Application Note

Rain Light Sensor MLX75308 parameter setup

Contents

1. Scope

The MLX75308 Rain Light Sensor interface chip is a very flexible chip with lots of registers to adjust. With all these registers to adjust it can be difficult to find the right settings to get the best performance. This application note explains the flow that should be followed to get the best performance of the MLX75308.

2. Registers description

There are two kinds of registers: registers that need to be set once during development and registers that can be changed when the application is running.

Figure 1: Block diagram of the rain signal

Figure 1 shows the different blocks of the rain channel. All relevant parameters are explained in the following section.

2.1. Tdem

This parameter changes the demodulator delay time to synchronize the demodulator clock with the rain pulses. The value that results in the highest ADC value should be used to maximize the sensitivity.

2.2. Unity_Gain

This bit selects whether the ADC buffer is bypassed or not. It is not recommended to use the ADC buffer to increase the gain of the rain channel. The GAIN_ADJ_AA parameter is more suited to increase the gain. It is recommended to keep Unity_Gain bit at its default value of 1 to bypass the buffer.

2.3. GAIN_ADJ_AA

This parameter sets the gain of the anti aliasing filter. For noise reasons it is best to start with this parameter to its default value. Only when the rain signal is too small, this parameter can be increased to boost the rain signal.

2.4. BW_ADJ_AA

This parameter changes the cut-off frequency of the anti aliasing filter. It can be changed to limit the noise of the AA filter. It is not a dominant contributor to noise. Changing the bandwidth of the low pass filter will result in a much bigger noise improvement.

2.5. BW_SEL_LP

The cut-off frequency of the low pass filter can be adjusted by this parameter. Lowering the cut off frequency will result in a better noise performance but also in a longer settling time of the filter. The number of pulses should be increased to let the filter settle.

2.6. NP

The amount of pulses that is used to perform a rain measurement is influenced by this parameter. The number of pulses can be changed when the bandwidth of the LP filter is changed to make sure the signal of the LP filter is completely settled.

2.7. RF

This parameter adjusts the pulse frequency. Changing the pulse frequency might be important for EMC emission. The frequency can be changed to improve EMC emission behavior.

2.8. GAIN_BUF

This parameter changes the gain of the ADC buffer. The Unity_Gain bit needs to be set to 0 for this parameter to have any influence. It is not recommended to use this parameter. Adjusting the GAIN_ADJ_AA is mostly enough to enlarge the rain signal.

3. Parameter setup flow

3.1. Parameters that should be set during development

The block diagram below shows the recommended flow to set the parameters that need to be set during the development of the Rain Light Sensor system to get the best performance. These parameters should not be changed anymore when optimized settings have been found.

