Open Source Automation Development Lab (OSADL) eG

The OSADL Latency Measurement Box

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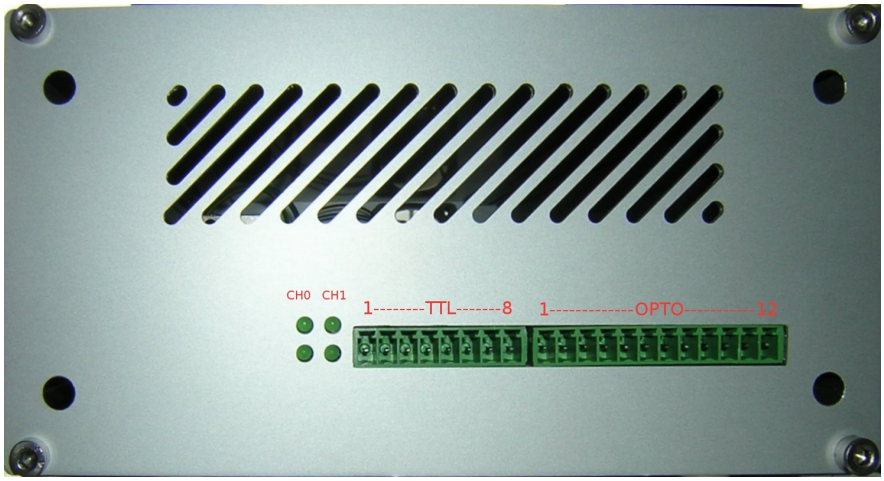
Getting started with the OSADL Latency Measurement Box

General hardware features

CPU PowerPC 750FX @ 600MHz
512 kB on-chip L2 cache
64 MB SDRAM on SODIMM
One 10/100 Mb/s network interface (10BaseT / 100BaseTX)
Two serial channels
Embedded Linux BSP support
16 MB (optionally 32 MB) Flash EPROM
Two TTL/OPTO output trigger channels
Four TTL/OPTO input ports
Four measurement indicator LEDs
One RS232 interface at Min-D connector (U-Boot)
One RS232 interface onboard (for debug purposes)
One RS485 channel, opto-decoupled
+ 6.3 V supply voltage

Front view



8-pin connector (pin 1 on the left)

