable or Vcc connection, disconnection or Vcc dropping will re-establish the priority logic which is the default until the front panel switch is touched again.

- RS232 control in Auto mode. In an application where the USB link via a JED 443 to a Whiteboard needs to be disconnected in Video mode but re-connected in Computer mode, it is possible to control the On/Off-switching via the RS232 interface. (If the output is disconnected via RS232 it can be turned on again via RS232, via the front panel switch or by dropping or connecting any USB input.)

The default after power-on is to always enable connections when USB cable 5 volts is detected, in accordance with the “Device:C has priority” specification detailed above. (If nothing is plugged in, there is no connection.)

The RS232 protocol is discussed below, but simply, the technique is to send a:

Clear channel A: **:R150<CR><LF>**

Command, to disconnect the USB connection to the Whiteboard, and to send in a:

Set channel A: **:R151<CR><LF>**

Command to re-connect (according the Vcc-determined priority).

As we are in “Auto” mode, the re-connection will connect one USB device in according to the “Auto” mode rules, i.e. Device:A if it’s the only one, and Device:B if USB-cable B by itself (or both A and B) are plugged in.

So this means that the USB switching to the Whiteboard can be simply turned ON (allowing “Auto” selection) or turned OFF at will (NO connection), with RS232 commands.

Note: Either Device A or Device B or Device C “Set” and “Clear” commands can be used ... in this “Auto” mode the USB channel used is determined **solely** by the logic associated with 5V Vcc sensing on the USB lines.

RS232 protocol

Serial commands are sent as ASCII text strings at 38400 baud, 8N1, and always are 7 bytes long. No gaps between bytes in the sequence longer than 50 milliseconds are allowed, as the input routine will time out and not action the command.

If testing these commands, just manually typing them into Hyperterminal will not work. Use a program such as DockLight or Bray terminal, preload the strings into macros and send them by clicking the macro’s icon/button.

See: <http://www.docklight.de/>

Set channel A: **:R151<CR><LF>**

Clear channel A: **:R150<CR><LF>**

Set channel B: **:R161<CR><LF>**

Clear channel B: **:R160<CR><LF>**

Set channel C: **:R171<CR><LF>**

Clear channel C: **:R170<CR><LF>**

Each command is replied to with a 4-byte string when actioned: **OK<CR><LF>**

(These commands are the same protocol and speed etc as commands sent from the JED T440 and T460 to the T441 and T461 audio, and T462 relay boxes, and the Rx input can actually be paralleled with a T461 or T462 Rx input. These commands are actually for Relay:6, 7 and 8 in a T461 with relays installed, but if used in parallel with a T462 relay box, the T462 will pick up the lower addresses and the JED 443 will process imaginary relays at addresses 6, 7 and 8. These commands can be setup and produced from a T460’s second serial port by programming the “relay” setup menu. If paralleling with a T441/T461/T462 do NOT connect the RS232 Tx line (output from the JED 443), but leave the bidirectional (Tx and Rx) lines between the T441/T461/T462 and T460 both in place so the T460 initial device poll keeps working.

If using a T461 with relays, simply use Relay:6 as the “Device A” select, Relay:7 as the “Device B” select, and Relay:8 as the “Device C” select lines.

The command processing software in the JED 443 is designed to reject messages not conforming to the protocol and to reset after a 50ms gap in transmission to look for the starting “:” again and re-sync. This allows the JED 443 to share a communications port with other communications, e.g. with a projector or with messages to a JED T464 network adaptor with the “:**STOP<CR><LF>**” message control sequences, and not hang up or mistake these for valid JED 443 control sequences (provided at least a recommended gap of 100mS between other messages and the JED 443 messages is incorporated.) Note: If system timing does not allow a 50mS period between a Clear message for one device via the JED 443 and a Set message for the next, simply omit the Clear message, as the new Set message has the same effect. Switchover timing is determined in the JED 443 anyway. Only then send the “Clear” message when switching to “Video”.

T460 setup for RS232 control of a JED 443

It is possible to drive the JED 443 from the relays in a T461 (if the 8-relay option **R8** is installed) and relays 6, 7 and 8 are wired to A, B and C inputs respectively, and the COM line on the T461 is wired to the ground pin on the JED 443.

If the **R8** option is NOT installed, or a T461 is not wired into the system, the format of the RS232 control signals is the same as the T461 relay control commands, so it is possible to wire the JED 443 RS232 receiver input to the second RS232 channel Tx output. (The Tx output of the JED 443 is not connected).

The relay menu in the T460 is setup to drive Contact: A, B or C inputs of the JED 443 with channels which need the JED 443 to switch USB ports. As an example of the setup, the following sets up T460 Channel 1, which is usually RGB1, as a channel which needs USB Device A active when selected, and sets up T460 Channel2, which is usually RGB2, as a channel which needs USB Device B active when selected.

Setup for Channel 1 RGB to USB Device A:

Go through the relay selections making sure to leave relays 7 and 8 as “**Free/Sw'cher**”

On the next menu selection:

**Relays don't
run switcher**

VOLUME UP toggles the selection to:

**Relays do
run switcher**

VOLUME DOWN moves to the relay switching by channel menu:

**Set relay fn
by channel**

then the screen showing a selected channel and its options and links is shown, and **VOLUME DOWN** rolls through all eight channels:

**Set Ch. 3 as
Proj. Switch**

This is the default for a channel, where the projector/screen does the video channel selection.

If channel, say **Channel 1** is to be linked to USB Device A, pressing **VOLUME UP** moves the relay selection through all available relays. Move to Rly6 for Device A driver. Select the “**sw.on**” (static switch rather than pulse setting).

**Set Ch. 1 as
Rly.6:sw.on**

Also in this example, pressing **ON/SOURCE** rolls the channel for the Switcher output selected in the projector/screen for that channel. It rolls through all eight projector/screen input selections.

Setup for Channel 2 RGB to USB Device B:

Using the **VOLUME DOWN** button select channel 2 (for Device B).

Using the **VOLUME UP** button, select **Relay:7** static mode “**sw.on**”.

Using the **ON/SOURCE** rolls the projector channel to 2.

The display will now be:

**Set Ch. 2 as
Rly.7:sw.on**

Similarly, set channel 3 for Rly.8: sw.on.

Pressing OFF saves the selected option. (don't select re-mapping)

(It is not anticipated that the T440 will be used with the JED 443, as the T440 only needs a 2-channel device such as the JED 439.)