Granite2 / Gemstone2 LSP (2015) kernel configs related to irq

kernel 3.18.7

```
/ {
        model = "Pegmatite SoC";
        compatible = "marvell,pegmatite";
        interrupt-parent = <&gic>;

        ......
};
```

由于在root device node中指定了interrupt-parent property为gic，这样如果child device node中没有特别显式指定，那么该device的interrupt都连接到gic。否则每个device node中都要注明“interrupt-parent”是谁。

Granite2 and Gemstone有两大类interrupt controller.

1. gic (one)

```
        gic: interrupt-controller@d1d01000 {
                compatible = "arm,cortex-a15-gic", "arm,cortex-a9-gic";
                #interrupt-cells = <3>;
                #address-cells = <0>;
                interrupt-controller;
                reg = <0 0xd1d01000 0 0x1000>,
                      <0 0xd1d02000 0 0x100>;
        };
```

gic interrupt specifier的说明：

```
        #interrupt-cells = <3>;
```

比如

```
    uart0: uart@d4030000 {
        compatible = "mrvl,pxa-uart";
        reg = <0 0xd4030000 0 0x1000>;
        interrupts = <0 16 4>;
        clocks = <&uart0_clkgate>;
        status = "disabled";
```

#interrupt-cells = <3>;

使得of code (in drivers/of)能够正确地parse device node中的"interrupt" property。使用interrupt specifier来parse "interrupt" property的code在

of_irq_parse_raw() function in drivers/of/irq.c.

但是of_irq_parse_raw()只是辨认出一个interrupt由多少数字表示，即 0， 16， 4这3个数字表示一个gic上的interrupt, 但这3个数字的意义，它是不负责解释的（它也不知道意义）。

负责解释的是对应interrupt controller的irq domain.在这里就是gic的irq domain。

in drivers/irqchip.irq/gic.c

static struct gic_chip_data gic_data[MAX_GIC_NR] __read_mostly;

struct gic_chip_data用于描述 gic.

```
struct gic_chip_data {
    union gic_base dist_base;
```

```
        union gic_base cpu_base;
#ifdef CONFIG_CPU_PM
        u32 saved_spi_enable[DIV_ROUND_UP(1020, 32)];
        u32 saved_spi_conf[DIV_ROUND_UP(1020, 16)];
        u32 saved_spi_target[DIV_ROUND_UP(1020, 4)];
        u32 __percpu *saved_ppi_enable;
        u32 __percpu *saved_ppi_conf;
#endif
        struct irq_domain *domain;
        unsigned int gic_irqs;
#ifdef CONFIG_GIC_NON_BANKED
        void __iomem *(*get_base)(union gic_base *);
#endif
};
```

而irq domain中的irq_domain_ops中的xlate()负责解释这些数字的含义。

```
/**
 * struct irq_domain_ops - Methods for irq_domain objects
 * @match: Match an interrupt controller device node to a host, returns
 *         1 on a match
 * @map: Create or update a mapping between a virtual irq number and a hw
 *       irq number. This is called only once for a given mapping.
 * @unmap: Dispose of such a mapping
 * @xlate: Given a device tree node and interrupt specifier, decode
 *         the hardware irq number and linux irq type value.
 *
 * Functions below are provided by the driver and called whenever a new mapping
 * is created or an old mapping is disposed. The driver can then proceed to
 * whatever internal data structures management is required. It also needs
 * to setup the irq_desc when returning from map().
 */
struct irq_domain_ops {
        int (*match)(struct irq_domain *d, struct device_node *node);
        int (*map)(struct irq_domain *d, unsigned int virq, irq_hw_number_t hw);
        void (*unmap)(struct irq_domain *d, unsigned int virq);
        int (*xlate)(struct irq_domain *d, struct device_node *node,
                     const u32 *intspec, unsigned int intsize,
                     unsigned long *out_hwirq, unsigned int *out_type);
};



static const struct irq_domain_ops gic_irq_domain_ops = {
        .map = gic_irq_domain_map,
        .unmap = gic_irq_domain_unmap,
        .xlate = gic_irq_domain_xlate,
};



static int gic_irq_domain_xlate(struct irq_domain *d,
                                struct device_node *controller,
                                const u32 *intspec, unsigned int intsize,
                                unsigned long *out_hwirq, unsigned int *out_type)
{
        unsigned long ret = 0;

        if (d->of_node != controller)
                return -EINVAL;
```

```
    if (intsize < 3)
        return -EINVAL;

    /* Get the interrupt number and add 16 to skip over SGIs */
    *out_hwirq = intspec[1] + 16;                    ①

    /* For SPIs, we need to add 16 more to get the GIC irq ID number */
    if (!intspec[0]) {                                               ②
        ret = gic_routable_irq_domain_ops->xlate(d, controller,
                            intspec,
                            intsize,
                            out_hwirq,
                            out_type);

        if (IS_ERR_VALUE(ret))
            return ret;
    }

    *out_type = intspec[2] & IRQ_TYPE_SENSE_MASK;            ③

    return ret;
}
```

3个数字intspec[0],intspec[1] and intspec[2]都得到解释。

G2使用的是gic-400，所有interrupt分为3类。

1. 0 - 15， SGI

2. 16 - 31， PPI

3. 32以上SPI

SGI + PPI产生的interrupt是由特定core服务的，而SPI则是由gic动态决定送往哪一个core.

同时SGI并不是由device触发的interrupt，它通过write GICD_SGIR register来trigger interrupt.

①

intspec[1] + 16就是gic的hardware interrupt number (引入irq domain后，kernel就只关心virtual interrupt number.而hardware interrupt number到

virtual interrupt number的mapping则是irq_domain_ops struct中map() function的责任。virtual interrupt number实际上就是kernel维护interrupt handling

的核心数据结构struct irq_desc array的index.这里 + 16,是因为gic的前16个interrupts是留给SGI的。

②

intspec[0]为0,表示该interrupt是SPI. SPI从32开始。

```
    if (!intspec[0]) {
        ret = gic_routable_irq_domain_ops->xlate(d, controller,
                                                 intspec,
                                                 intsize,
                                                 out_hwirq,
                                                 out_type);

        if (IS_ERR_VALUE(ret))
            return ret;
    }
```

```
const struct irq_domain_ops *gic_routable_irq_domain_ops =
                    &gic_default_routable_irq_domain_ops;
```

```
static const struct irq_domain_ops gic_default_routable_irq_domain_ops = {
        .map = gic_routable_irq_domain_map,
        .unmap = gic_routable_irq_domain_unmap,
        .xlate = gic_routable_irq_domain_xlate,
};

static int gic_routable_irq_domain_xlate(struct irq_domain *d,
                                struct device_node *controller,
                                const u32 *intspec, unsigned int intsize,
                                unsigned long *out_hwirq,
                                unsigned int *out_type)
{
        *out_hwirq += 16;
        return 0;
}
```

其实就是在原来①的基础上再加上16,就是原来值的基础上加了32.

