To learn more about ON Semiconductor, please visit our website at www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor’s system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.
QSE158, QSE159
Plastic Silicon OPTOLOGIC® Photosensor

Features
- Bipolar silicon IC
- Package type: Sidelooker
- Medium wide reception angle, 50°
- Package material and color: black epoxy
- Matched emitter: QEE113/QEE123
- Daylight filter
- High sensitivity
- Direct TTL/LSTTL interface

Description
The QSE15X family are OPTOLOGIC® ICs which feature a Schmitt trigger at output which provides hysteresis for noise immunity and pulse shaping. The basic building block of this IC consists of a photodiode, a linear amplifier, voltage regulator, Schmitt trigger and four output options. The TTL/LSTTL compatible output can drive up to ten TTL loads over supply currents from 4.5 to 16.0 Volts. The devices are marked with a color stripe for easy identification.

Package Dimensions

Note:
1. Dimensions for all drawings are in millimeters.
Block Diagrams

QSE158
Open-Collector Output Buffer

QSE159
Open-Collector Output Inverter

Absolute Maximum Ratings \((T_A = 25°C \text{ unless otherwise specified})\)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_{OPR}</td>
<td>Operating Temperature</td>
<td>-40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>T_{STG}</td>
<td>Storage Temperature</td>
<td>-40 to +100</td>
<td>°C</td>
</tr>
<tr>
<td>T_{SOL-I}</td>
<td>Soldering Temperature (Iron)(^{2,3,4})</td>
<td>240 for 5 sec</td>
<td>°C</td>
</tr>
<tr>
<td>T_{SOL-F}</td>
<td>Soldering Temperature (Flow)(^{2,3})</td>
<td>260 for 10 sec</td>
<td>°C</td>
</tr>
<tr>
<td>I_O</td>
<td>Output Current</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td>V_{CC}</td>
<td>Supply Voltage</td>
<td>4.0 to 16</td>
<td>V</td>
</tr>
<tr>
<td>V_O</td>
<td>Output Voltage</td>
<td>35</td>
<td>V</td>
</tr>
<tr>
<td>P_D</td>
<td>Power Dissipation(^{(1)})</td>
<td>100</td>
<td>mW</td>
</tr>
</tbody>
</table>

Notes:
1. Derate power dissipation linearly 2.50mW/°C above 25°C.
2. RMA flux is recommended.
3. Methanol or isopropyl alcohols are recommended as cleaning agents.
4. Soldering iron tip 1/16" (1.6mm) minimum from housing.
## Electrical Characteristics (\(T_A = -40°C\) to +85°C, \(V_{CC} = 4.5\)V to 16V)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ee(+))</td>
<td>Positive Going Threshold Irradiance(^{(5)})</td>
<td>(T_A = 25°C)</td>
<td>0.025</td>
<td>0.250</td>
<td>mW/cm(^2)</td>
<td></td>
</tr>
<tr>
<td>(Ee(+))/(Ee(-))</td>
<td>Hysteresis Ratio</td>
<td></td>
<td>1.10</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(I_{CC})</td>
<td>Supply Current(^{(5)})</td>
<td>(Ee = 0) or 0.3mW/cm(^2)</td>
<td></td>
<td>5.0</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peak to Peak Ripple which will Cause False Triggering</td>
<td>(f = DC) to 50MHz</td>
<td></td>
<td>2.00</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**QSE158 (Buffer Open Collector)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_{OH})</td>
<td>High Level Output Current(^{(5)})</td>
<td>(Ee = 0.3)mW/cm(^2), (V_{OH} = 30)V</td>
<td></td>
<td>100</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>(V_{OL})</td>
<td>Low Level Output Voltage</td>
<td>(Ee = 0), (I_{OL} = 16)mA</td>
<td></td>
<td>0.40</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**QSE159 (Inverter Open Collector)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_{OH})</td>
<td>High Level Output Current</td>
<td>(Ee = 0), (V_{OH} = 30)V</td>
<td></td>
<td>100</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>(V_{OL})</td>
<td>Low Level Output Voltage(^{(5)})</td>
<td>(Ee = 0.3)mW/cm(^2), (I_{OL} = 16)mA</td>
<td></td>
<td>0.40</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**QSE158, QSE159**

