GAP_CMP

REVISION HISTORY

Revision Number	Date	Description of Change	Author
V0.0	10/14/2022	Draft version	Taoli

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GAP_CMP

Introduction

GAP_CMP is designed for functional safety goal, in order to monitor whether ADC works normally, the system use an auxiliary ADC converts along with the main ADC, GAP_CMP automatically compares the gap of the two ADC measurement results with configurable threshold, if the gap exceeds the given range, a warning will be asserted.

Main features

The GAP_CMP module has the following features:

- Configurable gap threshold of CELL's measurement
- Configurable gap threshold of others(GPIO's) measurement
- Configurable gap filter range of CELL's measurement

Functional Details

Block Diagram

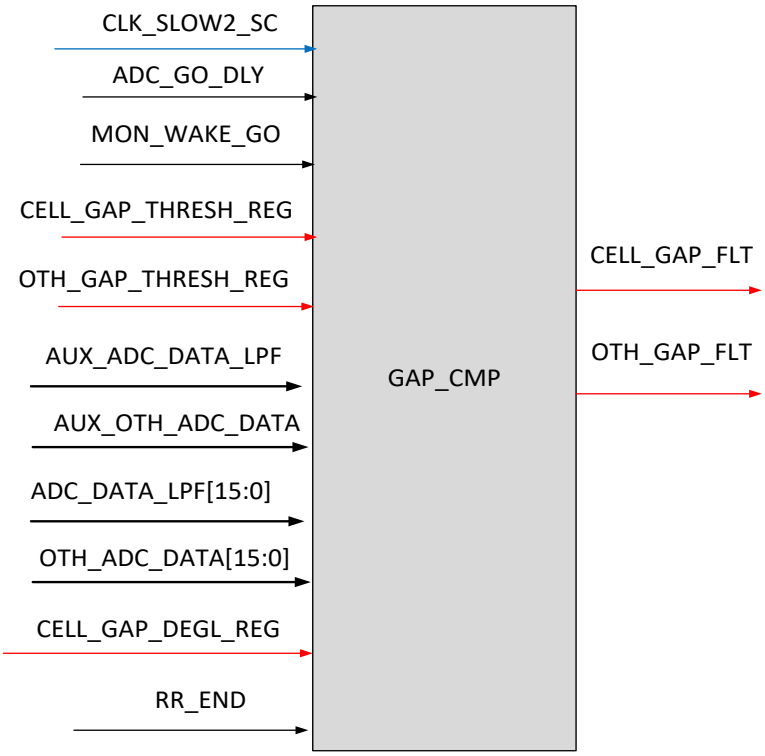

Fig 1 GAP_CMP block diagram

GAP_CMP I/O signals description shows in table.

Pin Name	Direction	Width	Default	Description

			Value	
resetb_SR_CLK_SLOW	Input	1b'	1'b1	Asynchronous power on reset
CLK_SLOW_SC	Input	1b'	1'b0	256K
SGLE_ADC_GO_DLY	Input	1b'	1'b0	ADC_SGLE_GO delay
CNTI_ADC_GO_DLY	Input	1b'	1'b0	
MON_WAKE_GO	Input	1b'	1'b0	ADC single conversion go
RR_END	Input	1b'	1'b0	GAP_CMP shall compare the gap between AUX_ADC_DATA_LPF and ADC_DATA_LPF with CELL_GAP_THRESH when RR_END is high
D2A_CELL_ADC_EN	Input	1b'	1'b0	ADC enable
CELL_GAP_THRESH_REG	Input	5b'	5'h0	CELL_GAP_THRESH shall cover from 20mV to 180mV, 5mV step
OTH_GAP_THRESH_REG	Input	3b'	3'h0	OTH_GAP_THRESH shall cover from 1% to 8%, 1% step
CELL_GAP_DEGL_REG	Input	5b'	5'h0	CELL_GAP_DEGL shall cover from 1 to 32
ADC_DATA_LPF_CH1 -ADC_DATA_LPF_CH18	Input	16b'	16'h8000	Main ADC converted data of CELL1-CELL18 with DLPF
ADC_DATA_GPIO1 -ADC_DATA_GPIO12	Input	16b'	16'h8000	Main ADC converted data of GPIO1-GPIO12
AUX_ADC_DATA_LPF_CH1 -AUX_ADC_DATA_LPF_CH18	Input	16b'	16'h8000	Auxiliary ADC converted data of CELL1-CELL18 with DLPF
AUX_ADC_DATA_GPIO1 -AUX_ADC_DATA_GPIO12	Input	16b'	16'h8000	Auxiliary ADC converted data of GPIO1-GPIO12
CELL_GAP_FLT	Output	18b'	18'h0	Over gap threshold flag of CELL1-CELL18
OTH_GAP_FLT	Output	12b'	12'h0	Over gap threshold flag of other channel

Compare flow

GAP_CMP reloads the values of CELL_GAP_THRESH_REG, OTH_GAP_THRESH_REG and CELL_GAP_DEGL_REG into CELL_GAP_THRESH, OTH_GAP_THRESH and CELL_GAP_DEGL when ADC_GO_DLY(includes ADC_SGLE_GO_DLY and ADC_CNTI_GO_DLY) or MON_WAKE_GO is detected high.**TSR001[GAP_CMP]**

