Supporting ACA-Dock Feature in Smartphone and Tablet Docks with HX3 USB 3.0 Hub Controller – KBA96321

1. Introduction

Accessory Charger Adapter Dock (ACA-Dock) enables charging and simultaneous data transfer for a mobile phone or a tablet (acting as an OTG[2] Host) with support for Battery Charging Specification Version 1.2 (BC v1.2). The CY4613 Development kit helps you evaluate the HX3 – the industry's only USB 3.0 Hub controller with the ACA-Dock feature. The CYUSB3324 and CYUSB3328 parts of the HX3 product family support ACA-Dock feature.

When a USB ACA-Dock-capable phone or tablet is connected to the CY4613 board's upstream (US) port, it is charged by the US port using HX3's ACA-Dock feature. At the same time, the connected phone or tablet enumerates the CY4613 hub, and devices connected to the downstream (DS) ports of CY4613 work as expected.

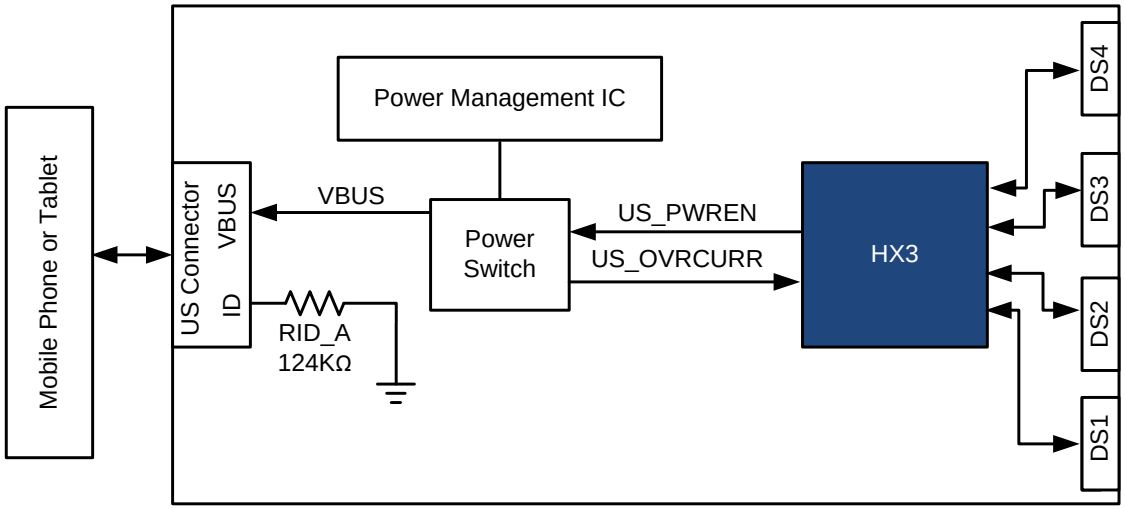
2. Supporting BC v1.2-Compliant, ACA-Dock-Capable Phones

A mobile phone or tablet connected to the US port of HX3 monitors the resistor (RID_A) value connected to the ID pin (Refer Figure 1). If the RID_A value matches the resistance value expected by the USB OTG host in the phone or tablet, the host allows the enumeration of HX3 and devices connected to the DS port of HX3. At the same time, the connected mobile phone or tablet is charged by the US port of HX3.

Figure 1 shows the HX3 hub system in the ACA-Dock mode as implemented in the CY4613 board. The CY4613 supports the RID_A (CY4613 schematics: R25) of 124 kΩ (standard RID_A value as per the BC v1.2 specification) by default. Refer to Step 9 of the CY4613 Quick Start Guide to configure the CY4613 for ACA-Dock functionality. When a BC v1.2-compliant OTG-capable phone, such as Sony Xperia (Neo V, P, or S), is connected to the CY4613 board's US port, the phone is charged, and simultaneously enumerates the hub and works like a normal host controller.

1: USB On-the-Go is a USB-IF specification that requires portable devices to function as a Host when connected to devices and to function as a device when connected to a Host.