③

intspec[2]是interrupt trigger type

in include/linux/irq.h

```
IRQ_TYPE_NONE                   = 0x00000000,
IRQ_TYPE_EDGE_RISING        = 0x00000001,
IRQ_TYPE_EDGE_FALLING       = 0x00000002,
IRQ_TYPE_EDGE_BOTH              = (IRQ_TYPE_EDGE_FALLING | IRQ_TYPE_EDGE_RISING),
IRQ_TYPE_LEVEL_HIGH           = 0x00000004,
IRQ_TYPE_LEVEL_LOW             = 0x00000008,
IRQ_TYPE_LEVEL_MASK           = (IRQ_TYPE_LEVEL_LOW | IRQ_TYPE_LEVEL_HIGH),
IRQ_TYPE_SENSE_MASK           = 0x0000000f,
IRQ_TYPE_DEFAULT            = IRQ_TYPE_SENSE_MASK,
```

```
    uart0: uart@d4030000 {
        compatible = "mrvl,pxa-uart";
        reg = <0 0xd4030000 0 0x1000>;
        interrupts = <0 16 4>;
        clocks = <&uart0_clkgate>;
        status = "disabled";
```

这样可以解释uart0 device的interrupts property的含义了。

0 --- gic的SPI interrupt，即还interrupt是属于Shared (SPI中“S”)，即uart0的interrupt将被某个ARM core服务，uart0并不关心是哪个core运行的interrupt handler，core 0, core 1, core 2, core 3(Granite2有4 cores)，无所谓。

16 --- uart0在gic上的真正的interrupt number是16 + 32 = 48

4 --- IRQ_TYPE_LEVEL_HIGH,表高电平触发，即uart0 device的interrupt pin是高电平时就表示需要interrupt服务了。

2. gpio interrupt controller (eight)

```
    gpio0: gpio@d4019000 {
        compatible = "marvell,peg-gpio";
        #address-cells = <2>;
        #size-cells = <2>;
        reg = <0 0xd4019000 0 0x1000>;
        gpio-controller;
```

```
#gpio-cells = <2>;
interrupts = <0 36 4>, <0 119 4>, <0 120 4>, <0 121 4>, <0 122 4>, <0 123 4>, <0 221 4>, <0 222 4>;
interrupt-names = "gpio_mux";
interrupt-controller;
#interrupt-cells = <2>;
clocks = <&apbus_apb_clkgate>;
ranges;

gcb0: gpio@d4019000 {
    reg = <0 0xd4019000 0 0x4>;
};

gcb1: gpio@d4019100 {
    reg = <0 0xd4019100 0 0x4>;
};

gcb2: gpio@d4019200 {
    reg = <0 0xd4019200 0 0x4>;
};

gcb3: gpio@d4019300 {
    reg = <0 0xd4019300 0 0x4>;
};

gcb4: gpio@d4019400 {
    reg = <0 0xd4019400 0 0x4>;
};

gcb5: gpio@d4019500 {
```

```
                reg = <0 0xd4019500 0 0x4>;
            };

            gcb6: gpio@d4019600 {
                reg = <0 0xd4019600 0 0x4>;
            };

            gcb7: gpio@d4019700 {
                reg = <0 0xd4019700 0 0x4>;
            };
        };
```

8个GPIO banks都是interrupt controller.它们级联在gic主controller上。

在gpio@d4019000 device node中，其有8个子设备(gcb0 to gcb7)。这8个device即是gpio-controller，又是interrupt-controller。8个gpio bank的本生级联在gic上，

在gic对应的interrupt为interrupts = <0 36 4>, <0 119 4>, <0 120 4>, <0 121 4>, <0 122 4>, <0 123 4>, <0 221 4>, <0 222 4>;

interrupt-controller property表明它也是"interrupt controller"。**凡是interrupt controller必须申明**。

interrupt-names = "gpio_mux";

这个property好象不是标准（ePAPR）定义的，不知道派什么用处！

```
start_kernel()
     |
     |
    \|/
```

init_IRQ()

in arch/arm/kernel/irq.c

```
void __init init_IRQ(void)
{
        int ret;

        if (IS_ENABLED(CONFIG_OF) && !machine_desc->init_irq)
                irqchip_init();
        else
                machine_desc->init_irq();

        if (IS_ENABLED(CONFIG_OF) && IS_ENABLED(CONFIG_CACHE_L2X0) &&
            (machine_desc->l2c_aux_mask || machine_desc->l2c_aux_val)) {
                outer_cache.write_sec = machine_desc->l2c_write_sec;
                ret = l2x0_of_init(machine_desc->l2c_aux_val,
                                    machine_desc->l2c_aux_mask);
                if (ret)
                        pr_err("L2C: failed to init: %d\n", ret);
        }
}
```

in drivers/irqchip/irqchip.c

```
void __init irqchip_init(void)
{
        of_irq_init(__irqchip_of_table);
}
```

in drivers/of/irq.c

```
/**
 * of_irq_init - Scan and init matching interrupt controllers in DT
 * @matches: 0 terminated array of nodes to match and init function to call
 *
 * This function scans the device tree for matching interrupt controller nodes,
 * and calls their initialization functions in order with parents first.
 */
void __init of_irq_init(const struct of_device_id *matches)
{
	struct device_node *np, *parent = NULL;
	struct intc_desc *desc, *temp_desc;
	struct list_head intc_desc_list, intc_parent_list;

	INIT_LIST_HEAD(&intc_desc_list);
	INIT_LIST_HEAD(&intc_parent_list);

	for_each_matching_node(np, matches) {
		if (!of_find_property(np, "interrupt-controller", NULL) ||
				!of_device_is_available(np))
			continue;
		/*
		 * Here, we allocate and populate an intc_desc with the node
		 * pointer, interrupt-parent device_node etc.
		 */
		desc = kzalloc(sizeof(*desc), GFP_KERNEL);
		if (WARN_ON(!desc))
			goto err;
	desc->dev = np;
	desc->interrupt_parent = of_irq_find_parent(np);
	if (desc->interrupt_parent == np)
		desc->interrupt_parent = NULL;
	list_add_tail(&desc->list, &intc_desc_list);
}

/*
 * The root irq controller is the one without an interrupt-parent.
 * That one goes first, followed by the controllers that reference it,
 * followed by the ones that reference the 2nd level controllers, etc.
 */
while (!list_empty(&intc_desc_list)) {
	/*
	 * Process all controllers with the current 'parent'.
	 * First pass will be looking for NULL as the parent.
	 * The assumption is that NULL parent means a root controller.
	 */
	list_for_each_entry_safe(desc, temp_desc, &intc_desc_list, list) {
		const struct of_device_id *match;
		int ret;
		of_irq_init_cb_t irq_init_cb;

		if (desc->interrupt_parent != parent)
			continue;

		list_del(&desc->list);
		match = of_match_node(matches, desc->dev);
```

```
        if (WARN(!match->data,
            "of_irq_init: no init function for %s\n",
            match->compatible)) {
                kfree(desc);
                continue;
        }

        pr_debug("of_irq_init: init %s @ %p, parent %p\n",
                 match->compatible,
                 desc->dev, desc->interrupt_parent);
        irq_init_cb = (of_irq_init_cb_t)match->data;
        ret = irq_init_cb(desc->dev, desc->interrupt_parent);
        if (ret) {
                kfree(desc);
                continue;
        }

        /*
         * This one is now set up; add it to the parent list so
         * its children can get processed in a subsequent pass.
         */
        list_add_tail(&desc->list, &intc_parent_list);
}

/* Get the next pending parent that might have children */
desc = list_first_entry_or_null(&intc_parent_list,
                                typeof(*desc), list);
if (!desc) {
        pr_err("of_irq_init: children remain, but no parents\n");
```

```
                break;
            }
            list_del(&desc->list);
            parent = desc->dev;
            kfree(desc);
        }

        list_for_each_entry_safe(desc, temp_desc, &intc_parent_list, list) {
            list_del(&desc->list);
            kfree(desc);
        }
err:
        list_for_each_entry_safe(desc, temp_desc, &intc_desc_list, list) {
            list_del(&desc->list);
            kfree(desc);
        }
}
```

