

linux / how to use peripherals under linux

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GPIO

Kernelgpio

<https://git.phytec.de/linux-mainline/tree/Documentation/gpio/drivers-on-gpio.txt?h=v4.9.98-phy>

gpioLED

```
- leds-gpio: drivers/leds/leds-gpio.c will handle LEDs connected to GPIO
lines, giving you the LED sysfs interface

- ledtrig-gpio: drivers/leds/trigger/ledtrig-gpio.c will provide a LED trigger,
i.e. a LED will turn on/off in response to a GPIO line going high or low
(and that LED may in turn use the leds-gpio as per above).

- gpio-keys: drivers/input/keyboard/gpio_keys.c is used when your GPIO line
can generate interrupts in response to a key press. Also supports debounce.

- gpio-keys-polled: drivers/input/keyboard/gpio_keys_polled.c is used when your
GPIO line cannot generate interrupts, so it needs to be periodically polled
by a timer.

- gpio_mouse: drivers/input/mouse/gpio_mouse.c is used to provide a mouse with
up to three buttons by simply using GPIOs and no mouse port. You can cut the
mouse cable and connect the wires to GPIO lines or solder a mouse connector
to the lines for a more permanent solution of this type.

- gpio-beeper: drivers/input/misc/gpio-beeper.c is used to provide a beep from
an external speaker connected to a GPIO line.

- gpio-tilt-polled: drivers/input/misc/gpio_tilt_polled.c provides tilt
detection switches using GPIO, which is useful for your homebrewn pinball
machine if for nothing else. It can detect different tilt angles of the
monitored object.

- extcon-gpio: drivers/extcon/extcon-gpio.c is used when you need to read an
external connector status, such as a headset line for an audio driver or an
HDMI connector. It will provide a better userspace sysfs interface than GPIO.

- restart-gpio: drivers/power/reset/gpio-restart.c is used to restart/reboot
the system by pulling a GPIO line and will register a restart handler so
userspace can issue the right system call to restart the system.

- poweroff-gpio: drivers/power/reset/gpio-poweroff.c is used to power the
system down by pulling a GPIO line and will register a pm_power_off()
callback so that userspace can issue the right system call to power down the
system.

- gpio-gate-clock: drivers/clk/clk-gpio.c is used to control a gated clock
(off/on) that uses a GPIO, and integrated with the clock subsystem.
```

- i2c-gpio: drivers/i2c/busses/i2c-gpio.c is used to drive an I2C bus (two wires, SDA and SCL lines) by hammering (bitbang) two GPIO lines. It will appear as any other I2C bus to the system and makes it possible to connect drivers for the I2C devices on the bus like any other I2C bus driver.
- spi_gpio: drivers/spi/spi-gpio.c is used to drive an SPI bus (variable number of wires, at least SCK and optionally MISO, MOSI and chip select lines) using GPIO hammering (bitbang). It will appear as any other SPI bus on the system and makes it possible to connect drivers for SPI devices on the bus like any other SPI bus driver. For example any MMC/SD card can then be connected to this SPI by using the mmc_spi host from the MMC/SD card subsystem.
- wl-gpio: drivers/wl/masters/wl-gpio.c is used to drive a one-wire bus using a GPIO line, integrating with the W1 subsystem and handling devices on the bus like any other W1 device.
- gpio-fan: drivers/hwmon/gpio-fan.c is used to control a fan for cooling the system, connected to a GPIO line (and optionally a GPIO alarm line), presenting all the right in-kernel and sysfs interfaces to make your system not overheat.
- gpio-regulator: drivers/regulator/gpio-regulator.c is used to control a regulator providing a certain voltage by pulling a GPIO line, integrating with the regulator subsystem and giving you all the right interfaces.
- gpio-wdt: drivers/watchdog/gpio_wdt.c is used to provide a watchdog timer that will periodically "ping" a hardware connected to a GPIO line by toggling it from 1-to-0-to-1. If that hardware does not receive its "ping" periodically, it will reset the system.
- gpio-nand: drivers/mtd/nand/gpio.c is used to connect a NAND flash chip to a set of simple GPIO lines: RDY, NCE, ALE, CLE, NWP. It interacts with the NAND flash MTD subsystem and provides chip access and partition parsing like any other NAND driving hardware.