Figure 1. HX3 Controller in ACA-Dock Mode in CY4613



3. Supporting ACA-Dock Capable Phones with Proprietary RID_A Values

The CY4613 board has been tested with popular tablets and phones available in the market with proprietary RID_A values. By changing the RID_A resistor (CY4613 schematics: R25) value on the CY4613 board, you can connect different phones and tablets to the CY4613 board in the ACA-Dock mode.

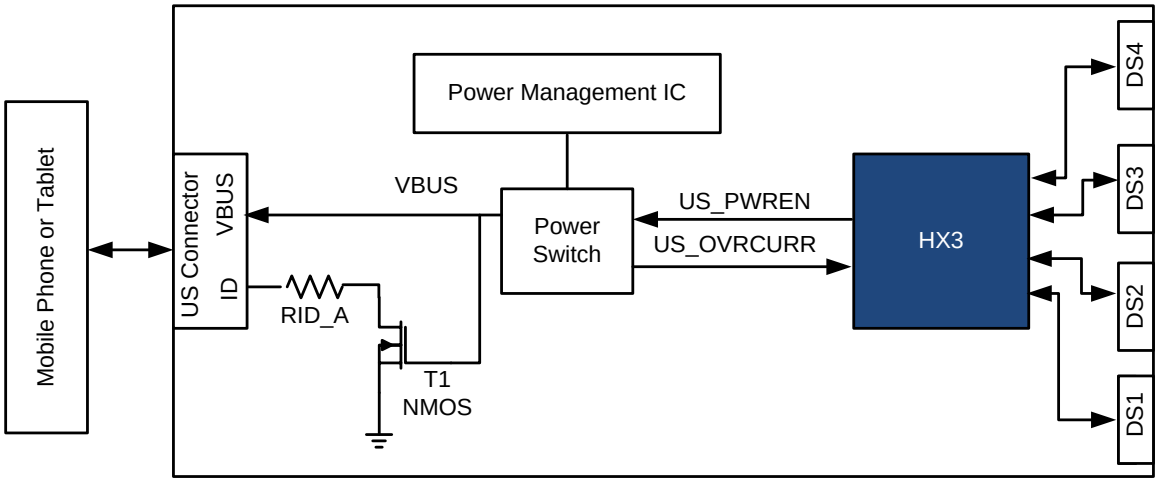
Table 1 provides examples of phone/tablet models and which support proprietary RID_A values. Figure 2 shows the HX3 hub system in the ACA-Dock mode, with modifications required to support a proprietary RID_A.

Table 1. Examples of Phones and Tablets that Support Proprietary RID_A Values

Manufacturer	Models	RID_A Value
Google	Nexus 7 Tablet	120 kΩ
Samsung	Galaxy Note Pro Tablet 12.2	80 kΩ - 85 kΩ
Samsung	Galaxy Note 2, Note 3	71 kΩ - 74 kΩ supported in Rev04[2] CY4613
Samsung	Galaxy S3, S4 phone	71 kΩ - 74 kΩ supported in Rev04[2] CY4613

