AN-023 Alerts and Data Capture Synchronization

For some applications it's of interest to combine sensors to provide a smarter overall system. One case in point is combining a radar sensor with a camera to know not only the speed of the object in the field of view but what it is. When combining sensors, an important part of the system design is to be able to synchronize when the data is captured so the system knows it's looking at the same information from the same point in time. Another application is using the radar sensor to trigger the camera only when a speed has been exceeded. Fortunately, the OPS243 sensor makes this easy by providing an output signal to identify when it is capturing data for a speed or range measurement and providing alerts.

System Architecture

Some example data capture systems using an OPS243 radar sensor and camera are shown in Figure 1. One architecture (1a) may take the radar sensor data capture signal as an input to the camera to trigger a snapshot. The OPS243 GPIO signals are 3.3V and it may require a voltage level shifter to interface to the camera. An alternative system (1b) such as a License Plate Recognition (LPR) system utilizes a video fed into an embedded processor such as a Raspbery Pi or Nvidia Jetson. In this case, the embedded processor board detects the radar sensor data capture signal and timestamps it with the appropriate video frame.

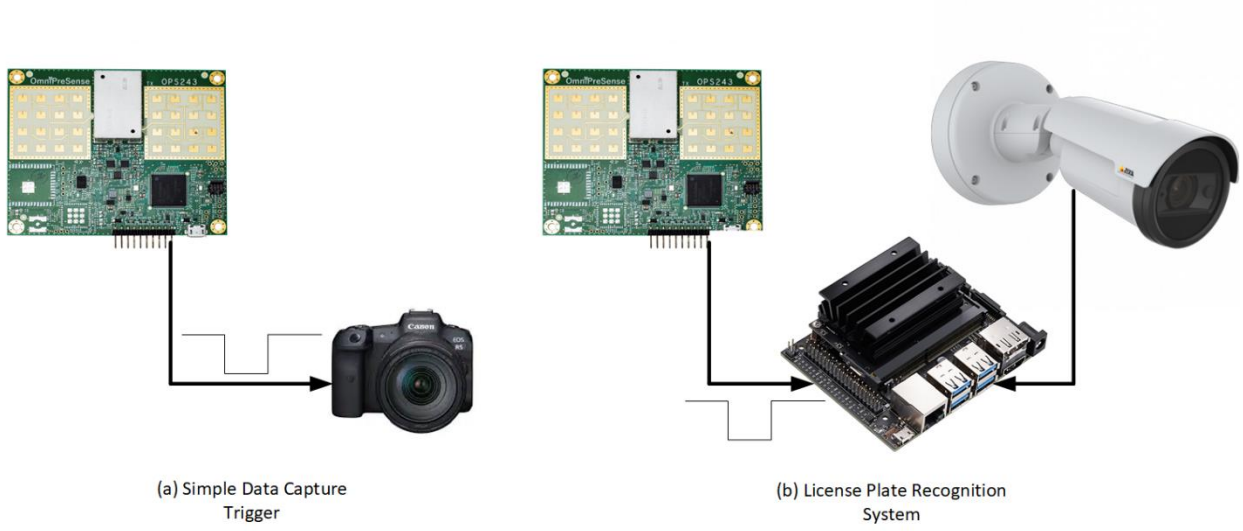

Figure 1. System Architectures

Sensor Interface

The data capture signal on the OPS243 is reflected out the GPIO_0 (pin 1) on the J3 header. The signal is 3.3V. If a 5V signal level is required, a simple logic level converter from Sparkfun or other can be added to the signal. The signals are active low and mirror the time the sensor is sampling the received signal (Figure 2). Adjusting the sample rate, buffer size, and FFT size will affect the timing of the data capture. As an example, in the default setting, the OPS243-A has a 1024 buffer and 10ksps. This results in a signal

high time of 102ms. If the sample rate is doubled to 20ksps (S2 API command), the ADC sample time and the signal high will reduce to 51ms.