Pin	Signal
pin 1	GND
pin 2	GND
pin 3	TRIG1_TTL
pin 4	TRIG2_TTL

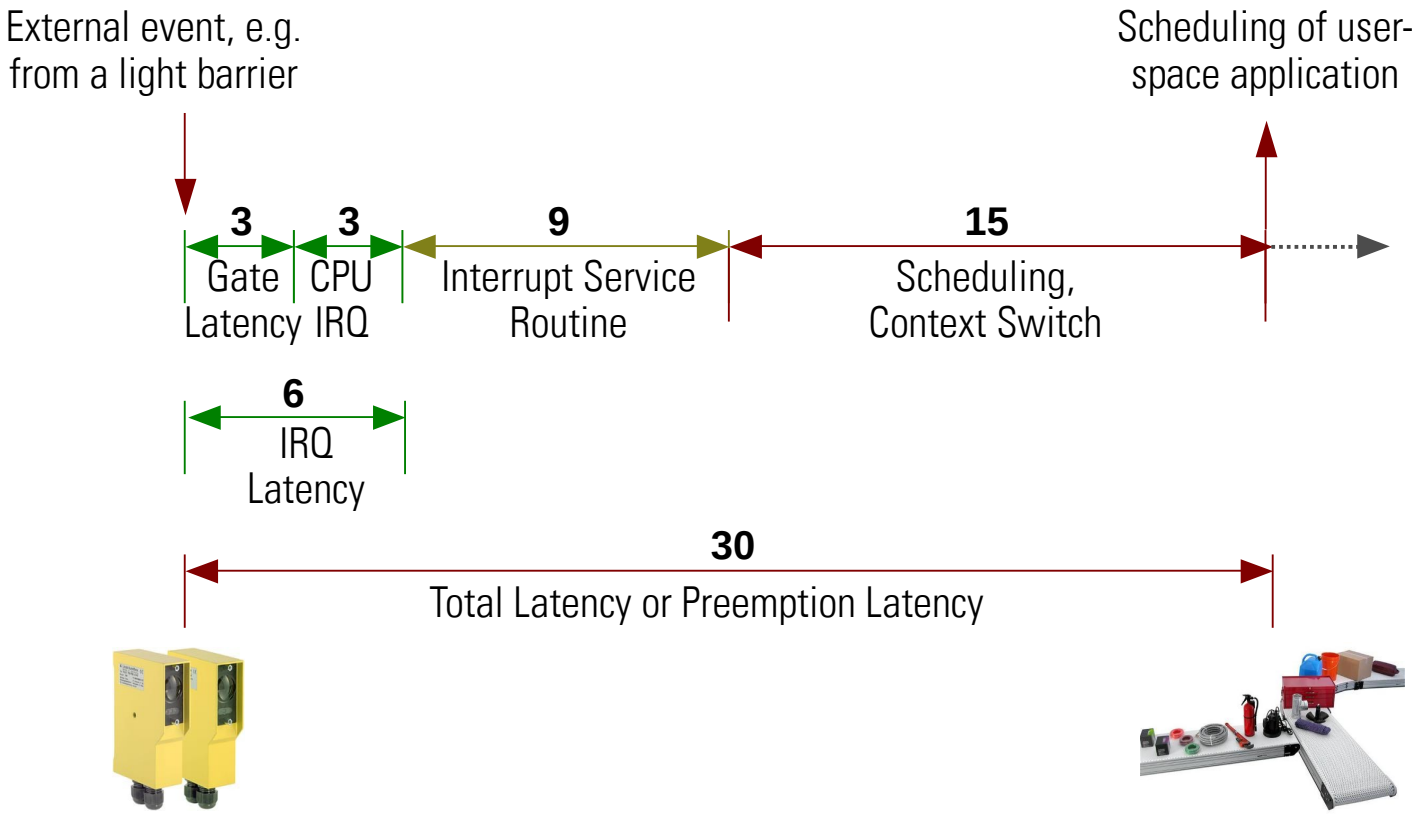
Pin	Signal
pin 5	IN1_TTL
pin 6	IN2_TTL
pin 7	IN3_TTL
pin 8	IN4_TTL

12-pin connector (pin 1 on the left)