2: Refer Appendix

Figure 2. Recommended ACA-Dock System Implementation Using HX3 Controller



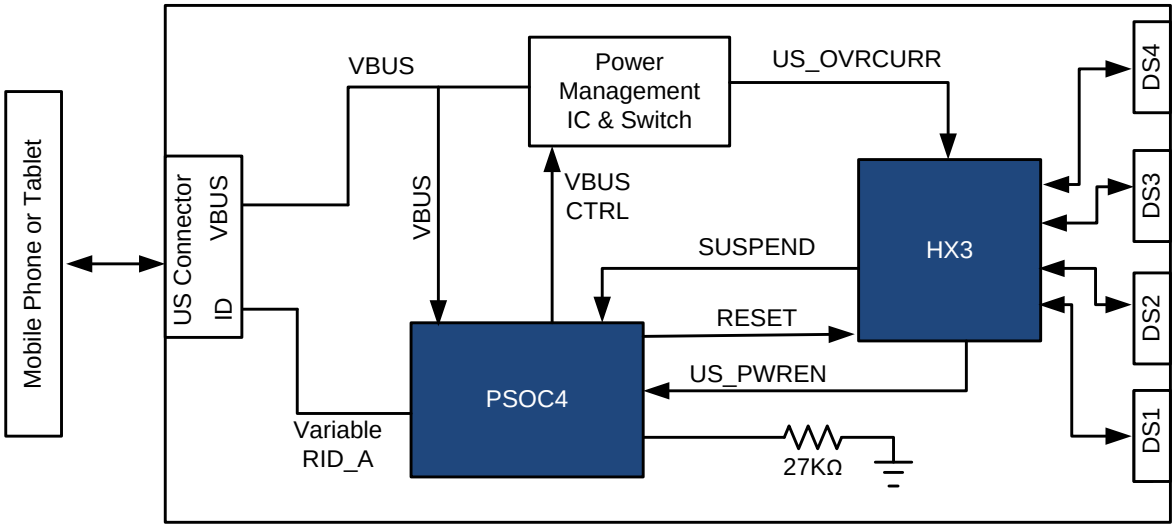
Some mobile phones or tablets (for example, Samsung Galaxy Note Pro Tablet 12.2) require the RID_A termination resistor to be floating when VBUS is powered OFF as shown in Figure 2. For this implementation, the transistor T1 (Part Number: BSN20-70 or equivalent) is required. Transistor T1 is not implemented on the CY4613 board and RID_A is directly connected to ground (as in Figure 1). However, it is highly advised to use the transistor T1 in ACA-Dock system designs.

4. HX3 and PSoC® 4-Based ACA-Dock Solution Supporting Various RID_A Values

In order to enable the ACA-Dock functionality for various phones and tablets that support either standard or proprietary RID_A resistor value, a solution which varies the value of resistor RID_A is required. This solution can be implemented by interfacing HX3 with a PSoC 4 (PSoC supporting ARM® Cortex®-M0 core and programmable mixed-signal hardware IP). Figure 3 shows the block diagram of the solution implementation; Figure 4 shows the Solution Demo Board.

Schematics and layout of the HX3 and PSoC 4-Based ACA-Dock Solution is available at http://www.cypress.com/?rid=107154. For additional information and to request a demo, contact Cypress at hx3@cypress.com

