

Lava Multipurpose Probes (Lava-Lmp)

Specification

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Introduction

This document describes a cheap, flexible hardware probe architecture for extending Lava tests via a “test buddy” to cover tests that are currently impossible for Lava.

Problem to be solved

Vendor boards that need Lava tests have many interfaces that cannot be exercised currently. It seriously restricts test coverage once the tests that can be done “from inside” the SoC have been implemented.

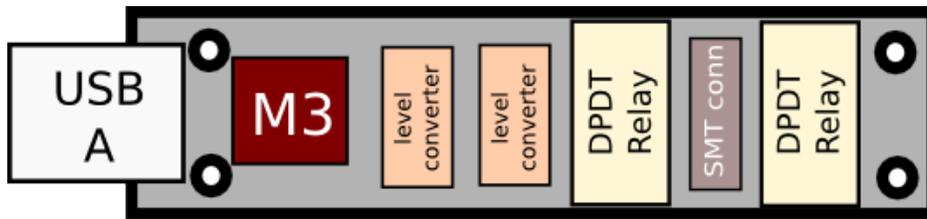
The kinds of test that are out of scope for lava at the moment include

Selecting boot source, eg, from USB, Sata, eMMC, SD
Ethernet Hotplug correctness
HDMI Hotplug correctness
USB Device Hotplug correctness
USB Host Hotplug correctness
USB OTG mode switching correctness
USB Host / OTG Host power provision correctness
SATA / eSATA Hotplug correctness
Audio socket hotplug correctness
LED operation
Switch operation
SoC Package accurate temperature verification
Scanned keypad operation simulation
Ambient light sensor
External SoC package heating
Proximity sensor
Capacitive touchscreen operation emulation

Lava-Lmp Solution

A small USB Cortex-M3 based “USB stick” device is defined with a selection of hardware interfaces needed to service all of the requirements above.

The rationale for this is USB will be compatible with all test hosts; it is extensible by hubs; the hubs can be placed physically near the DUT; power is provided to the devices in a clean way; you can have as many as you need next to any DUT.



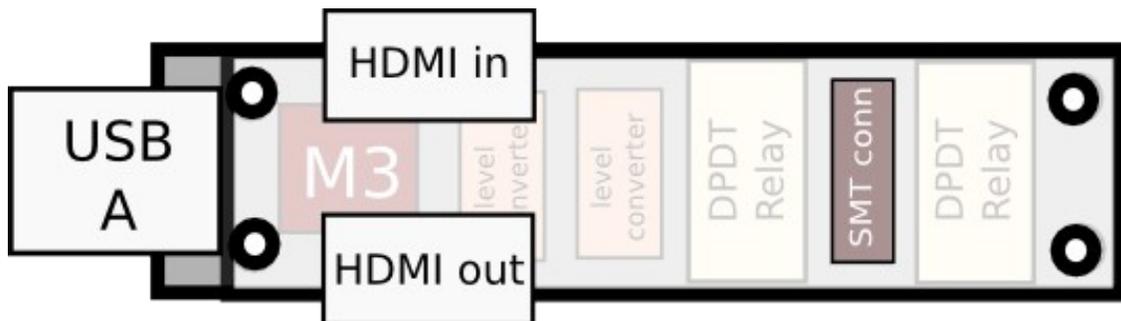
The selected IO appears at a single SMT connector.

The selection of IO provided is the following

IO	Capability	Provides testing for	
2 x 2-channel relay switching (ATE relay 50M operations lifetime minimum)	Allows all kinds of “interruption” disconnect / hotplug testing without having to take care about protocol compatibility for muxing or levels	<ul style="list-style-type: none"> HDMI hotplug / EDID source select USB host / device / otg hotplug Audio hotplug Ethernet hotplug SATA / E-Sata hotplug 	
8 x level-converted output, individually tristateable	Drive 8 x logical signal at any voltage reference	<ul style="list-style-type: none"> Boot source selection Switch actuation simulation Ambient light sensor (open collector) 	<ul style="list-style-type: none"> Scanned keypad testing up to 8x8 I2C device emulation HDMI EDID emulation I2C temperature sensor
8 x level-converted input	Sense 8 x logical signal at any voltage reference	<ul style="list-style-type: none"> LED test Confirm state of any static signal 	

In addition to this “base” board additional “scenario” boards are defined.