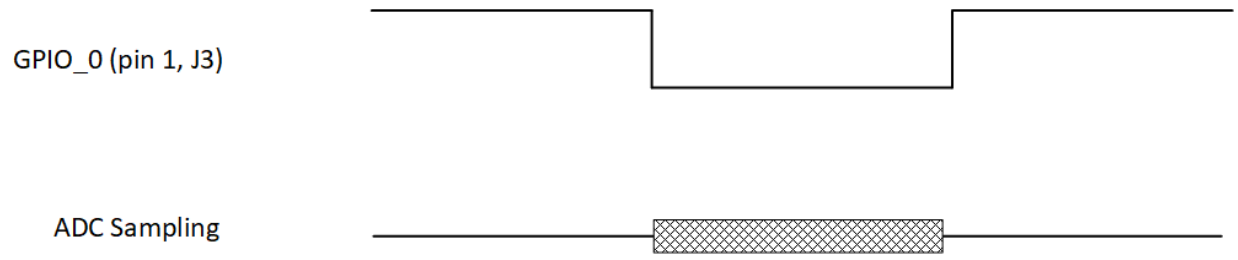

Figure 2. Signal Pin and Data Capture Timing

Object Detect Interrupt

If less critical timing is needed for the synchronization, pin 3 on the J3 header (INT) can be used to monitor when objects are detected in the sensors field of view. This works for the OPS243-A only and is enabled by issuing the IG API command (Ig to turn off). The signal on pin 3 is active low and uses a requirement of 2 consecutive speed values which meet filter thresholds to determine an object is present and 4 missed speeds to determine whether the object is gone or out of the field of view. The values of 2 and 4 are adjustable in the API. See AN-17 Simple Counter for more information.

Alert Levels

Additional capabilities have been added to the API to allow setting of high and low detection alert levels. The alert settings are available for both speed and range reports on OPS243-A and -C. The new API commands provided are listed in Table 1.

Speed alerts are enabled by setting either a high or low-level alert value. The high-speed alert is provided on GPIO pin 1 of header J3 (active low) and as a message over the wired or wireless interface. GPIO pin 2 normally is used to indicate active ADC sampling time but when a high-level alert is set, it reverts to only report alerts. The low-speed alert is reflected on GPIO pin 1 of header J3 and likewise is active low.

Table 1. Alert API Commands

Command	Name	Read/Write	Value
Y<n.n	Speed High Level Alert	Write	Set to value above which the alert will be triggered. If triggered, an Alert message will be sent and pin 2 on OPS243 header J3 will trigger (active low).
Y>n.n	Speed Low Level Alert	Write	Set to value below which the alert will be triggered. If triggered, an Alert message will be sent and pin 1 on OPS243 header J3 will trigger (active low). The default value is 0. If set to 0, the GPIO pin 1 on J3 header will output high when the ADC is sampling.
y<n.n	Range High Level Alert	Write	Set to value above which the alert will be triggered. If triggered, an Alert message will be sent and pin 2 on OPS243 header J3 will trigger (active low).
y>n.n	Range Low Level Alert	Write	Set to value below which the alert will be triggered. If triggered, an Alert message will be sent and pin 1 on OPS243 header J3 will trigger (active low).

An example low-speed alert setting, speed reading, and alert message output in JSON format is shown below.

{"HighSpeedAlertSetting":0.00, "LowSpeedAlertSetting":3.00}
0.06
{"ALERT": Low Speed inbound 0.06 mps}

A graphical explanation is shown in Figure 3 with a 10 mph low speed and 35 mph high speed alert values.

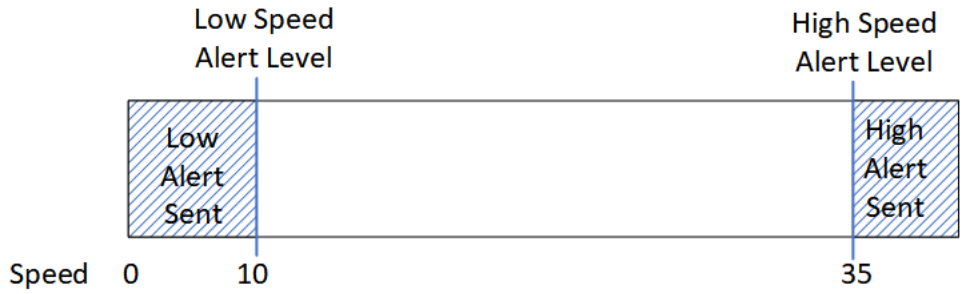

Figure 3. Speed Alert Settings

Range alert settings work similar to speed alerts. A typical range application is expected to have the sensor mounted vertically looking down at the ground or water surface (Figure 4). A low alert setting will report if the distance from the object is shorter than expected and below the low threshold setting. A high alert

will report if the object is too far from the sensor. As an example, if the water height under a bridge is above a certain height, a flood warning may be sent. Figure 4 shows graphically how range settings are used and example values.