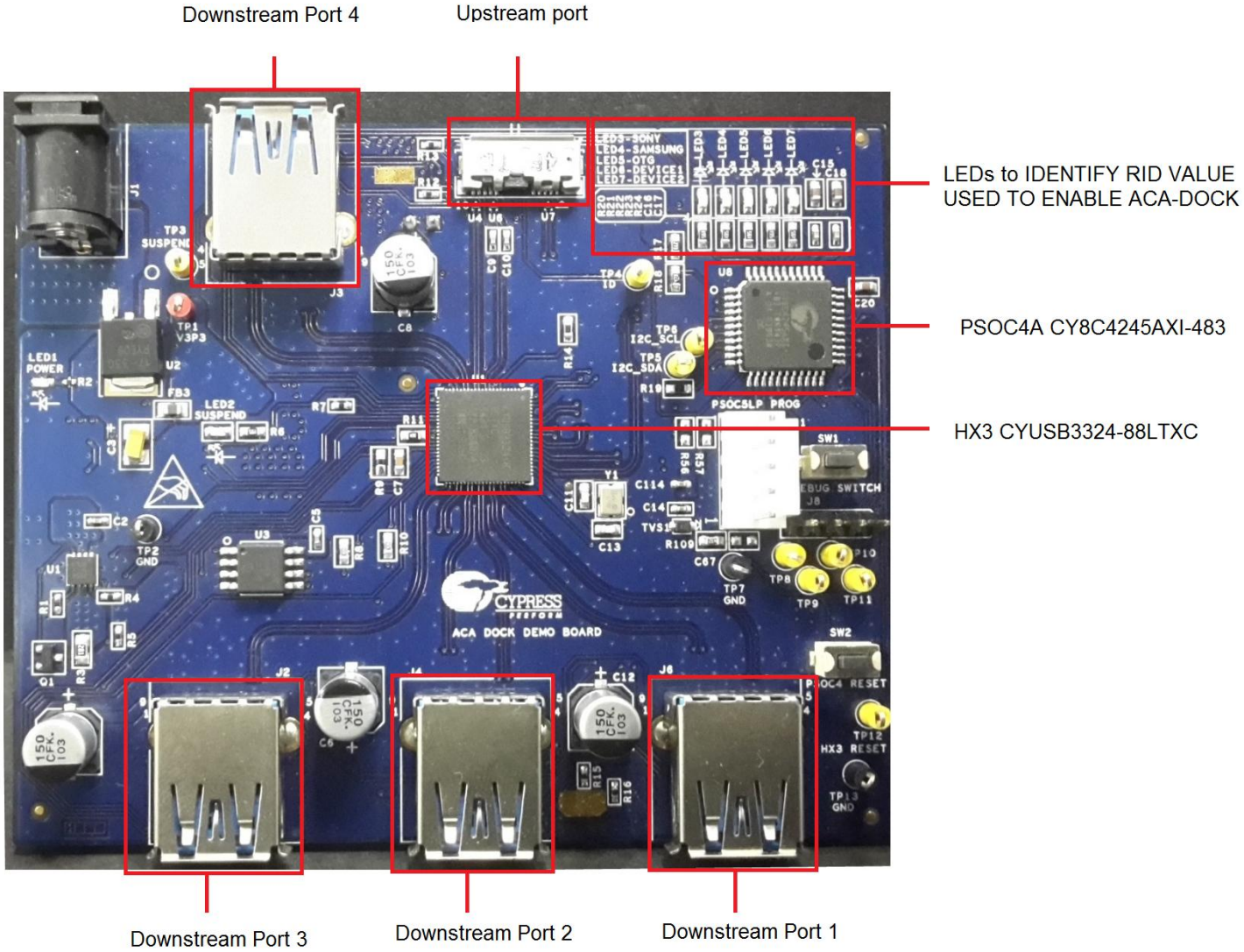
Figure 3. HX3 and PSoC 4-Based ACA-Dock Solution Block Diagram



The function and purpose of the signals shown in Figure 3 are as follows:

1) **SUSPEND**: The SUSPEND pin is held HIGH when HX3's US port is not connected to any host controller. The SUSPEND pin is pulled LOW only when HX3 is successfully enumerated by the host connected to the US port. PSoC 4 monitors the SUSPEND pin to determine successful enumeration. The enumeration process takes up to one second.
2) **ID pin of US USB Connector**: The ID pin of the US port is connected to the output of the iDAC in the PSoC 4. PSoC 4 will vary the current driven on the ID pin to emulate varying RID_A values.
3) **US_PWREN**: HX3 informs the PSoC 4 of the overcurrent event on the US port. PSoC 4 controls the power switch on the VBUS line.
4) **VBUS**: The VBUS line is usually driven to 5 V by the USB Host except in the ACA-Dock mode. The PSoC 4 is designed to monitor the VBUS line and ensure that the ACA-Dock does not drive the VBUS signal until the USB Host has stopped driving the VBUS line.
5) **RESET**: PSoC 4 has the capability to RESET the HX3.

Figure 4: HX3 and PSOC 4 Based ACA-Dock Solution Demo-Board



The algorithm implemented on PSoC 4 is as follows:

Step 1:

On initial power-on or reset, PSoC 4 will ensure the power management IC and switch is OFF (VBUS driven by USB Host) and holds the variable RID_A at GND. PSoC 4 monitors the VBUS line to identify the US connect event (VBUS = 5 V). As soon as a US connect event is detected, Step 2 is initiated.