该function就是负责初始化device tree中的所有interrupt controller(凡是带有"interrupt controller" property的device node).

由于interrupt controller由依赖关系，即child依赖parent，这里就是gpio interrupt controller依赖gic interrupt controller。所以

初始化时要先parent后child。试想一下，如果先初始化gpio interrupt controller,则gpio初始化时要向gic register interrupt,但gic

这是都还没初始化，自然失败。

在gpio0 device node中

```
#interrupt-cells = <2>;
```

in drivers/gpio/gpio-pxa.c

```
const struct irq_domain_ops pxa_irq_domain_ops = {
        .map        = pxa_irq_domain_map,
        .xlate      = irq_domain_xlate_twocell,
};
```

in kernel/irq/irqdomain.c

```
/**
 * irq_domain_xlate_twocell() - Generic xlate for direct two cell bindings
 *
 * Device Tree IRQ specifier translation function which works with two cell
 * bindings where the cell values map directly to the hwirq number
 * and linux irq flags.
 */
int irq_domain_xlate_twocell(struct irq_domain *d, struct device_node *ctrlr,
                        const u32 *intspec, unsigned int intsize,
                        irq_hw_number_t *out_hwirq, unsigned int *out_type)
{
        if (WARN_ON(intsize < 2))
                return -EINVAL;
        *out_hwirq = intspec[0];                                    ④
        *out_type = intspec[1] & IRQ_TYPE_SENSE_MASK;       ⑤
        return 0;
}
```

④

intspec[0]是某个gpio bank上的0 - 31中的one pin。

⑤

intspec[1]，interrupt trigger type.

在Gemstone2 board上没有device的interrupt是连接到8个GPIO bank上的，所以没有device node的“interrupt-parent” property是GPIO的。

如果有的话，我想应该是这样的，

```
fake_device@XXXX {
        ......

        interrupt-parent = <&gcb1>;
        interrupts = <0x3 0x4>;

        ......
};
```

这里interrupt-parent必须指向某个特定的gpio bank，而不能是gpio@d4019000。

0x3表示gcb1 gpio bank的0x3 pin作为该device的interrupt pin。

如果interrupt-parent = <&gpio0>,那么现在的gpio0 device node的#interrupt-cells = #interrupt-cells = <2>是错的。

正确的应该是

```
        gpio0: gpio@d4019000 {
                compatible = "marvell,peg-gpio";
                #address-cells = <2>;
                #size-cells = <2>;
                reg = <0 0xd4019000 0 0x1000>;
                gpio-controller;
                #gpio-cells = <2>;
                interrupts = <0 36 4>, <0 119 4>, <0 120 4>, <0 121 4>, <0 122 4>, <0 123 4>, <0 221 4>, <0 222 4>;
                interrupt-names = "gpio_mux";
                interrupt-controller;
                #interrupt-cells = <3>;
                clocks = <&apbus_apb_clkgate>;
                ranges;

                ......

        };
```

而

```
fake_device@XXXX {
    ......

    interrupt-parent = <&gpio0>;
    interrupts = <0x1 0x3 0x4>;

    ......
};
```