Similar to speed alert reports, GPIO pins 1 and 2 are used to signal a high or low-level alert, and a message will be sent. If set, pin 1 signal will no longer represent the ADC sampling time. An example setting of y<2 and alert message is shown below:

{"high_distance_alert_m": 2.00}
{"low_distance_alert_m": 0.00}
{"ALERT": High Distance 2.4 m}
If the OPS243-C/OPS7243-C is positioned as shown in Figure 4, it's possible a noise value could be reported beyond the ground or base level. It's suggested that a range filter value be set to eliminate the chance of any noise reports. For Figure 4, an appropriate setting would be r>20 to prevent any values detected larger than a distance of 20.

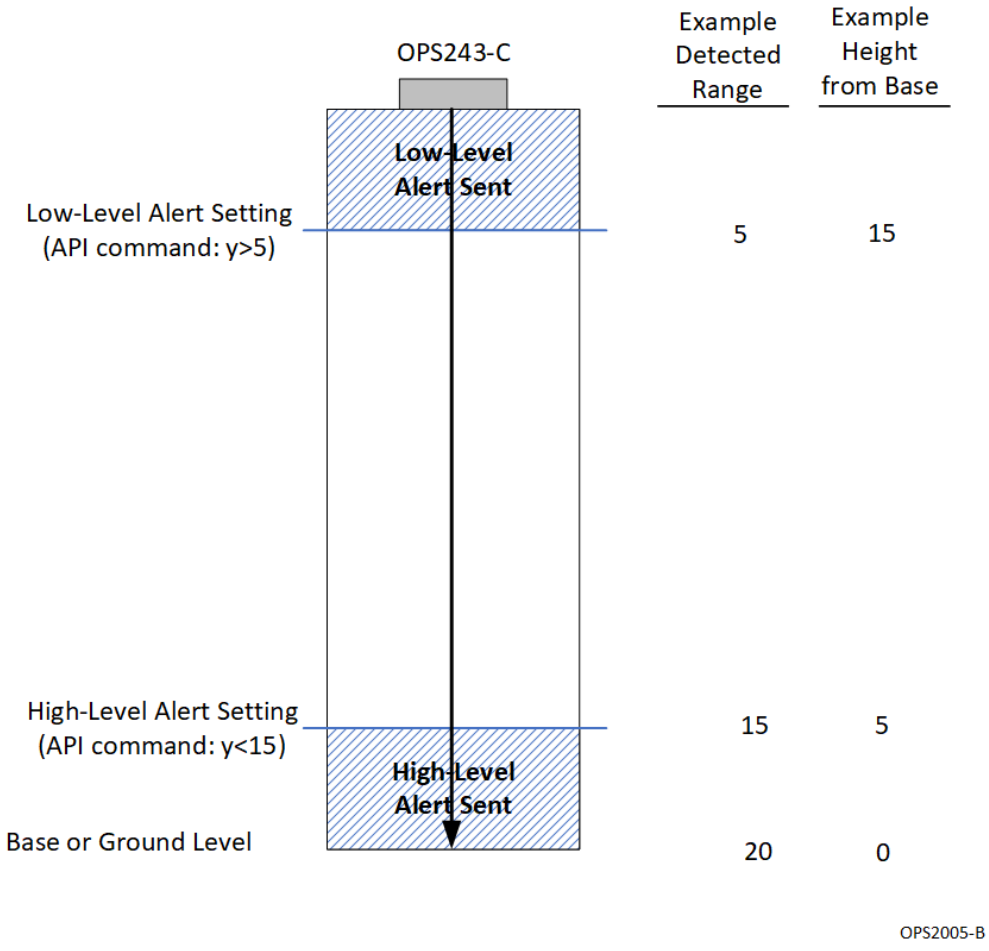

Figure 4. Range Alert Settings

Revision History

Version	Date	Description
A	September 28, 2021	Initial release.
B	June 6, 2023	Added Object Detect and INT pin operation. Added information about High/Low speed and range alert levels.