These mount on top of the base board and provide appropriate connectors for the test activity. Here is an example scenario board for HDMI test (covering HDMI hotplug control, and ability to either pass through EDID or provide a synthetic EDID from the test host instead)



The scenario boards typically do not need additional components, just appropriate connectors hooked

up to the provided signals from the base board.

Scenario Board identification

A 3-bit bus is provided on the SMT Connector to identify which scenario the board is configured for. These may be tied high, low or left floating for a total of 26 possible scenario boards + all-floating reserved to detect no scenario board present.

Software interface to PC

The base board always presents itself as a ttyACM serial device and uses human-readable control and status protocol, dependent on the scenario board fitted. It has a unique USB serial number.

Base board firmware

There is only one base board firmware which supports all scenarios. The correct scenario software support in the Cortex M3 firmware is selected when it boots, from querying the scenario board ID it is fitted with. No state regarding scenario selection is required to be sent by the PC or appears at the USB configuration level.

Base Board IO Connector signals

A 40-pin SMT connector provides the following signals. Note Relay 1 + 2 are controlled by one signal from the Cortex M3 and Relay 3 + 4 are controlled by a second signal independently.

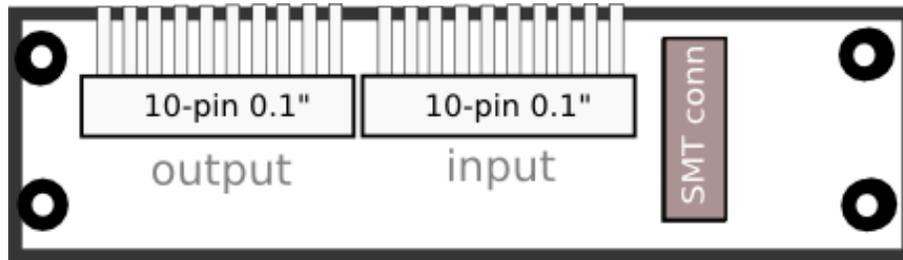
Row	A	B
1	Relay 1 NO	Relay 1 COM
2	Relay 1 NC	0V
3	Relay 2 NO	Relay 2 COM
4	Relay 2 NC	0V
5	OUT0	OUT1
6	OUT2	OUT3
7	OUT4	OUT5
8	OUT6	OUT7
9	+5V	Vref for In and Out signals
10	IN0	IN1
11	IN2	IN3
12	IN4	IN5
13	IN6	IN7
14	0V	SCEN1
15	ADC IN 1	ADC IN 2

16	0V	SCEN2
17	Relay 3 NO	Relay 3 COM
18	Relay 3 NC	SCEN3
19	Relay 4 NO	Relay 4 COM
20	Relay 4 NC	0V

Scenario boards

Scenario: Digital IO

This provides 8 level-converted 3-state outputs suitable for controlling pulled-up or pulled-down wired boot control signals, and 8 level-converted inputs suitable for checking the state of signals



Pin	Output connector signal	Input connector signal
1	Vref (wire to board supply to be used for a high level output, eg, 1.8V)	Vref (wire to board supply the input signals are referenced to, eg, 1.8V)
2	OUT0	IN0
3	OUT1	IN1
4	OUT2	IN2
5	OUT3	IN3
6	OUT4	IN4
7	OUT5	IN5
8	OUT6	IN6
9	OUT7	IN7
10	0V	0V

Scenarios useful for

- Boot source selection
- Switch actuation simulation

- LED state confirmation
- Scanned keypress simulation (practically will need custom scenario board with matching flat cable socket)

Host Software interface

- WXXX10XX
 - W = write new levels
 - 8 characters defining the 8 IO levels, 0 = 0V, 1=Vref, X=floating
- R
 - R = return input states