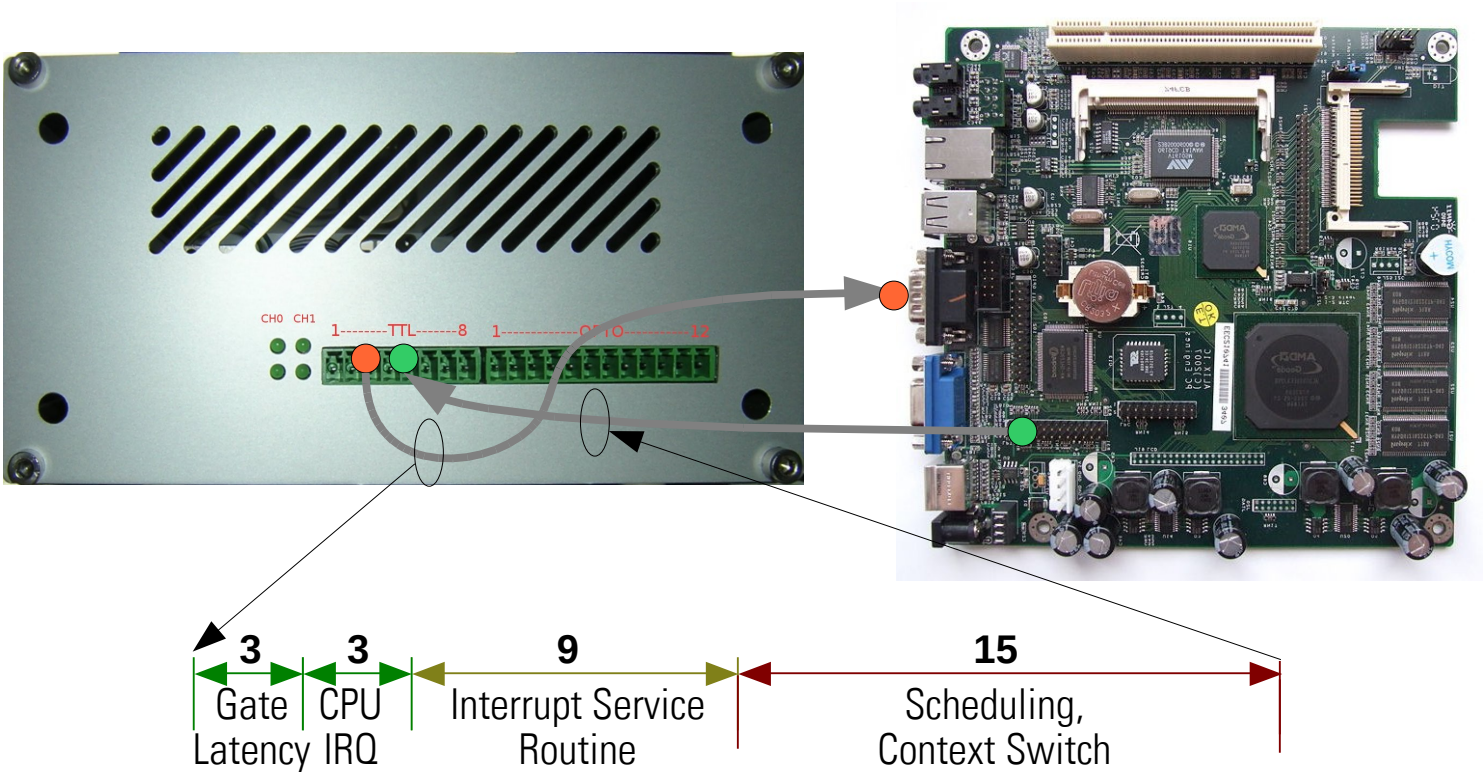
Pin	Signal
pin 1	GND_EXT
pin 2	GND_EXT
pin 3	TRIG1
pin 4	TRIG2
pin 5	IN4+
pin 6	IN4-
pin 7	IN3+
pin 8	IN3-
pin 9	IN2+
pin 10	IN2-
pin 11	IN1+
pin 12	IN1-

Back view

Path flow of interrupt execution



Example measurement set-up



Standard U-Boot environment of the user FEPROM

The system needs a proper network configuration. Connect the RS232 port (lower 9 pin DSUB female) to a serial terminal with a 1-to-1 cable.

The default port configuration is:

9600 baud, 8N1, no handshake

The network parameters can be configured via BOOTP, DHCP or manually, e.g.:

```
=> setenv serverip 192.168.2.100
=> setenv ipaddr 192.168.2.105
=> setenv gatewayip 192.168.2.1
=> setenv netmask 255.255.255.0
```

An optional NTP Server IP can also be configured (SIMS 550 has no RTC).

```
=> setenv ntpserverip 129.69.1.153
```

The following must be entered as a single line string. The backslash before a semicolon prevents the command from being executed immediately.

```
=> setenv bootcmd fsload 1000000 osadl_t.img\; setenv bootargs console=ttyS0
     root=/dev/ram rw rootfstype=tmpfs ip=\$(ipaddr):\$(serverip):\$(gatewayip):
     \$(netmask):\$(hostname):eth0:none:\$(ntpserverip)\; bootm
```

After power on U-Boot starts with an autoboot delay of 5 seconds.

Login into the system

After Linux has finished booting from the flash file, the system is waiting for login. Two users are configured: 'root' and 'osadl'.

1. user=root, password=osadl
2. user=osadl, password=osadl

A user can login at the serial RS232 port (9600 baud, 8N1, no HS) or via ssh.

Starting the latency measurement application

The OSADL Latency Measurement Box has two independent channels for latency measurements. The I/O connectors are located on the front panel, see front view on page 3.

Each channel has one output trigger signal. This trigger signal can either have TTL or OPTO level. A channel can measure one or two input signals.

