

## Catapult EJ-1

### Overview

Catapult EJ-1 is a high performance Ethernet-to-JTAG cable. It is powered by a wall transformer, communicates with a system host (or via an Ethernet hub or switch), using a standard Ethernet cable in an IP network. Catapult EJ-1 attaches to a target system using a standard 14-pin ribbon cable, or a set of flying leads. In addition to the required JTAG signals (TDI, TDO, TMS, TCK), Catapult supports two sideband signals that can be independently driven or disabled under software control. The JTAG interface operating voltage is set by the target hardware.

Catapult EJ-1 is supported by a driver, JTAG interface library and various JTAG applications, which are discussed in other documents.

Catapult EJ-1 is capable of supporting a variety of JTAG applications, including:

- FPGA & CPLD programming
- Boundary Scan PCB testing
- Boundary Scan-based Flash programming
- JTAG-based microprocessor/microcontroller debuggers

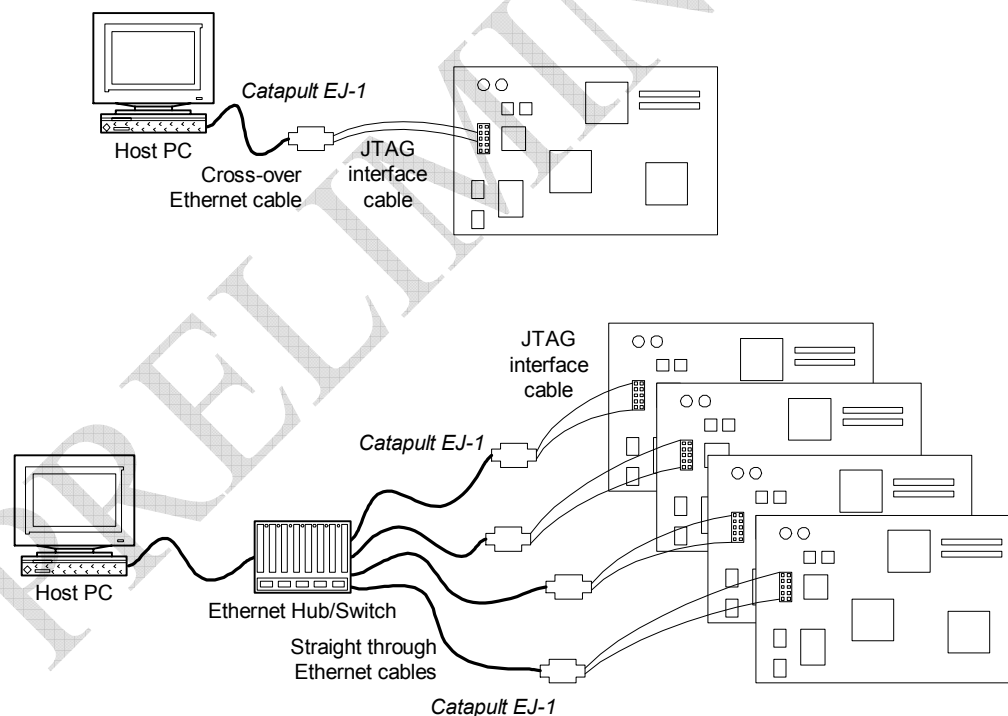
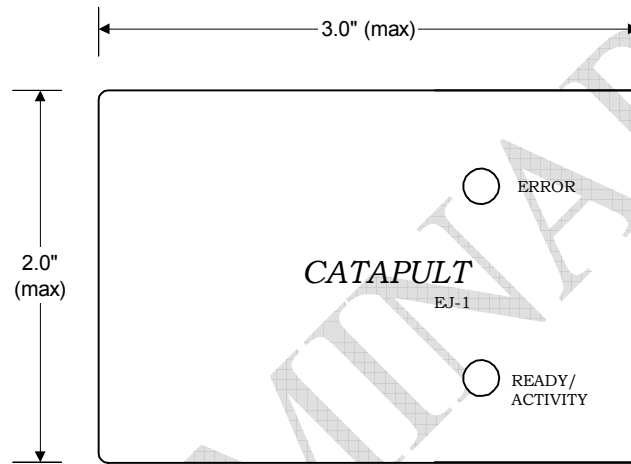