kernelLED/GPIO

IOpinmuxGPIOIoGPIOdatasheet

IObootloaderGPIOMUX/

am335x-pcm-953.dtsi	<pre> &am33xx_pinmux { pinctrl-names = "default"; pinctrl-0 = <cb_gpio_pins>; cb_gpio_pins: pinmux_cb_gpio { pinctrl-single,pins = < 0x168 (PIN_OUTPUT_PULLDOWN MUX_MODE7) /* uart0_ctsn.gpio1_8 */ 0x16C (PIN_OUTPUT_PULLDOWN MUX_MODE7) /* uart0_rtsn.gpio1_9 */ >; }; }; </pre>

imx6qdl-phytec-pfla02.dtsi	<pre> &iomuxc { pinctrl-names = "default"; pinctrl-0 = <&pinctrl_hog>; pinctrl_hog: hoggrp { fsl,pins = < MX6QDL_PAD_SD4_DAT1__GPIO2_IO09 0x1b0b0 /* PMIC interrupt */ MX6QDL_PAD_ENET_TXD0__GPIO1_IO30 0x1b0b0 /* Green LED */ >; }; };</pre>
----------------------------	--

linux / linux kernel device tree modify guide

pinmux

GPIO

	gpio	gpiosys
una me - r	V4.8	V4.8
	<div>gpio422</div> <div>22=0</div> <div>gpioset 3</div> <div>gpio422</div> <div>0</div> <div>gpioget 3 22</div>	<div><ul style="list-style-type: none">• i.MX6q/i.MX6ul: Linux GPIO number: <N> = (<X> - 1) * 32 + <Y>• AM57x: Linux GPIO number: <N> = (<X> - 1) * 32 + <Y>• AM335x: Linux GPIO number: <N> = <X> * 32 + <Y>• The GPIOs are identified as GPIO<X>_<Y> (e.g. GPIO5_07). <X> identifies the GPIO bank and counts from 1 to 7, while <Y> stands for the GPIO within the bank. <Y> is being counted from 0 to 31 (32 GPIOs on each bank).</div> <div>echo 65 > /sys/class/gpio/export echo out > /sys/class/gpio/gpio65/direction echo 1 > /sys/class/gpio/gpio65/value echo 0 > /sys/class/gpio/gpio65/value</div>
	<div>https://github.com/brgl/libgpiod/blob/master/README</div> <div>https://git.kernel.org/pub/scm/libs/libgpiod/libgpiod.git</div> <div>tools</div> <div>https://git.kernel.org/pub/scm/libs/libgpiod/libgpiod.git/tree/tools/gpioset.c</div>	

KEY

gpio_keys:

<https://www.kernel.org/doc/Documentation/devicetree/bindings/input/gpio-keys.txt>

imx6qdl-phytec-mira-peb-eval-01.dtsi

```

&iomuxc {
    pinctrl_gpio_keys: gpiokeysgroup {
        fsl,pins = <
            MX6QDL_PAD_SD3_DAT6__GPIO6_IO18          0x1b0b0
            MX6QDL_PAD_CSI0_DAT10__GPIO5_IO28          0x1b0b0
        >;
    };
};

/ {
    gpio-keys {
        compatible = "gpio-keys";
        pinctrl-names = "default";
        pinctrl-0 = <&pinctrl_gpio_keys>;
        status = "disabled";

        home {
            label = "Home";
            gpios = <&gpio6 18 GPIO_ACTIVE_LOW>;
            linux,code = <KEY_HOME>;
        };

        power {
            label = "Power Button";
            gpios = <&gpio5 28 GPIO_ACTIVE_LOW>;
            linux,code = <KEY_POWER>;
            gpio-key,wakeup;
        };
    };
};

```

:

```

$ evtest
No device specified, trying to scan all of /dev/input/event*
Available devices:
/dev/input/event0:      stmpe-ts
/dev/input/event1:      gpio-keys
Select the device event number [0-1]:1

```

LED

gpio-leds:

<https://www.kernel.org/doc/Documentation/devicetree/bindings/leds/leds-gpio.txt>

imx6qdl-phytec-mira-peb-eval-01.dtsi

```

&iomuxc {
    pinctrl_user_leds: userledsgrp {
        fsl,pins = <
            MX6QDL_PAD_SD3_DAT4__GPIO7_IO01          0x1b0b0
            MX6QDL_PAD_SD3_DAT5__GPIO7_IO00          0x1b0b0
            MX6QDL_PAD_CSI0_DAT11__GPIO5_IO29        0x1b0b0
        >;
    };
};

/ {
    user_leds: user-leds {
        compatible = "gpio-leds";
        pinctrl-names = "default";
        pinctrl-0 = <&pinctrl_user_leds>;
        status = "disabled";

        user-led1 {
            gpios = <&gpio7 1 GPIO_ACTIVE_HIGH>;
            linux,default-trigger = "gpio";
            default-state = "on";
        };

        user-led2 {
            gpios = <&gpio7 0 GPIO_ACTIVE_HIGH>;
            linux,default-trigger = "gpio";
            default-state = "on";
        };

        user-led3 {
            gpios = <&gpio5 29 GPIO_ACTIVE_HIGH>;
            linux,default-trigger = "gpio";
            default-state = "on";
        };
    };
};

```

linuxled:

led:

```

$ ls /sys/class/leds
mira-blue      mira-red      mmc1::        user-led1     user-led3
mira-green     mmc0::        phycore-green user-led2

```

led:

```
$ echo 255 > /sys/class/leds/user-led1/brightness
```



led, led.

led:

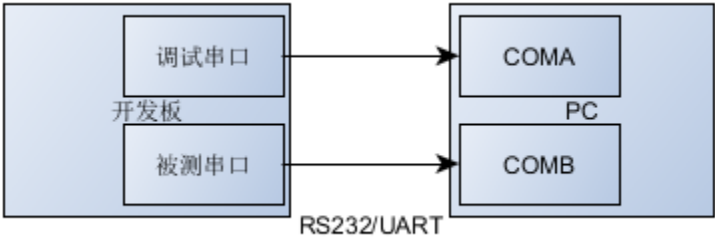
```
$ echo 0 > /sys/class/leds/user-led1/brightness
```

led:

```
$ echo timer > /sys/class/leds/user-led1/trigger
$ echo 200 > /sys/class/leds/user-led1/delay_on
$ echo 200 > /sys/class/leds/user-led1/delay_off
```

#led
#led

SOC		
am335x	/dev/ttyO2	O
imx6/6ul/7	/dev/ttymxc2	



am335x

```
stty -F /dev/ttyO2 115200 raw
```

Unknown macro: 'snippet'

echo

am335x

```
echo "hello~tty device" > /dev/ttyO2
```

cat

am335x

```
cat /dev/ttyO2
```

echoechostty

am335x

```
stty -F /dev/ttyO2 115200 -onlcr -iexten -echo -echoe -echok -echoctl -echoke raw
```

CAN

CANDB9

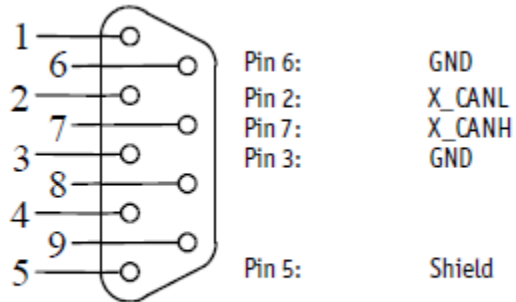
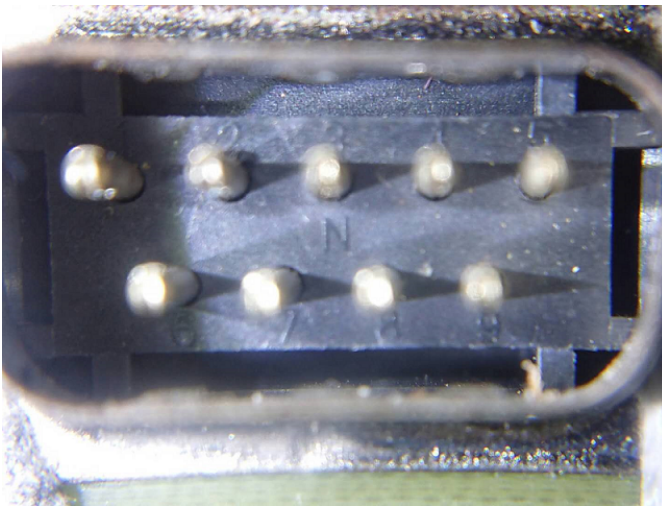