Channel 0 (/dev/sims_lt0) input configurations

1. [IN1_TTL] or [IN1+/IN1-] for one input signal
2. [IN1_TTL, IN2_TTL] or [IN1+/IN1-, IN2+/IN2-] for two input signals

Channel 1 (/dev/sims_lt1) input configurations

1. [IN3_TTL] or [IN3+/IN3-] for one input signal
2. [IN3_TTL, IN4_TTL] or [IN3+/IN3-, IN4+/IN4-] for two input signals

The latency measurement application is called 'lthisto'.

 # lthisto

Usage: lthisto [DEVICE] [OPTIONS]
Build latency time histogram (output pulse to response) on '/dev/sims_lt0' and '/dev/sims_lt1'.

-O -- use OPTO input port instead of TTL (=default) inputs
-B -- summarize both input ports instead of first input only (=default)
-n -- use negative edge for trigger input instead of positiv (=default)
-b -- use both (neg/pos) edges for trigger input instead of positiv (=default)
-v -- time to measure starts the falling edge output instead of rising (=default)
-r runtime -- set program runtime (measurement time) in seconds (default: 10)
-t timeout -- set response timeout value in microseconds (default: 1000)
-h hightime -- set trigger output hightime value in microseconds (default: 100)
-l lowtime -- set trigger output lowtime value in microseconds (default: 100)
-H values -- set count for histogram entries (default: 1000)
-f filename -- set output filename of measurement on input 1/3 (default: lt0-0.txt/lt1-0.txt)
-F filename -- set output filename of measurement on input 2/4 (default: lt0-1.txt/lt1-1.txt)

The result output file first reports the measurement configuration. This is followed by the histogram values. The latter are continuously listed with a resolution of 1 µs, e.g.

```
# lthisto /dev/sims_lt0 -B -b -h 10 -l 10
.....

# cat lt0-0.txt
#
# Date: Thu Jan 1 03:43:51 1970
#
# Runtime parameter:
# ------------------
# Measurement time: 10 seconds
# Device: /dev/sims_lt0
# Input port(s): OPTO
# Number of inputs: 1
# Trigger input on: all edges
# Measurement starts at: rising edge
# Wait input timeout: 10000 microseconds
# Signal out high time: 100 microseconds
# Signal out low time: 100 microseconds
# Histogram entries: 1000
#
0 <-- response after 1 µs
```

0
0
0
0 <-- *response after 5 µs*
0
0
0
0
0
76 <-- *response after 11 µs*
2238
8800
20027 <-- *peak after 14 µs*
18433
430
25
14
16
15
12
21
38
47
6
1
0
3
4
0
1
0
1
2
0
1
.....
0 <-- *response after 1000 µs or timeout reached*

Getting the measurement results

The OSADL Latency Measurement Box includes a Web server and an FTP daemon. The Web server offers two demo files. Please make a backup of the files and adjust the network address in the file in use.

OSADL.sh - A script to get the measurement results via ftp and to convert the text files into jpg images.

osadl.html - A simple Web page to display the measurement results in a browser.

Please note: Running the script OSADL.sh requires the gnuplot utility to be installed on the Linux host computer.

Update of the Linux image

The application Linux image is stored as a file in a JFFS on /dev/mtdblock2. After the Linux system has been started, this partition is mounted as /flash.

A network connection is required to update the Linux image.
The new image can be transferred via NFS or using the scp utility, e.g.

```
# mkdir /nfs
# mount 192.168.2.100:/nfsroot /nfs -o nolock,noac,mountvers=2
# cp /nfs/osadl_t.img /flash
```

At U-Boot Prompt:

```
=> ls
Scanning JFFS2 FS: . done.
-rw-r--r-- 4185443 Thu Jan 01 00:06:42 1970 sims.img
=> fsload 1000000 osadl_t.img
### JFFS2 loading 'osadl_t.img' to 0x1000000
### JFFS2 load complete: 4081058 bytes loaded to 0x1000000
```

Manufacturer information, authors and support

The OSADL Latency Measurement Box was developed by ELTEC Elektronik AG, Mainz, Germany. This documentation was written by Frank Gottschling, ELTEC, and Carsten Emde, OSADL.

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Please send support requests to OSADL (info@osadl.org).