这里interrupts中的0x1表示gpio bank 1。

当然gpio-pxa.c中相应的interrupt controller相关code也要稍作改写。

==

从/sys/kernel/debug/irq_domain_mapping可以查看irq information.

```
root@granite2:/# cat /sys/kernel/debug/irq_domain_mapping
 name              mapped  linear-max  direct-max  devtree-node
 mv-pegmatite-u3d       1           1          0  /usb3_top@d4220000
 GPIO                 256         256          0  /gpio@d4019000
 GIC                  288         288          0  /interrupt-controller@d1d01000
irq    hwirq    chip name        chip data    active  type          domain
   16  0x00010  GIC             0xc0609154          LINEAR          GIC
   17  0x00011  GIC             0xc0609154          LINEAR          GIC
   18  0x00012  GIC             0xc0609154          LINEAR          GIC
   19  0x00013  GIC             0xc0609154          LINEAR          GIC
   20  0x00014  GIC             0xc0609154          LINEAR          GIC
   21  0x00015  GIC             0xc0609154          LINEAR          GIC
   22  0x00016  GIC             0xc0609154          LINEAR          GIC
   23  0x00017  GIC             0xc0609154          LINEAR          GIC
   24  0x00018  GIC             0xc0609154          LINEAR          GIC
   25  0x00019  GIC             0xc0609154          LINEAR          GIC
   26  0x0001a  GIC             0xc0609154          LINEAR          GIC
   27  0x0001b  GIC             0xc0609154          LINEAR          GIC
   28  0x0001c  GIC             0xc0609154          LINEAR          GIC
   29  0x0001d  GIC             0xc0609154     *    LINEAR          GIC
   30  0x0001e  GIC             0xc0609154     *    LINEAR          GIC
   31  0x0001f  GIC             0xc0609154          LINEAR          GIC
   32  0x00020  GIC             0xc0609154          LINEAR          GIC
   33  0x00021  GIC             0xc0609154          LINEAR          GIC
   34  0x00022  GIC             0xc0609154          LINEAR          GIC
   35  0x00023  GIC             0xc0609154          LINEAR          GIC
   36  0x00024  GIC             0xc0609154          LINEAR          GIC
```

```
37  0x00025  GIC         0xc0609154   *   LINEAR      GIC
38  0x00026  GIC         0xc0609154       LINEAR      GIC
39  0x00027  GIC         0xc0609154   *   LINEAR      GIC
40  0x00028  GIC         0xc0609154       LINEAR      GIC
41  0x00029  GIC         0xc0609154       LINEAR      GIC
42  0x0002a  GIC         0xc0609154   *   LINEAR      GIC
43  0x0002b  GIC         0xc0609154       LINEAR      GIC
44  0x0002c  GIC         0xc0609154       LINEAR      GIC
45  0x0002d  GIC         0xc0609154       LINEAR      GIC
46  0x0002e  GIC         0xc0609154       LINEAR      GIC
47  0x0002f  GIC         0xc0609154   *   LINEAR      GIC
48  0x00030  GIC         0xc0609154   *   LINEAR      GIC
49  0x00031  GIC         0xc0609154       LINEAR      GIC
50  0x00032  GIC         0xc0609154       LINEAR      GIC
51  0x00033  GIC         0xc0609154       LINEAR      GIC
52  0x00034  GIC         0xc0609154       LINEAR      GIC
53  0x00035  GIC         0xc0609154       LINEAR      GIC
54  0x00036  GIC         0xc0609154       LINEAR      GIC
55  0x00037  GIC         0xc0609154   *   LINEAR      GIC
56  0x00038  GIC         0xc0609154       LINEAR      GIC
57  0x00039  GIC         0xc0609154   *   LINEAR      GIC
58  0x0003a  GIC         0xc0609154       LINEAR      GIC
59  0x0003b  GIC         0xc0609154   *   LINEAR      GIC
60  0x0003c  GIC         0xc0609154       LINEAR      GIC
61  0x0003d  GIC         0xc0609154   *   LINEAR      GIC
62  0x0003e  GIC         0xc0609154   *   LINEAR      GIC
63  0x0003f  GIC         0xc0609154       LINEAR      GIC
64  0x00040  GIC         0xc0609154   *   LINEAR      GIC
65  0x00041  GIC         0xc0609154       LINEAR      GIC
```

```
66  0x00042  GIC           0xc0609154        LINEAR        GIC
67  0x00043  GIC           0xc0609154        LINEAR        GIC
68  0x00044  GIC           0xc0609154        LINEAR        GIC
69  0x00045  GIC           0xc0609154        LINEAR        GIC
70  0x00046  GIC           0xc0609154    *    LINEAR        GIC
71  0x00047  GIC           0xc0609154    *    LINEAR        GIC
72  0x00048  GIC           0xc0609154        LINEAR        GIC
73  0x00049  GIC           0xc0609154        LINEAR        GIC
74  0x0004a  GIC           0xc0609154    *    LINEAR        GIC
75  0x0004b  GIC           0xc0609154        LINEAR        GIC
76  0x0004c  GIC           0xc0609154        LINEAR        GIC
77  0x0004d  GIC           0xc0609154        LINEAR        GIC
78  0x0004e  GIC           0xc0609154    *    LINEAR        GIC
79  0x0004f  GIC          0xc0609154        LINEAR        GIC
80  0x00050  GIC           0xc0609154        LINEAR        GIC
81  0x00051  GIC           0xc0609154        LINEAR        GIC
82  0x00052  GIC           0xc0609154        LINEAR        GIC
83  0x00053  GIC           0xc0609154        LINEAR        GIC
84  0x00054  GIC           0xc0609154        LINEAR        GIC
85  0x00055  GIC           0xc0609154    *    LINEAR        GIC
86  0x00056  GIC           0xc0609154    *    LINEAR        GIC
87  0x00057  GIC           0xc0609154    *    LINEAR        GIC
88  0x00058  GIC           0xc0609154    *    LINEAR        GIC
89  0x00059  GIC           0xc0609154        LINEAR        GIC
90  0x0005a  GIC           0xc0609154        LINEAR        GIC
91  0x0005b  GIC           0xc0609154        LINEAR        GIC
92  0x0005c  GIC           0xc0609154        LINEAR        GIC
93  0x0005d  GIC           0xc0609154        LINEAR        GIC
94  0x0005e  GIC           0xc0609154        LINEAR        GIC
```

```
 95  0x0005f  GIC          0xc0609154       LINEAR        GIC
 96  0x00060  GIC          0xc0609154       LINEAR        GIC
 97  0x00061  GIC          0xc0609154       LINEAR        GIC
 98  0x00062  GIC          0xc0609154       LINEAR        GIC
 99  0x00063  GIC          0xc0609154       LINEAR        GIC
100  0x00064  GIC          0xc0609154       LINEAR        GIC
101  0x00065  GIC          0xc0609154       LINEAR        GIC
102  0x00066  GIC          0xc0609154       LINEAR        GIC
103  0x00067  GIC          0xc0609154       LINEAR        GIC
104  0x00068  GIC          0xc0609154       LINEAR        GIC
105  0x00069  GIC          0xc0609154       LINEAR        GIC
106  0x0006a  GIC          0xc0609154       LINEAR        GIC
107  0x0006b  GIC          0xc0609154       LINEAR        GIC
108  0x0006c  GIC          0xc0609154       LINEAR        GIC