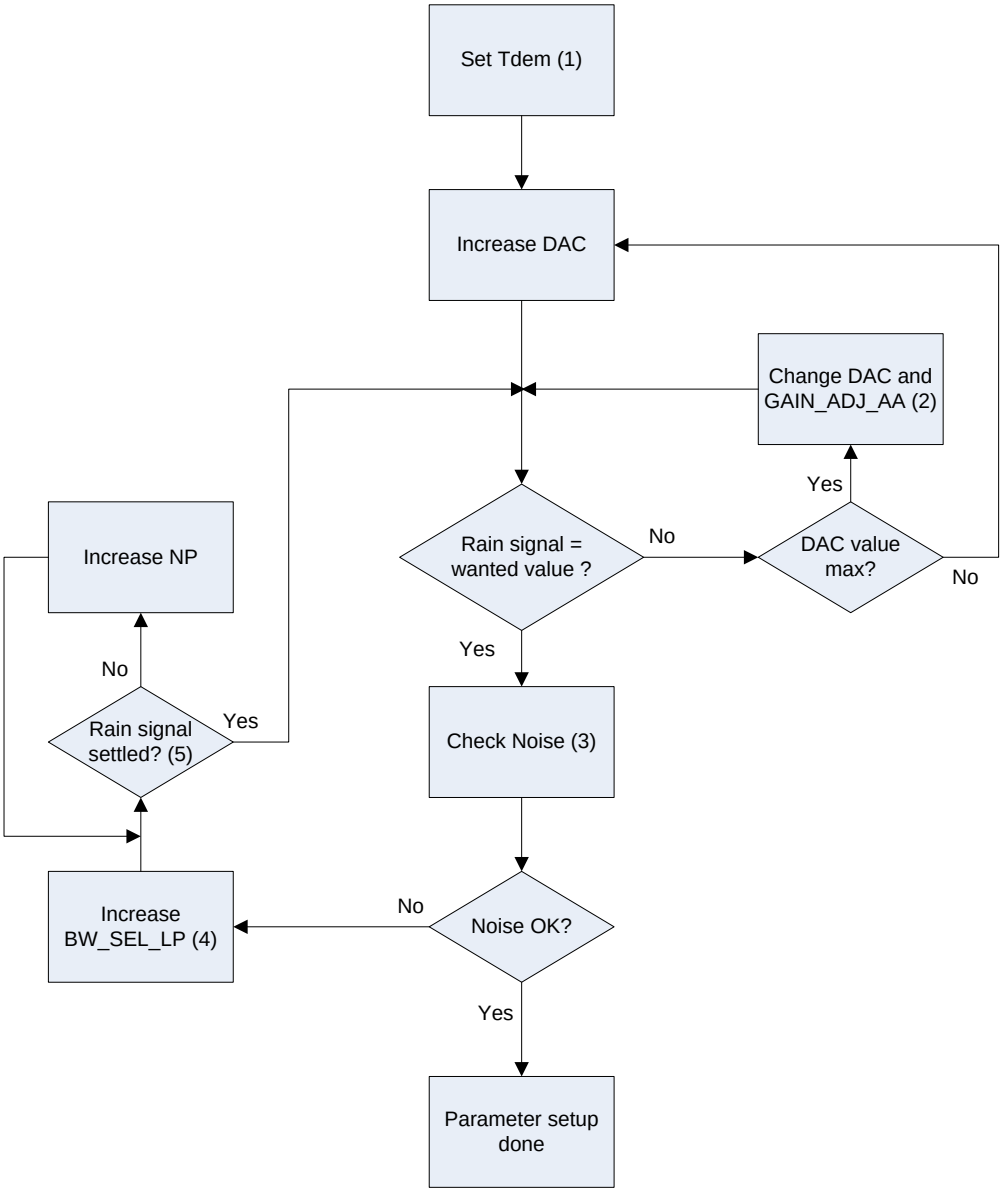
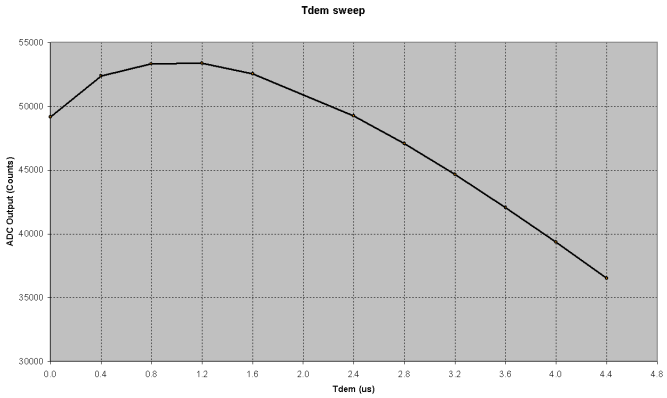


Figure 2: Parameter setup flow

(1) The Tdem parameter must be set to get the highest ADC value. A sweep of this parameter will result in a chart like the one below. The Tdem parameter that corresponds to the highest ADC value should be selected.



(2) When using glass with a low transmission, the wanted ADC rain signal might not be reached with the default gain settings. The GAIN_ADJ_AA parameter changes the anti aliasing gain to boost the rain signal. For better noise performance this gain should be kept as low as possible to reach the wanted ADC rain value.
(3) The noise level should always be lower then the smallest rain drop event that needs to be detected.
(4) BW_SEL_LP sets the cut-off frequency of the low pass filter. To reduce noise this frequency can be set to a lower value.
(5) When the cut-off frequency of the low pass filter is reduced, the settling time of the filter increases. To confirm the signal is settled, the number of pulses (NP) must be increased and checked if the rain signal doesn't change anymore between 2 consecutive settings.

3.2. Parameters that can be changed in the application

There are only 2 parameters that should be changed in the application by the algorithm.
The DAC can be changed to adjust the ADC rain signal in runtime.
The GAIN_ADJ_AA can be changed to reach the wanted ADC rain signal when a darker windshield type is used without making any changes to the hardware (shunt resistor).
It is important that no other parameters are changed during operation. Changing other parameter might result in performance degradation.

4. Shunt resistor value selection

When multiple glass types need to be supported without changing the shunt resistor it is important to choose a value that gives a good performance for all the different glass types. The best way is to start setting up the system with the clearest glass type. For clear glass the gain settings (GAIN_ADJ_AA) should be set to the minimum value. In this way the gain can be used to boost the rain signal for dark glass. Different possible combinations of DAC and shunt resistor values are possible. The aim is to choose a shunt resistor that is high enough so the DAC value for clear glass is not too low (128LSB or more is fine), but not too high so the rain signal is still sufficiently big for dark glass.
When the shunt/DAC combination is working for clear glass, it should be tested with dark glass. The rain signal received will be a lot smaller compared to the value with clear glass. The GAIN_ADJ_AA can be used to get the rain signal in the wanted range. If the wanted rain signal cannot be reached with the highest possible gain settings, a smaller shunt value has to be selected. For clear glass this will result in a lower DAC value to reach the same rain signal. A lower DAC value will result in more noise. It is important to choose the shunt resistor as high as possible for noise reasons on the clear glass, but not too high so the rain signal will still be high enough with dark glass.

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