Figure 1: Catapult EJ-1 usage scenarios

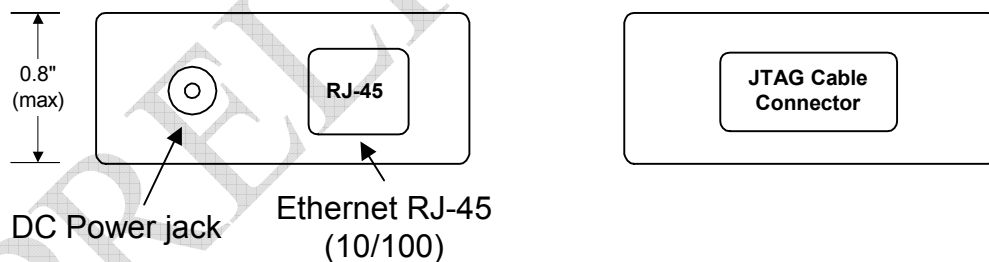
### Features

- Supports a JTAG operating voltage of 1.8V to 3.3V
- LED status indicators for error and ready/running
- Small size, low profile

- Easily identified using an external serial number for applications that use more than one Catapult, or to determine hostname
- Multiple Catapult EJ-1s can be used simultaneously, limited only by the capability of host software Ethernet hub/switch topology
- 10/100 Ethernet support with auto-negotiation
- Static and dynamic IP address support. Built-in DHCP client for automatic IP address and host acquisition in a DHCP-capable network.
- Configurable TCK clock frequency
- FCC (Class A, part 15) Compliant
- Built using flame retardant, UL-94 plastic



**Figure 2: Catapult EJ-1 Top View**



**Figure 3: Catapult Side Views showing the Ethernet connector and JTAG Cable Connector**

### Host/Hub/Switch Requirements

Catapult can be connected either directly to a PC host, or through an Ethernet hub or switch. When connecting directly to a host, an Ethernet cross-over cable is required. When connecting to a switch, a straight-through cable is required. When the device is powered up, it attempts to acquire an IP address using the DHCP protocol. In the event that DHCP-based IP address acquisition fails (times out), the device assumes a default IP address<sup>1</sup>.

<sup>1</sup> The factory-default IP address is 192.168.15.120

## Operating Power

Catapult receives its operating power from two sources: the external wall adapter that connects to the Catapult unit with a barrel jack, and the JTAG cable itself. The wall adapter powers the bulk of the components on the Catapult PCB. The JTAG VREF cable is provided by the target system to set the voltage levels of the JTAG interface, and to power the corresponding Catapult EJ-1 outputs (TDI, TDO, TMS and TCK and sideband signals).

## Status Indicators

Catapult EJ-1 offers four LED status indicators. Two of these indicators are located on the top of unit, as shown in Figure 4. A steady green LED indicates that the device is powered, has determined its IP address (either through DHCP, or the default IP address), and ready for operation. If this green LED blinks slowly (after power-up, or with an Ethernet cable has been just plugged in), then it indicates that it is attempting to acquire its IP address. The green LED is steady when the device is read and waiting for JTAG operations, and flickers when there is activity on the JTAG bus. The red LED indicates that an error has occurred. The cause of the error will be reported to you via the software interface.

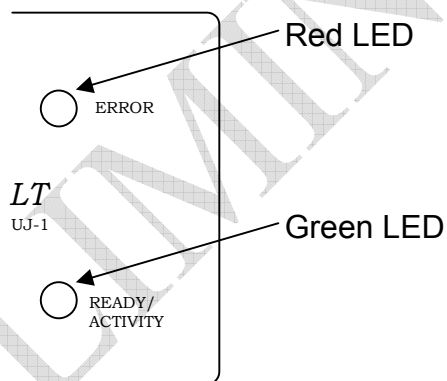
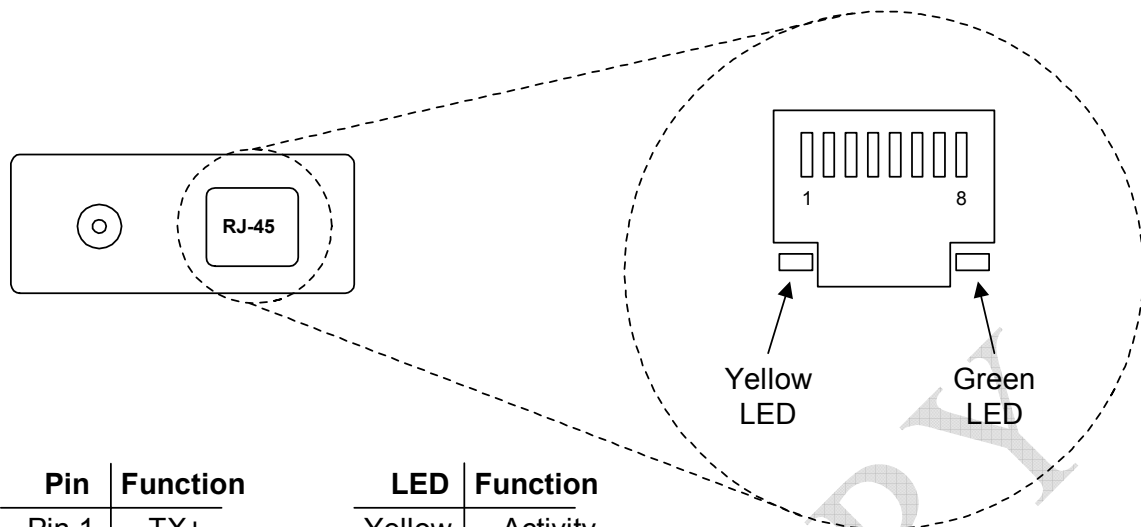


