JETSON TX1 AND TX2 VOLTAGE AND CURRENT MONITOR CONFIGURATION APPLICATION NOTE

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Release 28.1

DOCUMENT CHANGE HISTORY

DA_08564_001

Version	Date	Authors	Description of Change
v1.0	4 May 2017	rajkumar/hlang	Initial release
v1.1	26 Jun 2017	rajkumar/hlang	Update for hardware throttling for VDD_IN OC interrupt for 28.1.

VOLTAGE AND CURRENT MONITOR

NVIDIA® Tegra® Board Support Package for the Jetson TX1 and TX2 module works together with platform hardware to implement a system Electrical Design Point (EDP) management strategy to maximize CPU and GPU performance within system EDP constraints for the platform.

Voltage comparator and a current monitor detect under-voltage and over-current scenarios are outlined. When the sensor outputs are asserted, Tegra hardware quickly throttles CPU and GPU clocks as configured by software to reduce the current load.

The Jetson module includes on-board power monitor, INA3221, to monitor the voltage and current of the following power rails:

- VDD_IN
- VDD_GPU
- VDD_GPU

The alert outputs of INA3221 include:

- ALERT
- CRIT
- WARN

They are fed into a `SOC_THERM` input on Tegra. When one or more of those alert outputs are asserted, `SOC_THERM` hardware reacts to reduce Tegra power consumption and avoid violating the current limits.

Configuring the Voltage and Current Monitor

The power monitor accepts the configuration data from the `powermon` Device Tree source file.

The `powermon` dtsi file for Jetson TX1 is available at:

```
kernel/arch/arm64/boot/dts/tegra210-platforms/tegra210-jetson-cv-
powermon-p2180-1000-a00.dtsi
```

The `powermon` dtsi file for Jetson TX2 is available at:

```
hardware/nvidia/platform/t18x/common/kernel-dts/t18x-common-
platforms/tegra186-quill-p3310-1000-a00-powermon.dtsi
```

The following code snippet is TX1 powermon dtsi file:

```
    i2c@7000c400 {
       ina3221x: ina3221x@40 {
           compatible = "ti,ina3221x";
           reg = <0x40>;
           ti,trigger-config = <0x7003>;
           ti,continuous-config = <0x7607>;
           ti,enable-forced-continuous;
           #io-channel-cells = <1>;
           #address-cells = <1>;
           #size-cells = <0>;
           status = "disabled";

           channel@0 {
               reg = <0x0>;
               ti,rail-name = "VDD_IN";
               ti,shunt-resistor-mohm = <20>;
               ti,current-critical-limit-ma = <2105>;
               shunt-volt-offset-uv = <&p2180_shuntv_offset>;
           };

           channel@1 {
               reg = <0x1>;
               ti,rail-name = "VDD_GPU";
               ti,shunt-resistor-mohm = <10>;
               shunt-volt-offset-uv = <&p2180_shuntv_offset>;
           };

           channel@2 {
               reg = <0x2>;
               ti,rail-name = "VDD_CPU";
               ti,shunt-resistor-mohm = <10>;
               shunt-volt-offset-uv = <&p2180_shuntv_offset>;
           };
      };
```

Where:

- The `current-critical-limit-ma` of channel 0 `VDD_IN` is calculated from the system EDP limit and the Jetson module input voltage.

```
The critical current limit = System EDP limit / VDD_IN voltage
```

- The system EDP limit for the Jetson TX1 module, as part of the Jetson TX1 Developer Kit, is defined at:

```
kernel/arch/arm64/boot/dts/tegra210-jetson-cv-base-p2597-2180-
a00.dts
```

  The code is as follows:

```
    sysedp {
        compatible = "nvidia,tegra124-sysedp";
        nvidia,margin = <0>;
        nvidia,min_budget = <0>;
        nvidia,initial_budget = <40000>;
    };
```

- Where the critical current limit for 19V VDD_IN is calculated as follows:

```
19V VDD_IN = 40,000 / 19 => 2105mA
```

  The system integrator must configure the correct critical current limit based on the module input voltage. For example, the critical current limit for 8V VDD_IN is calculated as follows:

```
Critical current limit for 8V VDD_IN = 40,000 / 8 => 5000mA
```

By default, the Jetson TX1 Developer Kit voltage and current monitor is configured for 19V input. If less than 19V input is used, the user must reconfigure the critical current limit of `VDD_IN`. If not set, unexpected CPU/GPU throttling and performance slowdown may occur.

By default, the Jetson TX2 Developer kit critical current limit of `VDD_IN` is set to the maximum possible value of 8190mA. Therefore, it is not necessary to modify the critical current for lower input voltage unless user wants to configure the critical current limit for a specific input voltage.

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