Infrared Remote Control Receivers | Application Note

# The New Cyllene Fixed Gain Receiver for Sensor Applications

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## INTRODUCTION

IR receivers are used in a large number of applications. These are not limited to remote controls for TV sets and hi-fi systems, but also include numerous types of sensors, such as light barriers, light curtains, and reflective beams. The devices can be found in everything from robot vaccum cleaners and paper towel dispensers to toy robots and 3D glasses. In most applications that utilize the receivers as presence or proximity sensors, a fixed range is required. For example, a towel dispensor should not respond to a person two meters away, but when their hand appears right in front of the device. With a standard remote control TSOP receiver, the sensitivity changes with the ambient light conditions. When sunlight enters a darkened room, the receiving range will decrease suddenly. This behavior can be tolerated by a remote control, but a sensor should not change its operation according to the background illumination.

In order to avoid such unwanted sensitivity changes, Vishay designed the TSSP series of IR receivers with a fixed gain, which provides a constant receiving range under all lighting conditions. These devices are now also available with the newly developed Cyllene IC. In the following sections, the enhanced characteristics of this new IC will be compared with the legacy TSSP4038.

**TABLE 1**

| | Typ. $E_{emin.}$ ($mW/m^2$) | Max. $E_{emin.}$ ($mW/m^2$) |
|---|---|---|
| Methone TSSP4038 | 0.4 | 0.7 |
| Cyllene TSSP94038 | 0.4 | 0.5 |

Challenges designers have to cope with when planning a sensor include the normal production distribution of the receiver's sensitivity, as well as the distribution of the applied emitter's intensity. The smaller these variations are, the easier the designer's task, since they always have to ensure the operation for the two extreme cases of short range (insensitive receiver + weak emitter) and long range (sensitive receiver + strong emitter).

The sensitivity distributions of the TSSP4038 and the new TSSP94038 are shown in Fig. 1. In each case, 100 samples were tested and the sensitivity was expressed in terms of the minimum irradiance ($E_{emin.}$) necessary to receive a valid signal. Both distributions were fitted with a Gaussian function, which shows a more narrow distribution for the TSSP94038. The tighter limits of the detection threshold for the TSSP94038 can also be seen in Table 1. The smaller sensitivity range of the TSSP94038 with respect to the TSSP4038 facilitates the integration of the new part into sensor applications with a fixed range requirement.

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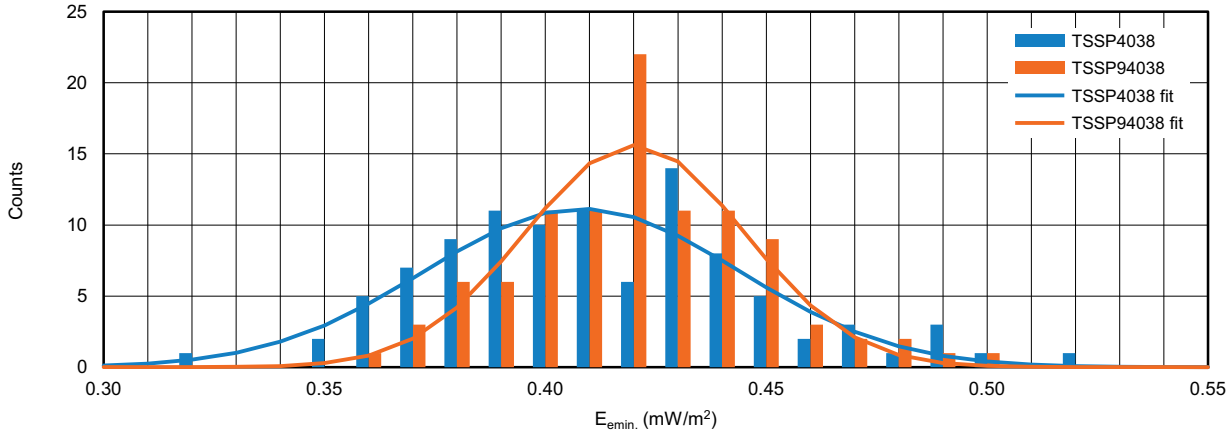


Fig. 1

## DC LIGHT INTERFERENCE

DC light, including sunlight or ambient light from incandescent lamps, is an interference source that affects most sensor and remote control receivers. Since fixed gain receivers cannot decrease their gain under ambient light conditions in order to suppress interference - as their analog remote control counterparts do - they are designed with slightly lower sensitivity to begin with.