Figure 4: Catapult EJ-1 Status Indicators

There are two LEDs built into the Ethernet RJ-45 connector, as shown in Figure 5. The green LED indicates that Catapult has successfully established a connection at the Ethernet LINK layer. The amber LED is blinks whenever there is Ethernet activity (either RX or TX).



Pin	Function	LED	Function
Pin 1	TX+	Yellow	Activity
Pin 2	TX-	Green	Link
Pin 3	RX+		
Pin 6	RX-		

Figure 5: Catapult RJ-45 jack (front view) pins and LEDs

### Cable Options

Catapult EJ-1 supports a right angle cable connector that has a positive latch with the mating connector on the cable. There are two standard cables available for the Catapult EJ-1, and Catapult EJ-1 ships standard with the 14-pin IDC ribbon cable:

#### *Flying leads*

This cable has a total of eight individual wires, each of which is terminated in a single crimp housing connector. Each of the wires is individually labeled on a white heat-shrink tube located near the single terminal housing.

Label	Description	Direction <sup>2</sup>
TDI	JTAG TDI	Output
TDO	JTAG TDO	Input
TMS	JTAG TMS	Output
TCK	JTAG TCK	Output
SB0	Sideband 0	Bidir
SB1	Sideband 1	Bidir
VREF	JTAG IO voltage	Input
GND	Signal Ground	Input

**IMPORTANT NOTE:** Take great care, and always double-check when connecting the flying leads to the target board. Pay particular attention to the VREF and GND wires –

<sup>2</sup> Direction of this signal is relative to the Catapult EJ-1 device. So, for example, a signal whose direction is “Output” is an output from Catapult to the target board.

mis-wiring these may **permanently damage** the Catapult EJ-1 device, the target board, or both.

The flying leads are terminated in female, single-pin housings. They connect to male header posts that are 0.025" sq. If a single row or dual row header is used, they must be at least a 0.100" center-line.

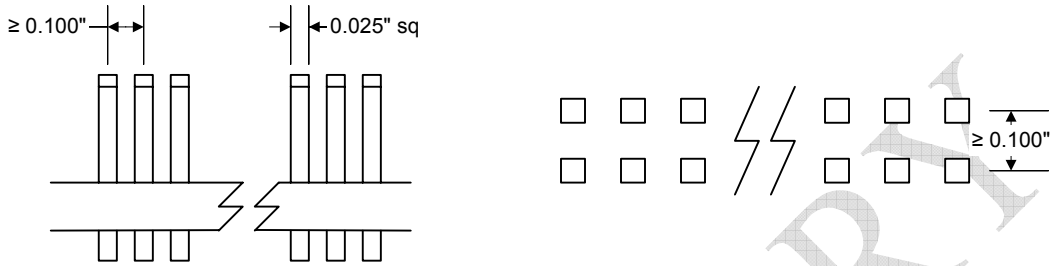


Figure 6: Headers for use with flying leads

#### IDC 14-pin

This is 14-conductor ribbon cable, with a keyed, dual-row, 14-pin IDC plug. The JTAG signal pinout on the 14-pin IDC plug is commonly used. The IDC plug mates with a 14-pin, dual row box header (3M 30314-6002HB or its equivalent).

TDI	1	2	GND
TDO	3	4	GND
TCK	5	6	GND
nc	7	8	nc
SB1	9	10	TMS
VREF	11	12	nc
nc	13	14	SB0

Figure 7: 14-pin IDC connector pinout

**IMPORTANT NOTE:** It is highly recommended that a polarized, dual row, 4-wall box header be used. Use of non-polarized header may result in incorrect attachment which could **permanently damage** the target board, the Catapult cable, or both.

#### Target reference voltage

The target reference voltage, VREF, is the voltage at which the JTAG port operates. This voltage also powers circuitry on the Catapult, and is in the 1.8V – 3.3V (nominal) range.