109  0x0006d  GIC          0xc0609154       LINEAR        GIC
110  0x0006e  GIC          0xc0609154       LINEAR        GIC
111  0x0006f  GIC          0xc0609154       LINEAR        GIC
112  0x00070  GIC          0xc0609154       LINEAR        GIC
113  0x00071  GIC          0xc0609154       LINEAR        GIC
114  0x00072  GIC          0xc0609154       LINEAR        GIC
115  0x00073  GIC          0xc0609154       LINEAR        GIC
116  0x00074  GIC          0xc0609154       LINEAR        GIC
117  0x00075  GIC          0xc0609154       LINEAR        GIC
118  0x00076  GIC          0xc0609154       LINEAR        GIC
119  0x00077  GIC          0xc0609154       LINEAR        GIC
120  0x00078  GIC          0xc0609154       LINEAR        GIC
121  0x00079  GIC          0xc0609154       LINEAR        GIC
122  0x0007a  GIC          0xc0609154       LINEAR        GIC
123  0x0007b  GIC          0xc0609154       LINEAR        GIC
```

```
124  0x0007c  GIC        0xc0609154      LINEAR     GIC

125  0x0007d  GIC        0xc0609154      LINEAR     GIC

126  0x0007e  GIC        0xc0609154      LINEAR     GIC

127  0x0007f  GIC        0xc0609154      LINEAR     GIC

128  0x00080  GIC        0xc0609154      LINEAR     GIC

129  0x00081  GIC        0xc0609154      LINEAR     GIC

130  0x00082  GIC        0xc0609154      LINEAR     GIC

131  0x00083  GIC        0xc0609154      LINEAR     GIC

132  0x00084  GIC        0xc0609154      LINEAR     GIC

133  0x00085  GIC        0xc0609154      LINEAR     GIC

134  0x00086  GIC        0xc0609154      LINEAR     GIC

135  0x00087  GIC        0xc0609154      LINEAR     GIC

136  0x00088  GIC        0xc0609154      LINEAR     GIC

137  0x00089  GIC        0xc0609154      LINEAR     GIC

138  0x0008a  GIC        0xc0609154   *  LINEAR     GIC

139  0x0008b  GIC        0xc0609154   *  LINEAR     GIC

140  0x0008c  GIC        0xc0609154      LINEAR     GIC

141  0x0008d  GIC        0xc0609154      LINEAR     GIC

142  0x0008e  GIC        0xc0609154      LINEAR     GIC

143  0x0008f  GIC        0xc0609154      LINEAR     GIC

144  0x00090  GIC        0xc0609154      LINEAR     GIC

145  0x00091  GIC        0xc0609154      LINEAR     GIC

146  0x00092  GIC        0xc0609154      LINEAR     GIC

147  0x00093  GIC        0xc0609154      LINEAR     GIC

148  0x00094  GIC        0xc0609154      LINEAR     GIC

149  0x00095  GIC        0xc0609154      LINEAR     GIC

150  0x00096  GIC        0xc0609154      LINEAR     GIC

151  0x00097  GIC        0xc0609154      LINEAR     GIC

152  0x00098  GIC        0xc0609154      LINEAR     GIC
```

```
153  0x00099  GIC          0xc0609154       LINEAR        GIC
154  0x0009a  GIC          0xc0609154       LINEAR        GIC
155  0x0009b  GIC          0xc0609154       LINEAR        GIC
156  0x0009c  GIC          0xc0609154       LINEAR        GIC
157  0x0009d  GIC          0xc0609154       LINEAR        GIC
158  0x0009e  GIC          0xc0609154       LINEAR        GIC
159  0x0009f  GIC          0xc0609154       LINEAR        GIC
160  0x000a0  GIC          0xc0609154       LINEAR        GIC
161  0x000a1  GIC          0xc0609154       LINEAR        GIC
162  0x000a2  GIC          0xc0609154       LINEAR        GIC
163  0x000a3  GIC          0xc0609154       LINEAR        GIC
164  0x000a4  GIC          0xc0609154       LINEAR        GIC
165  0x000a5  GIC          0xc0609154       LINEAR        GIC
166  0x000a6  GIC          0xc0609154       LINEAR        GIC
167  0x000a7  GIC          0xc0609154       LINEAR        GIC
168  0x000a8  GIC          0xc0609154       LINEAR        GIC
169  0x000a9  GIC          0xc0609154       LINEAR        GIC
170  0x000aa  GIC          0xc0609154       LINEAR        GIC
171  0x000ab  GIC          0xc0609154       LINEAR        GIC
172  0x000ac  GIC          0xc0609154       LINEAR        GIC
173  0x000ad  GIC          0xc0609154       LINEAR        GIC
174  0x000ae  GIC          0xc0609154       LINEAR        GIC
175  0x000af  GIC          0xc0609154       LINEAR        GIC
176  0x000b0  GIC          0xc0609154    *  LINEAR        GIC
177  0x000b1  GIC          0xc0609154       LINEAR        GIC
178  0x000b2  GIC          0xc0609154       LINEAR        GIC
179  0x000b3  GIC          0xc0609154       LINEAR        GIC
180  0x000b4  GIC          0xc0609154       LINEAR        GIC
181  0x000b5  GIC          0xc0609154       LINEAR        GIC
```

```
182  0x000b6  GIC            0xc0609154        LINEAR       GIC
183  0x000b7  GIC            0xc0609154        LINEAR       GIC
184  0x000b8  GIC            0xc0609154        LINEAR       GIC
185  0x000b9  GIC            0xc0609154        LINEAR       GIC
186  0x000ba  GIC            0xc0609154        LINEAR       GIC
187  0x000bb  GIC            0xc0609154        LINEAR       GIC
188  0x000bc  GIC            0xc0609154        LINEAR       GIC
189  0x000bd  GIC            0xc0609154        LINEAR       GIC
190  0x000be  GIC            0xc0609154    *    LINEAR       GIC
191  0x000bf  GIC           0xc0609154    *    LINEAR       GIC
192  0x000c0  GIC            0xc0609154    *    LINEAR       GIC
193  0x000c1  GIC            0xc0609154    *    LINEAR       GIC
194  0x000c2  GIC            0xc0609154    *    LINEAR       GIC
195  0x000c3  GIC            0xc0609154    *    LINEAR       GIC
196  0x000c4  GIC            0xc0609154    *    LINEAR       GIC
197  0x000c5  GIC            0xc0609154    *    LINEAR       GIC
198  0x000c6  GIC            0xc0609154    *    LINEAR       GIC
199  0x000c7  GIC            0xc0609154    *    LINEAR       GIC
200  0x000c8  GIC            0xc0609154    *    LINEAR       GIC
201  0x000c9  GIC            0xc0609154    *    LINEAR       GIC
202  0x000ca  GIC            0xc0609154    *    LINEAR       GIC
203  0x000cb  GIC            0xc0609154    *    LINEAR       GIC
204  0x000cc  GIC            0xc0609154    *    LINEAR       GIC
205  0x000cd  GIC            0xc0609154    *    LINEAR       GIC
206  0x000ce  GIC            0xc0609154    *    LINEAR       GIC
207  0x000cf  GIC           0xc0609154    *    LINEAR       GIC
208  0x000d0  GIC            0xc0609154    *    LINEAR       GIC
209  0x000d1  GIC            0xc0609154    *    LINEAR       GIC
210  0x000d2  GIC            0xc0609154        LINEAR       GIC
```

```
211  0x000d3  GIC          0xc0609154    *   LINEAR        GIC
212  0x000d4  GIC          0xc0609154    *   LINEAR        GIC
213  0x000d5  GIC          0xc0609154    *   LINEAR        GIC
214  0x000d6  GIC          0xc0609154        LINEAR        GIC