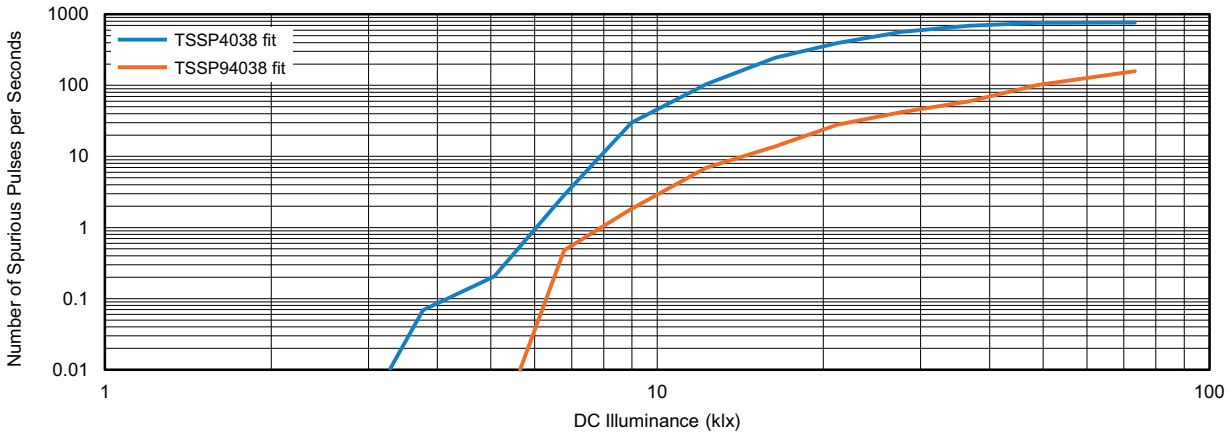


Fig. 2

This lower gain improves their robustness against ambient light for limited illuminance levels. However, if the illuminance becomes too strong, unwanted pulses can begin occurring at the output of the receiver, which may disturb the sensor function depending on the specific type of application. Some sensor applications are more tolerant of spurious pulses than others.

Fig. 2 shows the number of spurious pulses appearing at the outputs of the TSSP94038 and TSSP4038 with increasing DC illuminance. The onset of spurious pulses clearly appears at higher illuminance levels for the TSSP94038, demonstrating its enhanced DC light suppression. In the case where the interference is too strong for the application to function correctly, a sensor with the XB option may be selected, which uses a smaller photodiode to further reduce its sensitivity. The XB option receiver may achieve the required desensitization without the additional cost of mounting an aperture or other attenuator in front of its lens.

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## SWITCHING ACCURACY

In a sensor application, precise switching behavior at the sensitivity limit can be of great importance. A sensor that is permanently jumping back and forth from on to off would cause a malfunction in many applications. For example, a towel dispenser should switch on and off a single time when it detects a hand. Otherwise it would eject a flood of towels for a single person. While building in hysteresis is the task of the application software, a tight transition characteristic makes the job easier. The new TSSP94038 shows enhanced on-off switching characteristics with respect to the TSSP4038. In Fig. 3, the average output voltage is plotted against the irradiance level. Since both receivers have the same sensitivity, their output transitions from Hi (inactive) to Lo (active) at the same detection threshold of approximately 0.4 mW/m$^2$. However, the range of irradiance levels where the receiver output is indecisive and is therefore switching on and off randomly is much shorter for the TSSP94038. Such precise on-off switching behavior at the receiving range limit is especially beneficial in reflective sensor applications.