GAP_CMP calculates the gap between AUX_ADC_DATA_LPF and ADC_DATA_LPF firstly, compares each gap of CELL18-CELL1 with CELL_GAP_THRESH when RR_END is detected high. If any gap takes place over range, the filter counter of corresponding CELL will increased by 1, while the gap is not over range, the filter counter will decreased by 1, until the counter reaches CELL_GAP_DEGL, a corresponding warning flag will be asserted to CELL_GAP_FLT register. CELL_GAP_THRESH covers range from 20mV to 180mV by 5mV per step, the LSB for Cn-Cn-1 is typical 200uV and CELL_GAP_DEGL covers from 1 to 32. **TSR001[GAP_CMP]**

After the completion of all CELLs gap comparison, GAP_CMP continues to compare the gap between AUX_OTH_ADC_DATA and OTH_ADC_DATA with OTH_GAP_THRESH. Any gap of GPIO channels over range, the corresponding warning flag will be output to OTH_GAP_FLT. OTH_GAP_THRESH covers range from 1% to 8%, by 1% step, the LSB for GPIO voltage ratio measurement shall be 100uV /2.5V(40uV). **TSR001[GAP_CMP]**

GAP_CMP compare flow is shown in Fig2.

As shown in Fig2, MON_ADC_GO and ADC_GO_DLY need to be synchronized and captured the rising edge to refresh GAP THRESHOLD registers by CLK_SLOW_SC(256K). If MON_ADC_GO or ADC_GO_DLY comes during the compare process(comparison enable[cmp_en] is high), GAP THRESHOLD registers can not be refreshed immediately until the compare process is finished(cmp_en is low). After ADC conversion is done,

and the synchronization signal of RR_END is detected high, cmp_en will be set to high to enable the 5bits counter automatically increment 1 by CLK_SLOW_SC. When the counter is less than 19, GAP_CMP starts to calculate the gaps of main ADC and auxiliary ADC CELL's measurement results and compare the gaps with CELL threshold. Otherwise GAP_CMP calculates the gaps of main ADC and auxiliary ADC GPIO's measurement results and compare the gaps with GPIO threshold. When the counter reaches 31, the counter is cleared to 0 and cmp_en is set to 0.

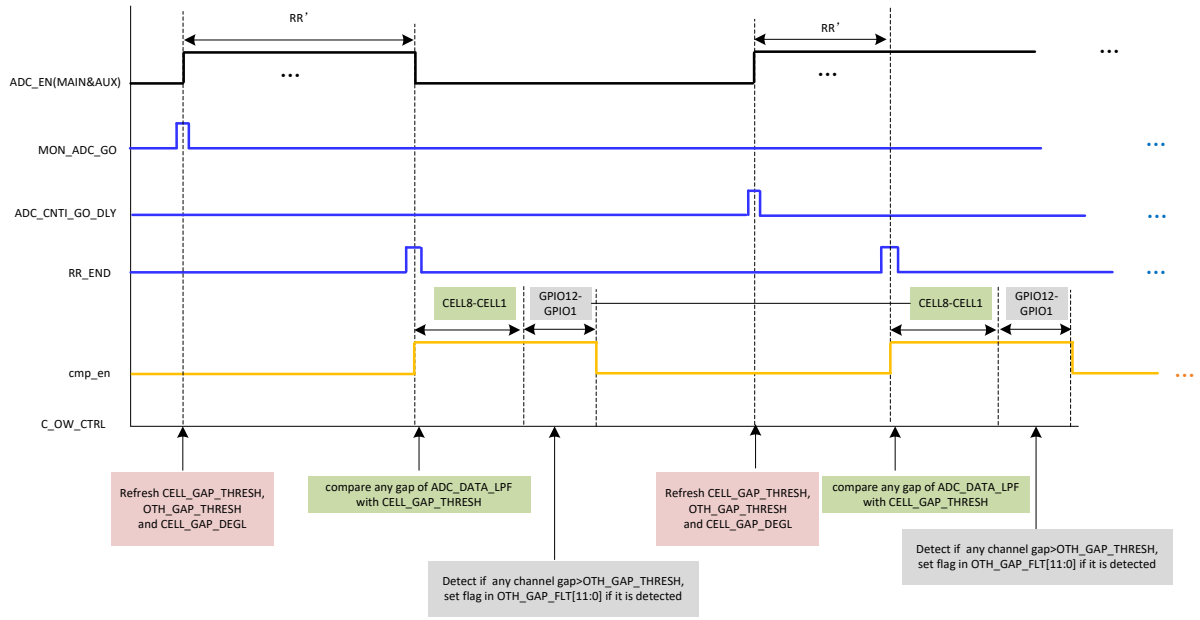

Fig 2 C_OW_CTRL state machine flow

Notes that although ADC_CNTO_GO_DLY only initiates continuous conversion of CELLs, GPIO channels are not converted and no new measurements are available. GAP_CMP still need to calculate the gap and compare the gap with threshold by previous converted results.