215  0x000d7  GIC          0xc0609154        LINEAR        GIC
216  0x000d8  GIC          0xc0609154        LINEAR        GIC
217  0x000d9  GIC          0xc0609154        LINEAR        GIC
218  0x000da  GIC          0xc0609154        LINEAR        GIC
219  0x000db  GIC          0xc0609154        LINEAR        GIC
220  0x000dc  GIC          0xc0609154        LINEAR        GIC
221  0x000dd  GIC          0xc0609154    *   LINEAR        GIC
222  0x000de  GIC          0xc0609154    *   LINEAR        GIC
223  0x000df  GIC          0xc0609154    *   LINEAR        GIC
224  0x000e0  GIC          0xc0609154    *   LINEAR        GIC
225  0x000e1  GIC          0xc0609154    *   LINEAR        GIC
226  0x000e2  GIC          0xc0609154    *   LINEAR        GIC
227  0x000e3  GIC          0xc0609154    *   LINEAR        GIC
228  0x000e4  GIC          0xc0609154        LINEAR        GIC
229  0x000e5  GIC          0xc0609154        LINEAR        GIC
230  0x000e6  GIC          0xc0609154        LINEAR        GIC
231  0x000e7  GIC          0xc0609154        LINEAR        GIC
232  0x000e8  GIC          0xc0609154        LINEAR        GIC
233  0x000e9  GIC          0xc0609154        LINEAR        GIC
234  0x000ea  GIC          0xc0609154        LINEAR        GIC
235  0x000eb  GIC          0xc0609154        LINEAR        GIC
236  0x000ec  GIC          0xc0609154    *   LINEAR        GIC
237  0x000ed  GIC          0xc0609154    *   LINEAR        GIC
238  0x000ee  GIC          0xc0609154    *   LINEAR        GIC
239  0x000ef  GIC          0xc0609154        LINEAR        GIC
```

```
240  0x000f0  GIC          0xc0609154       LINEAR        GIC

241  0x000f1  GIC          0xc0609154       LINEAR        GIC

242  0x000f2  GIC          0xc0609154       LINEAR        GIC

243  0x000f3  GIC          0xc0609154    *   LINEAR        GIC

244  0x000f4  GIC          0xc0609154       LINEAR        GIC

245  0x000f5  GIC          0xc0609154       LINEAR        GIC

246  0x000f6  GIC          0xc0609154       LINEAR        GIC

247  0x000f7  GIC          0xc0609154       LINEAR        GIC

248  0x000f8  GIC          0xc0609154       LINEAR        GIC

249  0x000f9  GIC          0xc0609154       LINEAR        GIC

250  0x000fa  GIC          0xc0609154       LINEAR        GIC

251  0x000fb  GIC          0xc0609154       LINEAR        GIC

252  0x000fc  GIC          0xc0609154       LINEAR        GIC

253  0x000fd  GIC          0xc0609154       LINEAR        GIC

254  0x000fe  GIC          0xc0609154       LINEAR        GIC

255  0x000ff  GIC          0xc0609154       LINEAR        GIC

256  0x00100  GIC          0xc0609154       LINEAR        GIC

257  0x00101  GIC          0xc0609154       LINEAR        GIC

258  0x00102  GIC          0xc0609154       LINEAR        GIC

259  0x00103  GIC          0xc0609154       LINEAR        GIC

260  0x00104  GIC          0xc0609154       LINEAR        GIC

261  0x00105  GIC          0xc0609154       LINEAR        GIC

262  0x00106  GIC          0xc0609154       LINEAR        GIC

263  0x00107  GIC          0xc0609154       LINEAR        GIC

264  0x00108  GIC          0xc0609154       LINEAR        GIC

265  0x00109  GIC          0xc0609154       LINEAR        GIC

266  0x0010a  GIC          0xc0609154       LINEAR        GIC

267  0x0010b  GIC          0xc0609154       LINEAR        GIC

268  0x0010c  GIC          0xc0609154       LINEAR        GIC
```

```
269  0x0010d  GIC          0xc0609154       LINEAR        GIC
270  0x0010e  GIC          0xc0609154       LINEAR        GIC
271  0x0010f  GIC          0xc0609154       LINEAR        GIC
272  0x00110  GIC          0xc0609154       LINEAR        GIC
273  0x00111  GIC          0xc0609154       LINEAR        GIC
274  0x00112  GIC          0xc0609154       LINEAR        GIC
275  0x00113  GIC          0xc0609154       LINEAR        GIC
276  0x00114  GIC          0xc0609154       LINEAR        GIC
277  0x00115  GIC          0xc0609154       LINEAR        GIC
278  0x00116  GIC          0xc0609154       LINEAR        GIC
279  0x00117  GIC          0xc0609154       LINEAR        GIC
280  0x00118  GIC          0xc0609154       LINEAR        GIC
281  0x00119  GIC          0xc0609154       LINEAR        GIC
282  0x0011a  GIC          0xc0609154       LINEAR        GIC
283  0x0011b  GIC          0xc0609154       LINEAR        GIC
284  0x0011c  GIC          0xc0609154       LINEAR        GIC
285  0x0011d  GIC          0xc0609154       LINEAR        GIC
286  0x0011e  GIC          0xc0609154       LINEAR        GIC
287  0x0011f  GIC          0xc0609154       LINEAR        GIC
288  0x00000  GPIO             (null)      LINEAR       GPIO
289  0x00001  GPIO             (null)      LINEAR       GPIO
290  0x00002  GPIO             (null)      LINEAR       GPIO
291  0x00003  GPIO             (null)      LINEAR       GPIO
292  0x00004  GPIO             (null)      LINEAR       GPIO
293  0x00005  GPIO             (null)      LINEAR       GPIO
294  0x00006  GPIO             (null)      LINEAR       GPIO
295  0x00007  GPIO             (null)      LINEAR       GPIO
296  0x00008  GPIO             (null)      LINEAR       GPIO
297  0x00009  GPIO             (null)      LINEAR       GPIO
```

```
298  0x0000a  GPIO        (null)     LINEAR     GPIO
299  0x0000b  GPIO        (null)     LINEAR     GPIO
300  0x0000c  GPIO        (null)     LINEAR     GPIO
301  0x0000d  GPIO        (null)     LINEAR     GPIO
302  0x0000e  GPIO        (null)     LINEAR     GPIO
303  0x0000f  GPIO       (null)     LINEAR     GPIO
304  0x00010  GPIO        (null)     LINEAR     GPIO
305  0x00011  GPIO        (null)     LINEAR     GPIO
306  0x00012  GPIO        (null)     LINEAR     GPIO
307  0x00013  GPIO        (null)     LINEAR     GPIO
308  0x00014  GPIO        (null)     LINEAR     GPIO
309  0x00015  GPIO        (null)     LINEAR     GPIO
310  0x00016  GPIO        (null)     LINEAR     GPIO
311  0x00017  GPIO        (null)     LINEAR     GPIO
312  0x00018  GPIO        (null)     LINEAR     GPIO
313  0x00019  GPIO        (null)     LINEAR     GPIO
314  0x0001a  GPIO        (null)     LINEAR     GPIO
315  0x0001b  GPIO        (null)     LINEAR     GPIO
316  0x0001c  GPIO        (null)     LINEAR     GPIO
317  0x0001d  GPIO        (null)     LINEAR     GPIO
318  0x0001e  GPIO        (null)     LINEAR     GPIO
319  0x0001f  GPIO       (null)     LINEAR     GPIO
320  0x00020  GPIO        (null)     LINEAR     GPIO
321  0x00021  GPIO        (null)     LINEAR     GPIO