Step 2:

The PSoC 4 solution has implemented three popular RID values as default (72 kΩ, 80 kΩ, and 124 kΩ). PSoC 4 varies the current to emulate various RID_A values and monitors the SUSPEND signal. If enumeration (SUSPEND = 0) is successful for any one of these values, the PSoC 4 device locks the RID value. PSoC 4 then waits for the USB Host to stop driving VBUS (VBUS = Floating) before allowing the power management IC to drive VBUS.

If enumeration is not successful (SUSPEND = 1), Step 4 is initiated.

Note The PSoC 4 firmware can be updated to support additional RID values as required.

Step 3:

PSoC 4 monitors the voltage across the RID to identify the US disconnect event. If a disconnect event is detected, HX3 and PSoC 4 will automatically reset.

Step 4:

If the connected phone or tablet is not ACA-Dock-capable, PSoC 4 will set RID = GND (OTG Mode which supports enumeration without US charging). If enumeration (SUSPEND = 0) is successful, PSoC 4 device locks the RID value. If enumeration is not successful (SUSPEND = 1), PSoC 4 will stop driving current on the RID line and wait for a disconnection event to occur.

5. Smartphones and Tablets Proven to support ACA-Dock or OTG Mode Operation

HX3's ACA-Dock solutions (CY4613 Development Kit and HX3 and PSoC 4-based Solution) have been proven through testing by third-party testing at Allion Labs. Based on test results, the following 27 mobile devices across 9 Brands have been proven to support ACA-Dock or OTG Mode operation on HX3.

Table 2: ACA-Dock Phones Proven with HX3 (14 Models)

Brand	Device Models	# of Mobile Devices Supported
Asus	PadFone Infinity A86, Nexus 7	2
DELL	XPS 10	1
Sony	Xperia Neo V, P, and S	3
	Xperia TX LT29i, Xperia Arc	2
Samsung	Galaxy Note 2, Note 3, Note 4 Galaxy Note Pro Tablet 12.2 Galaxy S3, S4	6

Table 3: OTG Mode Phones Proven with HX3 (13 Models)

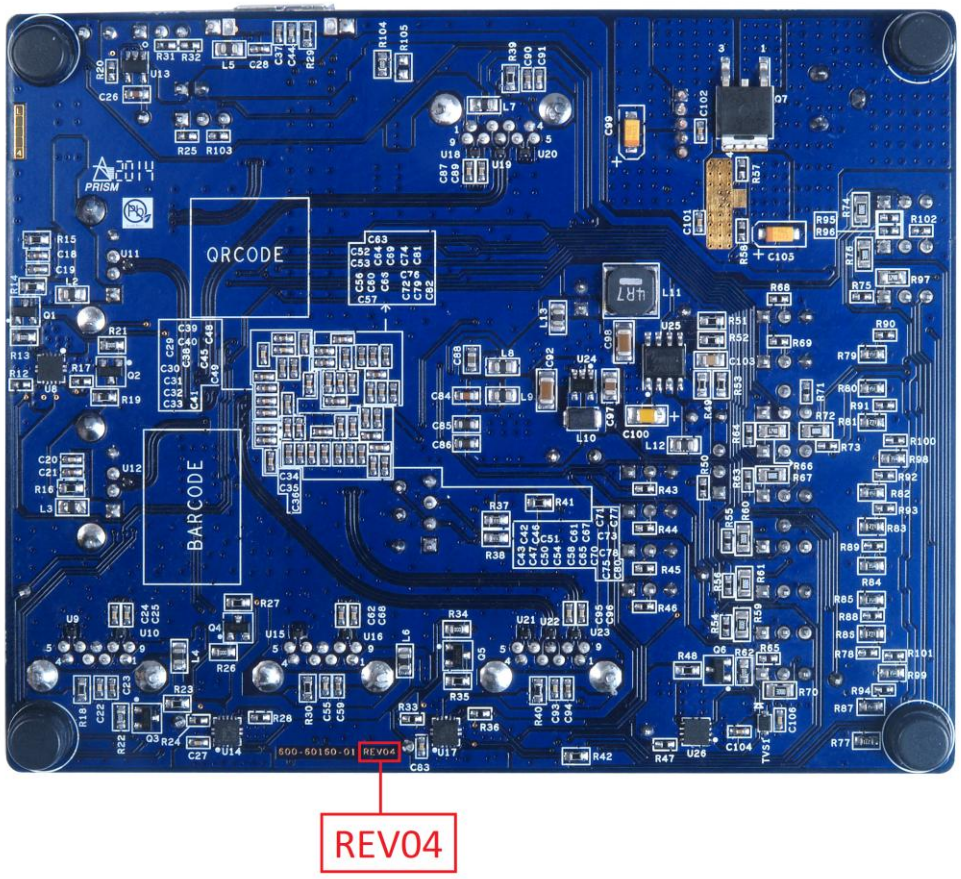
OEMs	Brand	# of Mobile Devices Supported
Asus	Zen Phone 5	1
ACER	Iconia W510-1666 Tablet	1
hTC	New One M8	1
LG	D838 (G Pro 2), Nexus 5 Optimus Pad G-Slate, T-Mobile Tablet	4
OPPO	N1T	1
Samsung	S5 (SM-G900I)	1
Sony	Xperia Z Ultra C6802, Xperia Z2 Phone Xperia Z2 tablet	3
Zotac	Tegra Note7	1