Figure 14: CAN Connector Signal Mapping



2&73&6

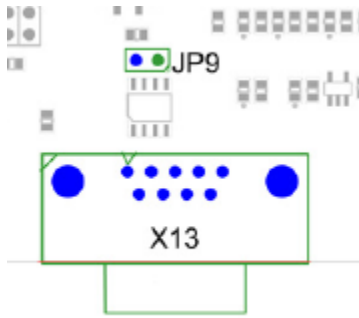
CAN https://en.wikipedia.org/wiki/CAN_bus#Layers

CAN(ISO 11898-2 High Speed CAN)120

blocked URL

<http://www.ni.com/white-paper/9759/en/>

120JP9



CAN_LCAN_H

CAN

/lib/systemd/system/can0.service

500k

```
cansend can0 123#45.67
```

```
candump can0
```

bus-off

```
ip -d -s link show can0

2: can0: <NOARP,UP,LOWER_UP,ECHO> mtu 16 qdisc pfifo_fast state UNKNOWN mode DEFAULT group default qlen 10
    link/can promiscuity 0
    can state ERROR-ACTIVE (berr-counter tx 0 rx 0) restart-ms 0
        bitrate 500000 sample-point 0.800
        tq 400 prop-seg 1 phase-seg1 2 phase-seg2 1 sjw 1
        c_can: tseg1 2..16 tseg2 1..8 sjw 1..4 brp 1..1024 brp-inc 1
        clock 25000000
        re-started bus-errors arbit-lost error-warn error-pass bus-off
            0          0          0          0          0          0          numtxqueues 1 gso_max_size 65536
gso_max_segs 65535
RX: bytes  packets  errors  dropped  overrun  mcast
   0         0         0         0         0         0
TX: bytes  packets  errors  dropped  carrier  collsns
   0         0         0         0         0         0
```

EEPROM

/eeprom


```

root@phycore-am335x-1:~# cd /
root@phycore-am335x-1:~# find . -name eeprom
./sys/devices/platform/ocp/44e0b000.i2c/i2c-0/0-0052/eeprom

```

eeprom1024

```

root@phycore-am335x-1:~# dd if=/sys/devices/platform/ocp/44e0b000.i2c/i2c-0/0-0052/eeprom bs=1 count=1024 |
od -x
00000000    55aa    6850    7479    6365    4d2d    7365    7473    6365
00000020    6e68    6b69    ffff    ffff    ffff    ffff    ffff    ffff
00000040    ffff    ffff    ffff    ffff    ffff    ffff    ffff    ffff
*
0002000
1024+0 records in
1024+0 records out

```

eeprom0

```

root@phycore-am335x-1:~# dd if=/dev/zero of=/sys/devices/platform/ocp/44e0b000.i2c/i2c-0/0-0052/eeprom
bs=4096 count=1
1+0 records in
1+0 records out
root@phycore-am335x-1:~# dd if=/sys/devices/platform/ocp/44e0b000.i2c/i2c-0/0-0052/eeprom bs=1 count=1024 | od -
x
00000000    0000    0000    0000    0000    0000    0000    0000    0000
*
0002000
1024+0 records in
1024+0 records out

```

SD/NAND/SATA

```
hdparm -Tt /dev/sda
```

```
dd if=/dev/zero of=/tmp/output bs=8k count=10k
```

```
iozone -a -g 256M -s 256M -b file.xls
```