322  0x00022  GPIO        (null)     LINEAR     GPIO
323  0x00023  GPIO        (null)     LINEAR     GPIO
324  0x00024  GPIO        (null)     LINEAR     GPIO
325  0x00025  GPIO        (null)     LINEAR     GPIO
326  0x00026  GPIO        (null)     LINEAR     GPIO
```

```
327  0x00027  GPIO          (null)      LINEAR       GPIO
328  0x00028  GPIO          (null)      LINEAR       GPIO
329  0x00029  GPIO          (null)      LINEAR       GPIO
330  0x0002a  GPIO          (null)      LINEAR       GPIO
331  0x0002b  GPIO          (null)      LINEAR       GPIO
332  0x0002c  GPIO          (null)      LINEAR       GPIO
333  0x0002d  GPIO          (null)      LINEAR       GPIO
334  0x0002e  GPIO          (null)      LINEAR       GPIO
335  0x0002f  GPIO          (null)      LINEAR       GPIO
336  0x00030  GPIO          (null)      LINEAR       GPIO
337  0x00031  GPIO          (null)      LINEAR       GPIO
338  0x00032  GPIO          (null)      LINEAR       GPIO
339  0x00033  GPIO          (null)      LINEAR       GPIO
340  0x00034  GPIO          (null)      LINEAR       GPIO
341  0x00035  GPIO          (null)      LINEAR       GPIO
342  0x00036  GPIO          (null)      LINEAR       GPIO
343  0x00037  GPIO          (null)      LINEAR       GPIO
344  0x00038  GPIO          (null)      LINEAR       GPIO
345  0x00039  GPIO          (null)      LINEAR       GPIO
346  0x0003a  GPIO          (null)      LINEAR       GPIO
347  0x0003b  GPIO          (null)      LINEAR       GPIO
348  0x0003c  GPIO          (null)      LINEAR       GPIO
349  0x0003d  GPIO          (null)      LINEAR       GPIO
350  0x0003e  GPIO          (null)      LINEAR       GPIO
351  0x0003f  GPIO          (null)      LINEAR       GPIO
352  0x00040  GPIO          (null)      LINEAR       GPIO
353  0x00041  GPIO          (null)      LINEAR       GPIO
354  0x00042  GPIO          (null)      LINEAR       GPIO
355  0x00043  GPIO          (null)      LINEAR       GPIO
```

```
356  0x00044  GPIO            (null)        LINEAR        GPIO

357  0x00045  GPIO            (null)        LINEAR        GPIO

358  0x00046  GPIO            (null)        LINEAR        GPIO

359  0x00047  GPIO            (null)        LINEAR        GPIO

360  0x00048  GPIO            (null)        LINEAR        GPIO

361  0x00049  GPIO            (null)        LINEAR        GPIO

362  0x0004a  GPIO            (null)        LINEAR        GPIO

363  0x0004b  GPIO            (null)        LINEAR        GPIO

364  0x0004c  GPIO            (null)        LINEAR        GPIO

365  0x0004d  GPIO            (null)        LINEAR        GPIO

366  0x0004e  GPIO            (null)        LINEAR        GPIO

367  0x0004f  GPIO           (null)        LINEAR        GPIO

368  0x00050  GPIO            (null)        LINEAR        GPIO

369  0x00051  GPIO            (null)        LINEAR        GPIO

370  0x00052  GPIO            (null)        LINEAR        GPIO

371  0x00053  GPIO            (null)        LINEAR        GPIO

372  0x00054  GPIO            (null)        LINEAR        GPIO

373  0x00055  GPIO            (null)        LINEAR        GPIO

374  0x00056  GPIO            (null)        LINEAR        GPIO

375  0x00057  GPIO            (null)        LINEAR        GPIO

376  0x00058  GPIO            (null)        LINEAR        GPIO

377  0x00059  GPIO            (null)        LINEAR        GPIO

378  0x0005a  GPIO            (null)        LINEAR        GPIO

379  0x0005b  GPIO            (null)        LINEAR        GPIO

380  0x0005c  GPIO            (null)        LINEAR        GPIO

381  0x0005d  GPIO            (null)        LINEAR        GPIO

382  0x0005e  GPIO            (null)        LINEAR        GPIO

383  0x0005f  GPIO           (null)        LINEAR        GPIO

384  0x00060  GPIO            (null)        LINEAR        GPIO
```

```
385  0x00061  GPIO          (null)      LINEAR      GPIO
386  0x00062  GPIO          (null)      LINEAR      GPIO
387  0x00063  GPIO          (null)      LINEAR      GPIO
388  0x00064  GPIO          (null)      LINEAR      GPIO
389  0x00065  GPIO          (null)      LINEAR      GPIO
390  0x00066  GPIO          (null)      LINEAR      GPIO
391  0x00067  GPIO          (null)      LINEAR      GPIO
392  0x00068  GPIO          (null)      LINEAR      GPIO
393  0x00069  GPIO          (null)      LINEAR      GPIO
394  0x0006a  GPIO          (null)      LINEAR      GPIO
395  0x0006b  GPIO          (null)      LINEAR      GPIO
396  0x0006c  GPIO          (null)      LINEAR      GPIO
397  0x0006d  GPIO          (null)      LINEAR      GPIO
398  0x0006e  GPIO          (null)      LINEAR      GPIO
399  0x0006f  GPIO          (null)      LINEAR      GPIO
400  0x00070  GPIO          (null)      LINEAR      GPIO
401  0x00071  GPIO          (null)      LINEAR      GPIO
402  0x00072  GPIO          (null)      LINEAR      GPIO
403  0x00073  GPIO          (null)      LINEAR      GPIO
404  0x00074  GPIO          (null)      LINEAR      GPIO
405  0x00075  GPIO          (null)      LINEAR      GPIO
406  0x00076  GPIO          (null)      LINEAR      GPIO
407  0x00077  GPIO          (null)      LINEAR      GPIO
408  0x00078  GPIO          (null)      LINEAR      GPIO
409  0x00079  GPIO          (null)      LINEAR      GPIO
410  0x0007a  GPIO          (null)      LINEAR      GPIO
411  0x0007b  GPIO          (null)      LINEAR      GPIO
412  0x0007c  GPIO          (null)      LINEAR      GPIO
413  0x0007d  GPIO          (null)      LINEAR      GPIO
```

```
414  0x0007e  GPIO          (null)       LINEAR       GPIO
415  0x0007f  GPIO          (null)       LINEAR       GPIO
416  0x00080  GPIO          (null)       LINEAR       GPIO
417  0x00081  GPIO          (null)       LINEAR       GPIO
418  0x00082  GPIO          (null)       LINEAR       GPIO
419  0x00083  GPIO          (null)       LINEAR       GPIO
420  0x00084  GPIO          (null)       LINEAR       GPIO
421  0x00085  GPIO          (null)       LINEAR       GPIO
422  0x00086  GPIO          (null)       LINEAR       GPIO
423  0x00087  GPIO          (null)       LINEAR       GPIO
424  0x00088  GPIO          (null)       LINEAR       GPIO
425  0x00089  GPIO          (null)       LINEAR       GPIO
426  0x0008a  GPIO          (null)       LINEAR       GPIO
427  0x0008b  GPIO          (null)       LINEAR       GPIO
428  0x0008c  GPIO          (null)       LINEAR       GPIO
429  0x0008d  GPIO          (null)       LINEAR       GPIO
430  0x0008e  GPIO          (null)       LINEAR       GPIO
431  0x0008f  GPIO          (null)       LINEAR       GPIO