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(t_R, t_F)</td>
<td>Output Rise, Fall Times</td>
<td>(Ee = 0) or 0.3mW/cm(^2), (f = 10kHz), (DC = 50%), (R_L = 360)Ω(^{(5)})</td>
<td></td>
<td>100</td>
<td>nS</td>
<td></td>
</tr>
<tr>
<td>(t_{PHL}, t_{PLH})</td>
<td>Propagation Delay</td>
<td>(Ee = 0) or 0.3mW/cm(^2), (f = 10kHz), (DC = 50%), (R_L = 360)Ω(^{(5)})</td>
<td></td>
<td>6.0</td>
<td>µS</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

5. \(\lambda = 880\)nm (AlGaAs).
Typical Performance Curves (Sensor Coupled to QEE113 Emitter)

**Fig. 1** Output Voltage vs. Input Current (Inverters)

- **V_{OH}** - Output Voltage (V)
- **V_{OL}** - Output Voltage (V)
- **I_{F} (OFF)**
- **I_{F} (ON)**
- \( V_{CC} = 5 \text{ V} \)
- \( R_L = 270 \Omega \)
- \( T_A = 25^\circ \text{C} \)
- \( d = 4 \text{ mm} \)

**Fig. 2** Output Voltage vs. Input Current (Buffers)

- **V_{OH}** - Output Voltage (V)
- **V_{OL}** - Output Voltage (V)
- **I_{F} (OFF)**
- **I_{F} (ON)**
- \( V_{CC} = 5 \text{ V} \)
- \( R_L = 270 \Omega \)
- \( T_A = 25^\circ \text{C} \)
- \( d = 4 \text{ mm} \)

**Fig. 3** Threshold Current vs. Distance

- \( I_{F} (ON) \)
- \( I_{F} (OFF) \)
- Normalized to:
  - \( V_{CC} = 5 \text{ V} \)
  - \( R_L = 270 \Omega \)
  - \( T_A = 25^\circ \text{C} \)
  - \( d = 4 \text{ mm} \)
  - Pulsed 100Hz
  - PW = 100\mu s

**Fig. 4** Normalized Threshold Current vs. Supply Voltage

- \( I_{F} (ON) \)
- \( I_{F} (OFF) \)
- Normalized to:
  - Turn ON Threshold
  - \( V_{CC} = 5 \text{ V} \)
  - \( T_A = 25^\circ \text{C} \)
Typical Performance Curves (Sensor Coupled to QEE113 Emitter) (Continued)

**Fig. 5** Normalized Threshold Current vs. Ambient Temperature

- Normalized to: 
  - $V_{CC} = 5$ V
  - $T_A = 25°C$

- $I_F = I_F(0)$
- $I_F = I_F(ON)$

**Fig. 6** Low Output Voltage vs. Output Current

- $V_{CC} = 5$ V
- $I_F = 10$ mA

**Fig. 7** Response Time vs. Forward Current

- $V_{CC} = 5$ V
- $R_L = 270$ Ω
- $T_A = 25°C$
- $I_F$ Pulsed
- $T = 10$ ms
- Duty Cycle = 50%

- $T_{PHL}$
- $T_{PLH}$
QSE158, QSE159
Plastic Silicon OPTOLOGIC® Photosensor

Fig. 8 Switching Speed Test Circuit

![Switching Speed Test Circuit Diagram]

- R1 = 360Ω
- R2 = 180Ω
- C1 = 15 pf
- C2 = 20 pf
- C1 and C2 include probe and stray wire capacitance

Fig. 9 Switching Times Definition for Buffers

![Switching Times Definition for Buffers Diagram]

Fig. 10 Switching Times Definition for Inverters

![Switching Times Definition for Inverters Diagram]
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<th>Product Status</th>
<th>Definition</th>
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<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
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<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.</td>
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<td>Full Production</td>
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