RTC

```
date -s "2017-7-17 15:44"
```

071715442017

```
hwclock -w -u
```

RTC

RTC

```
[ 1.943438] rtc-m41t80 0-0068: Oscillator failure, data is invalid.
[ 1.950394] rtc-m41t80 0-0068: rtc core: registered rv4162 as rtc0
```

RTC1/RTC2

RTCPHYCORE i.MX62RTCi.MX6 CPUSNVs rtcPMICRTCRTCRTC2C

```
oot@phyboard-mira-imx6-3:/sys/class/rtc# cat rtc*/name
rtc-m41t80 0-0068
da9063-rtc da9062-rtc
snvs_rtc 20cc000.snvs:snvs-rtc-lp
```

/dev/rtc#RTC aliases

```
aliases {
    rtc1 = &da9062_rtc;
    rtc2 = &snvs_rtc;
};
```

RTCRTC

```
hwclock -s -u -f /dev/rtc#
RTC
hwclock -w -u -f /dev/rtc#
```

RTCMenueconfighttps://cateee.net/lkddb/web-lkddb/RTC_HCTOSYS_DEVICE.html

```
.config - Linux/arm 4.14.39 Kernel Configuration
> Device Drivers > Real Time Clock
----- Real Time Clock -----
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenu --
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modular
Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]
<M> module < > module capable
-----
--- Real Time Clock
[*] Set system time from RTC on startup and resume
(rtc1) RTC used to set the system time
[*] Set the RTC time based on NTP synchronization
(rtc1) RTC used to synchronize NTP adjustment
[ ] RTC debug support
[*] RTC non volatile storage support
*** RTC interfaces ***
[*] /sys/class/rtc/rtcN (sysfs)
[*] /proc/driver/rtc (procfs for rtcN)
[*] /dev/rtcN (character devices)
[*] RTC UIE emulation on dev interface
< > Test driver/device
*** I2C RTC drivers ***
< > Abracon AB-RTCMC-32.768kHz-B5ZE-S3
v(+)
-----
<Select> < Exit > < Help > < Save > < Load >
```

I2C

i2ci2ctools<https://manpages.debian.org/unstable/i2c-tools/index.html>

```
imx7d-phyboard-zeta-001:~# i2cdetect 1
WARNING! This program can confuse your I2C bus, cause data loss and worse!
I will probe file /dev/i2c-1.
I will probe address range 0x03-0x77.
Continue? [Y/n] y
    0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:  -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
10:  -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20:  -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30:  -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40:  -- UU -- -- -- -- -- -- -- -- -- -- -- -- --
50:  -- UU -- -- -- -- -- -- -- -- -- -- -- -- --
60:  -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70:  -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

i2cdetecti2c1i2c

i2ctoolsi2c

UUi2ctools

```
imx7d-phyboard-zeta-001:~# i2cdump 1 0x41
No size specified (using byte-data access)
Error: Could not set address to 0x41: Device or resource busy
```

i2ci2ctools

<https://github.com/mozilla-b2g/i2c-tools>

SPI

<https://git.phytec.de/linux-mainline/tree/tools/spi?h=v4.9.98-phy>
[spidev /how to test spidev](#)

CPU

CPU

linuxcpufreq/cpuCPU

<https://www.kernel.org/doc/Documentation/cpu-freq/user-guide.txt>

	<div>cat /sys/devices/system/cpu/cpu0/cpufreq/scaling_cur_freq</div>

	<pre>cat /sys/devices/system/cpu/cpu0/cpufreq /scaling_available_frequencies</pre>
	<pre>echo 2700000 > /sys/devices/system/cpu/cpu0/cpufreq /scaling_max_freq</pre>
(governors) https://www.kernel.org/doc/Documentation/cpu-freq/governors.txt	<pre>cat /sys/devices/system/cpu/cpu0/cpufreq /scaling_available_governors</pre>
	<pre>echo userspace > /sys/devices/system/cpu/cpu0/cpufreq /scaling_governor echo 2700000 > /sys/devices/system/cpu/cpu0/cpufreq/scaling_setspeed</pre>

CPU/

CPU

```
ls /sys/devices/system/cpu -l
```

```
echo 0 > /sys/devices/system/cpu/cpu3/online
```

echo 1