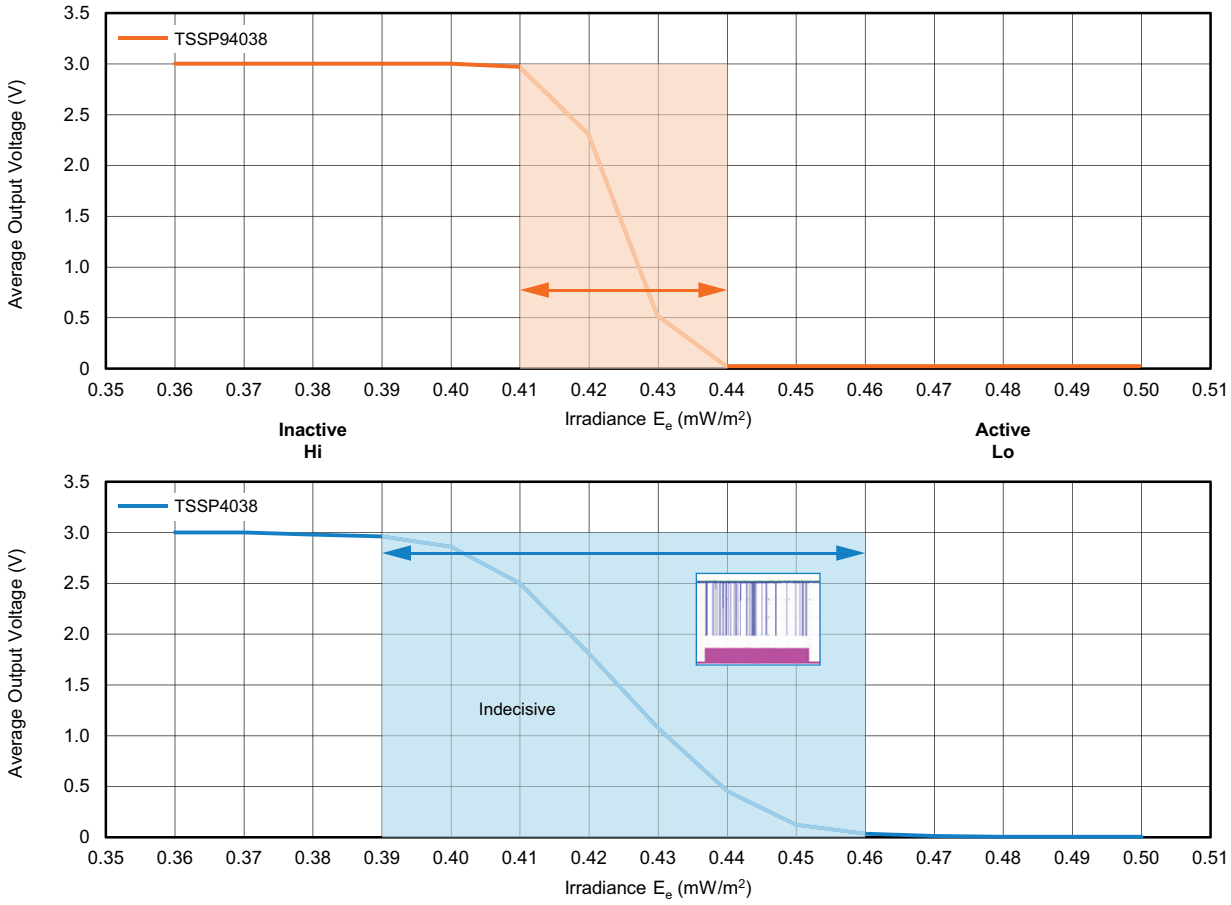


Fig. 3

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## TEMPERATURE STABILITY

In outdoor applications, a sensor system is generally exposed to large temperature variations, which can alter the sensitivity of the receiver due to slight parameter changes within the IC. Fig. 4 shows how the detection threshold changes with temperature for the TSSP94038. The flat sensitivity characteristic with temperature is advantageous in all sensor applications requiring a fixed receiving range.

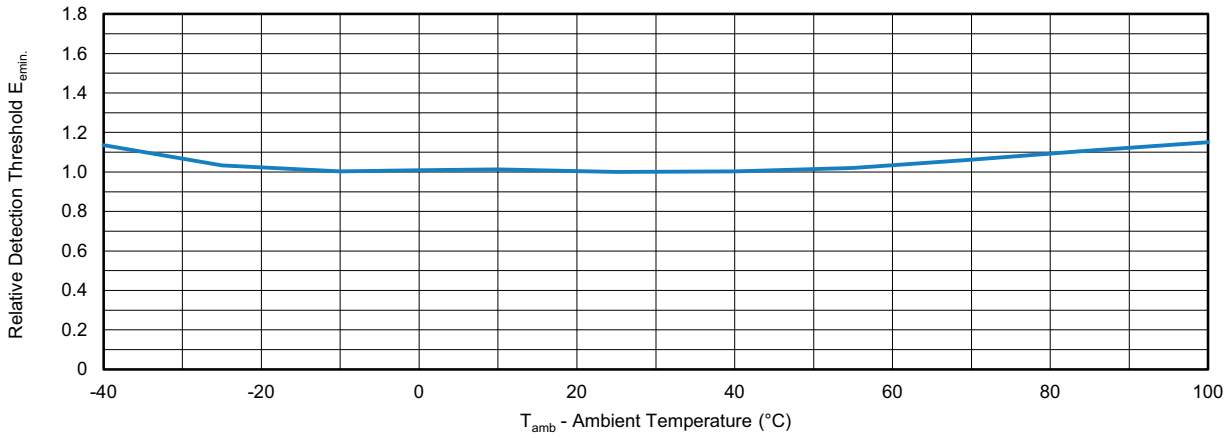


Fig. 4 - Temperature Dependence of the Detection Threshold

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