6. Appendix:

Question: How do I identify a Rev04 CY4613 board?

Answer: The revision number is printed on the back of the CY4613 board as shown in Figure 5.

Figure 5: Marking of Revision Number on CY4613 Board



Question: How is the Rev04 CY4613 different from the previous CY4613 boards?

Answer:

Rev04 CY4613 Board:

Supports two RID_A values: 124 kΩ and 73.2 kΩ

RID_A selection jumper (J27) is a 3-pin jumper

The RID_A can be set to 124 kΩ by setting jumper J27 to connect Pin 1 and Pin 2.

The RID_A can be set to 73.2 kΩ by setting jumper J27 to connect Pin 2 and Pin 3.

Earlier versions of CY4613 Board:

Supports RID_A value of 124 kΩ

RID_A selection jumper (J27) is a 2-pin jumper.

RIA_A can be set to 124 kΩ by setting jumper J27 to connect Pin 1 and Pin 2.

1) Related Categories:

Keywords: HX3, ACA-Dock, ACA Dock, ACAdock, upstream charging, Battery charging, BC V1.2, SmartPhone charging, Smart phone charging, Tablet charging

Product Family: USB Super Speed Hubs

Related Tags: [Select the Tags by clicking the checkbox associated to the Tags]

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☐ Timer	☐ UART	☐ UDMA	☐ USBFS	☐ USBUART	☐ USBSerial
☐ Vendor Command	☐ Video Class	☐ WHQL	☐ WLK	☐ cyapi	☐ uVision
SuperSpeed					
☐ FX3	☐ ADMux	☐ ARM926EJ -S	☐ Bootloader	☐ DMA	☐ Eclipse
☐ FX3 GPIO	☐ FX3 Power Management	☐ FX3 Power supply	☐ FX3 SDK	☐ GPIF II	☐ HS-OTG
☐ JTAG	☐ LPP	☐ MSC	☐ Oscillator	☐ RTOS	☐ SD Card
☐ Slavefifo	☒ USB 3.0	☐ USB Compliance Test	☐ USB Host	☐ UVC	☐
☐ FX3S	☐ eMMC	☐ SDIO	☐ S-Ports	☐ Bay	☐ Benicia
☒ HX3	☐ ASSP	☒ Battery charging	☐ Bootloader	☐ Cortex-M0	☐ EEPROM
☐ GPIOs	☒ HX3 Power Management	☒ HX3 Power supply	☒ I2C	☐ In-system programming	☐ Oscillator
☒ USB 3.0 hub	☐ USB Shared Link™	☒ ACA-Dock	☐	☐	☐

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	☐ Datapath
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☐ Known Problems and Solutions	
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	☐ PSoC Creator
☐ User Modules	☐ Analog
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DOCUMENT HISTORY

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