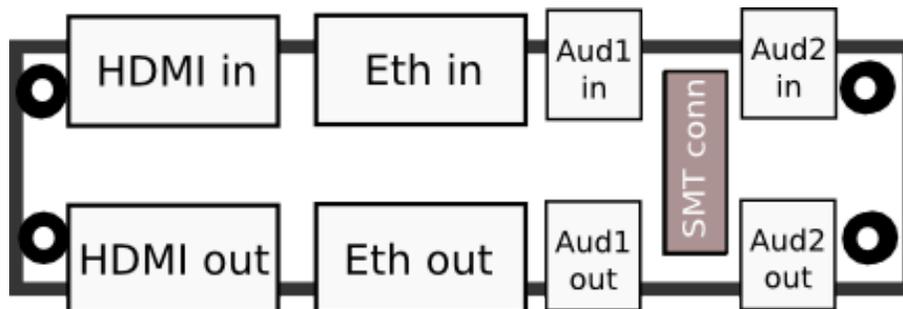
00001001

Scenario: Common Hotplug

This board provides hotplug test support for the following interfaces:

- Ethernet (no explicit plug detect signal, RX₋ and TX₊ must be disconnected)
- HDMI (Edid and hotplug signal controllable)
- 2 x 3.5mm Stereo audio (explicit and implicit plug detect: independently controlled)

Only one kind of interface can be used at a time on a single board. If you need to control them all three base + scenario boards will be needed.



For implicit (impedance-based) audio hotplug sensing, just pass the audio connectors through the jacks and both stereo audio signals will be interrupted under software control. If explicit plug detect (switch in the jack) is used, interrupt the plug detect signal on the board and pass it through one of the audio jacks on the scenario board so it can be interrupted under software control.

Scenarios useful for

- HDMI hotplug
- HDMI EDID emulation
- Ethernet hotplug test

- Audio jack presence detect x 2

Host Software interface

- W00
 - W = write new relay levels
 - For each relay pair, 0 = off / “normal”, 1 = actuated
- EDID=<hex bytes until CR>
 - Set the emulated EDID for use with HDM when the second relay pair is actuated

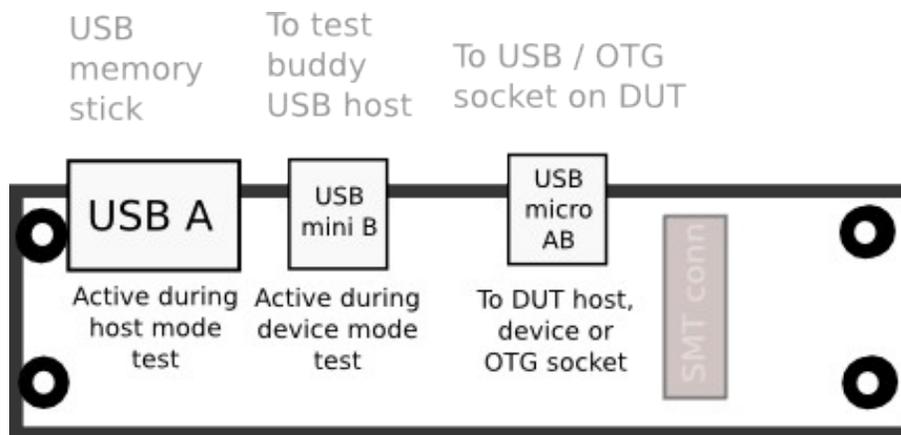
Scenario: USB2 hotplug

This provides test support for all kinds of USB-related hotplug. When plugged into a DUT USB OTG socket, it can simulate

- Disconnect
- Connection to USB device plugged into the A socket, eg, USB memory stick
- Connection to USB host plugged into the mini B socket, eg, test host buddy

It can also provide the correct SENSE pin level for the OTG scenario being tested, simulating the correct cable plugged in.

Additionally it monitors the voltage provided by the DUT in the host mode.



Scenarios useful for

- USB Host hotplug and functionality confirm
- USB Host voltage monitoring
- USB Device hotplug
- USB OTG mode sensing by SENSE pin
- USB OTG role switching

Host software interface

- M_
 - _ is H or D for Host or Device
- V
 - 5.13
 - Report minimum voltage seen since last V