#### Operating Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
VREF	JTAG Target	With respect to GND	-0.2	3.6	V

	Reference Voltage				
V <sub>I</sub>	Signal DC Input voltage	With respect to GND	-0.5	3.6	V

**Table 1: Catapult EJ-1 Absolute Maximum Ratings<sup>3</sup>**

Symbol	Parameter	Conditions	Min	Max	Units
V <sub>REF</sub>	JTAG Target 3.3V Operation	With respect to GND	3.14	3.47	V
	JTAG Target 2.5V Operation	With respect to GND	2.38	2.63	
	JTAG Target 1.8V Operation	With respect to GND	1.71	1.9	
V <sub>IH</sub>	High level input voltage		V <sub>REF</sub> - 0.2V		V
V <sub>IL</sub>	Low level input voltage			0.2	V
V <sub>OH</sub>	3.3V high level output voltage	V <sub>REF</sub> = 3.14V, I <sub>OH</sub> = 1mA	3.04		V
	2.5V high level output voltage	V <sub>REF</sub> = 2.38V, I <sub>OH</sub> = 1mA	2.28		
	1.8V high level output voltage	V <sub>REF</sub> = 1.71V, I <sub>OH</sub> = 1mA	1.61		
V <sub>OL</sub>	3.3V low level output voltage	V <sub>REF</sub> = 3.47V, I <sub>OL</sub> = 1mA		0.13	V
	2.5V low level output voltage	V <sub>REF</sub> = 2.63V, I <sub>OL</sub> = 1mA		0.13	
	1.8V low level output voltage	V <sub>REF</sub> = 1.9V, I <sub>OL</sub> = 1mA		0.13	
I <sub>CC-ETH</sub>	Operating current drawn from wall adapter connector			350	mA
I <sub>CC-VREF</sub>	JTAG Interface operating current drawn from target board			100	mA

**Table 2: Catapult EJ-1 DC Recommended Operating Conditions**

## Timing

<sup>3</sup> Functional operation of the device beyond the Recommended Operating Condition is not implied or guaranteed.

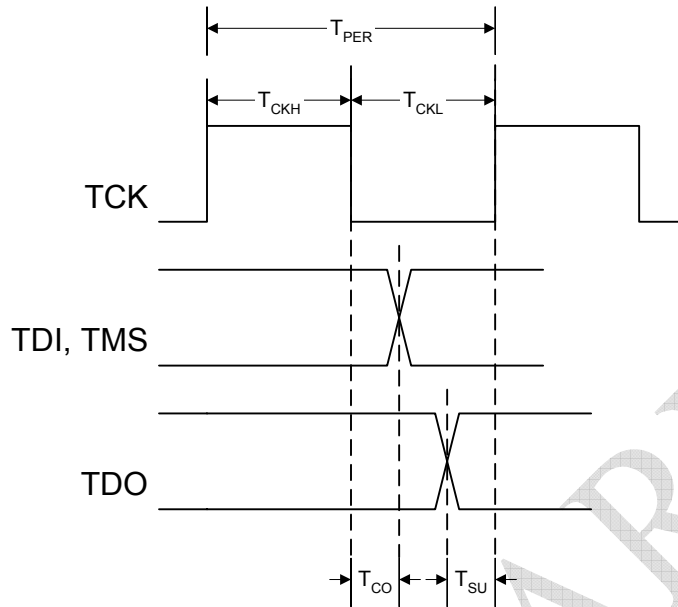


Figure 8: Catapult EJ-1 signal timing waveform

Symbol	Parameter	Conditions	Min	Max	Units
$T_{PER}$	TCK period		64		ns
$T_{CKH}$	TCK high time		32		ns
$T_{CKL}$	TCK low time		32		ns
$T_{CO}$	TDI/TMS propagation delay			20	ns
$T_{SU}$	TDO setup time		20		ns

Figure 9: Catapult EJ-1 AC Timing Specifications

The sideband signals, SB0 and SB1 operate asynchronously to the JTAG interface, and have no relationship to any of the JTAG signals.

### Performance

Catapult EJ-1 runs the JTAG bus at a selectable TCK clock frequency, (between 2.083 MHz and 12.5 MHz), yielding a peak throughput of 12.5 Mbps on the JTAG bus<sup>4</sup>.

### FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed in accordance with the instructions, may cause

<sup>4</sup> Actual JTAG application “useful throughput” depends on various factors, such as the nature and type of JTAG operations, host IP stack performance, workload on the host machine, and several other software considerations.

harmful interference to radio communications. Operation of this equipment in a residential environment is likely to cause harmful interference. Such operation is performed at the user's risk, and any correction of such interference must be done at the user's time and expense.

### Ordering information

Description	Order Code
Catapult EJ-1 <sup>5</sup>	BT-CAT-EJ1
JTAG Interface Cable with flying leads	BT-CB-FLY
JTAG Interface Cable with 14-pin IDC connector	BT-CB-A14

### Revision History

Revision	Date	Comments
0.5	Jan. 24, 2006	Initial
0.6	Jan. 31, 2006	Added variable TCK clock frequency

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<sup>5</sup> BT-CAT-EJ1 ships standard with a BT-CB-A14 cable.