432  0x00090  GPIO          (null)       LINEAR       GPIO
433  0x00091  GPIO          (null)       LINEAR       GPIO
434  0x00092  GPIO          (null)       LINEAR       GPIO
435  0x00093  GPIO          (null)       LINEAR       GPIO
436  0x00094  GPIO          (null)       LINEAR       GPIO
437  0x00095  GPIO          (null)       LINEAR       GPIO
438  0x00096  GPIO          (null)       LINEAR       GPIO
439  0x00097  GPIO          (null)       LINEAR       GPIO
440  0x00098  GPIO          (null)       LINEAR       GPIO
441  0x00099  GPIO          (null)       LINEAR       GPIO
442  0x0009a  GPIO          (null)       LINEAR       GPIO
```

```
443  0x0009b  GPIO              (null)        LINEAR        GPIO
444  0x0009c  GPIO              (null)        LINEAR        GPIO
445  0x0009d  GPIO              (null)        LINEAR        GPIO
446  0x0009e  GPIO              (null)        LINEAR        GPIO
447  0x0009f  GPIO              (null)        LINEAR        GPIO
448  0x000a0  GPIO              (null)        LINEAR        GPIO
449  0x000a1  GPIO              (null)        LINEAR        GPIO
450  0x000a2  GPIO              (null)        LINEAR        GPIO
451  0x000a3  GPIO              (null)        LINEAR        GPIO
452  0x000a4  GPIO              (null)        LINEAR        GPIO
453  0x000a5  GPIO              (null)        LINEAR        GPIO
454  0x000a6  GPIO              (null)        LINEAR        GPIO
455  0x000a7  GPIO              (null)        LINEAR        GPIO
456  0x000a8  GPIO              (null)        LINEAR        GPIO
457  0x000a9  GPIO              (null)        LINEAR        GPIO
458  0x000aa  GPIO              (null)        LINEAR        GPIO
459  0x000ab  GPIO              (null)        LINEAR        GPIO
460  0x000ac  GPIO              (null)        LINEAR        GPIO
461  0x000ad  GPIO              (null)        LINEAR        GPIO
462  0x000ae  GPIO              (null)        LINEAR        GPIO
463  0x000af  GPIO              (null)        LINEAR        GPIO
464  0x000b0  GPIO              (null)        LINEAR        GPIO
465  0x000b1  GPIO              (null)        LINEAR        GPIO
466  0x000b2  GPIO              (null)        LINEAR        GPIO
467  0x000b3  GPIO              (null)        LINEAR        GPIO
468  0x000b4  GPIO              (null)        LINEAR        GPIO
469  0x000b5  GPIO              (null)        LINEAR        GPIO
470  0x000b6  GPIO              (null)        LINEAR        GPIO
471  0x000b7  GPIO              (null)        LINEAR        GPIO
```

```
472  0x000b8  GPIO      (null)    LINEAR    GPIO

473  0x000b9  GPIO      (null)    LINEAR    GPIO

474  0x000ba  GPIO      (null)    LINEAR    GPIO

475  0x000bb  GPIO      (null)    LINEAR    GPIO

476  0x000bc  GPIO      (null)    LINEAR    GPIO

477  0x000bd  GPIO      (null)    LINEAR    GPIO

478  0x000be  GPIO      (null)    LINEAR    GPIO

479  0x000bf  GPIO      (null)    LINEAR    GPIO

480  0x000c0  GPIO      (null)    LINEAR    GPIO

481  0x000c1  GPIO      (null)    LINEAR    GPIO

482  0x000c2  GPIO      (null)    LINEAR    GPIO

483  0x000c3  GPIO      (null)    LINEAR    GPIO

484  0x000c4  GPIO      (null)    LINEAR    GPIO

485  0x000c5  GPIO      (null)    LINEAR    GPIO

486  0x000c6  GPIO      (null)    LINEAR    GPIO

487  0x000c7  GPIO      (null)    LINEAR    GPIO

488  0x000c8  GPIO      (null)    LINEAR    GPIO

489  0x000c9  GPIO      (null)    LINEAR    GPIO

490  0x000ca  GPIO      (null)    LINEAR    GPIO

491  0x000cb  GPIO      (null)    LINEAR    GPIO

492  0x000cc  GPIO      (null)    LINEAR    GPIO

493  0x000cd  GPIO      (null)    LINEAR    GPIO

494  0x000ce  GPIO      (null)    LINEAR    GPIO

495  0x000cf  GPIO      (null)    LINEAR    GPIO

496  0x000d0  GPIO      (null)    LINEAR    GPIO

497  0x000d1  GPIO      (null)    LINEAR    GPIO

498  0x000d2  GPIO      (null)    LINEAR    GPIO

499  0x000d3  GPIO      (null)    LINEAR    GPIO

500  0x000d4  GPIO      (null)    LINEAR    GPIO
```

```
501  0x000d5  GPIO        (null)     LINEAR     GPIO
502  0x000d6  GPIO        (null)     LINEAR     GPIO
503  0x000d7  GPIO        (null)     LINEAR     GPIO
504  0x000d8  GPIO        (null)     LINEAR     GPIO
505  0x000d9  GPIO        (null)     LINEAR     GPIO
506  0x000da  GPIO        (null)     LINEAR     GPIO
507  0x000db  GPIO        (null)     LINEAR     GPIO
508  0x000dc  GPIO        (null)     LINEAR     GPIO
509  0x000dd  GPIO        (null)     LINEAR     GPIO
510  0x000de  GPIO        (null)     LINEAR     GPIO
511  0x000df  GPIO        (null)     LINEAR     GPIO
512  0x000e0  GPIO        (null)     LINEAR     GPIO
513  0x000e1  GPIO        (null)     LINEAR     GPIO
514  0x000e2  GPIO        (null)     LINEAR     GPIO
515  0x000e3  GPIO        (null)     LINEAR     GPIO
516  0x000e4  GPIO        (null)     LINEAR     GPIO
517  0x000e5  GPIO        (null)     LINEAR     GPIO
518  0x000e6  GPIO        (null)     LINEAR     GPIO
519  0x000e7  GPIO        (null)     LINEAR     GPIO
520  0x000e8  GPIO        (null)     LINEAR     GPIO
521  0x000e9  GPIO        (null)     LINEAR     GPIO
522  0x000ea  GPIO        (null)     LINEAR     GPIO
523  0x000eb  GPIO        (null)     LINEAR     GPIO
524  0x000ec  GPIO        (null)     LINEAR     GPIO
525  0x000ed  GPIO        (null)     LINEAR     GPIO
526  0x000ee  GPIO        (null)     LINEAR     GPIO
527  0x000ef  GPIO        (null)     LINEAR     GPIO
528  0x000f0  GPIO        (null)     LINEAR     GPIO
529  0x000f1  GPIO        (null)     LINEAR     GPIO
```

```
530  0x000f2  GPIO              (null)          LINEAR   GPIO
531  0x000f3  GPIO              (null)          LINEAR   GPIO
532  0x000f4  GPIO              (null)          LINEAR   GPIO
533  0x000f5  GPIO              (null)          LINEAR   GPIO
534  0x000f6  GPIO              (null)          LINEAR   GPIO
535  0x000f7  GPIO              (null)          LINEAR   GPIO
536  0x000f8  GPIO              (null)          LINEAR   GPIO
537  0x000f9  GPIO              (null)          LINEAR   GPIO
538  0x000fa  GPIO              (null)          LINEAR   GPIO
539  0x000fb  GPIO              (null)          LINEAR   GPIO
540  0x000fc  GPIO              (null)          LINEAR   GPIO
541  0x000fd  GPIO              (null)          LINEAR   GPIO
542  0x000fe  GPIO              (null)          LINEAR   GPIO
543  0x000ff  GPIO              (null)          LINEAR   GPIO
544  0x00000  mv-pegmatite-u3d  0xc06a8c50   *  LINEAR   mv-pegmatite-u3d
```