RV1S9184Q

AUTOMOTIVE 1 Mbps, OPEN COLLECTOR OUTPUT, 5-PIN SOP (SO5) PHOTOCOUPLER

DESCRIPTION
The RV1S9184Q is a photocoupler featuring high-speed communication with open-collector output which consists of an AlGaAs LED on the input side and a one-chip signal processing circuit with built-in photo diode on the output side. The package is a small outline package (SOP) type and has a shield effect to cut the ambient light. The RV1S9184Q is designed specifically for high voltage isolation and wide temperature operation (−40 to +135 °C), which is suitable for automotive application.

FEATURES
- Operating ambient temperature ($T_A = -40$ to $+135$ °C)
- High isolation voltage ($BV = 3750$ Vr.m.s.)
- High speed response ($tpHL = 700$ ns MAX., $tpLH = 700$ ns MAX., $PWD = 500$ ns MAX.)
- High common mode transient immunity ($CMIH, CMIL = \pm 15$ kV/µs MIN.)
- Small package (SO5)
- Pb-free product
- AEC-Q100 (Grade 1: $T_A = -40$ to $+125$ °C) compliant
- Safety standard
  - UL : UL1577, Double protection

APPLICATIONS
- Consumer Vehicle

PIN CONNECTION
(Top View)

Start of mass production
Feb.2020
PACKAGE DIMENSIONS (UNIT: mm)

Weight: 0.08 g (TYP.)

PHOTOCOUPLE CONSTRUCTION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MIN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Distance</td>
<td>4.2 mm</td>
</tr>
<tr>
<td>Creepage Distance</td>
<td>4.2 mm</td>
</tr>
<tr>
<td>Isolation Distance</td>
<td>0.2 mm</td>
</tr>
</tbody>
</table>
MARKING EXAMPLE

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Order Number</th>
<th>Solder Plating Specification</th>
<th>Packing Style</th>
<th>Safety Standard Approval</th>
<th>Application Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV1S9184QKCSP-1000</td>
<td>RV1S9184QKCSP-1000#SC/D</td>
<td>Pb-Free (Ni/Pd/Au) Plating</td>
<td>Embossed Tape 20 pcs</td>
<td>Standard Products (UL Approved)</td>
<td>RV1S9184Q</td>
</tr>
<tr>
<td>RV1S9184QKCSP-1000#KC/D</td>
<td>Embossed Tape 2500 pcs/reel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: *1. For the application of the safety standard, the following part number should be used.

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward Current*1</td>
<td>I_F</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Reverse Voltage</td>
<td>V_R</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Detector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>V_CC</td>
<td>0.5 to +30</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>V_O</td>
<td>0.5 to V_CC</td>
<td>V</td>
</tr>
<tr>
<td>Output Current</td>
<td>I_O</td>
<td>15</td>
<td>mA</td>
</tr>
<tr>
<td>Power Dissipation*2</td>
<td>P_C</td>
<td>100</td>
<td>mW</td>
</tr>
<tr>
<td>Isolation Voltage*3</td>
<td>B_V</td>
<td>3750</td>
<td>V_r.m.s.</td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>T_A</td>
<td>-40 to +135</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_stg</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Notes: *1. Reduced at a rate of 0.5 mA/°C above T_A = 115 °C.
*2. Reduced at a rate of 1.5 mW/°C above T_A = 75 °C.
*3 AC voltage for 1 minute at T_A = 25 °C, RH = 60% between input and output.
Pins 1-2 shorted together, 3-4 shorted together.

RECOMMENDED OPERATING CONDITIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V_CC</td>
<td>4.5</td>
<td>15</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>V_O</td>
<td>0</td>
<td>20</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Forward Current (ON)*1</td>
<td>I_F(ON)</td>
<td>6</td>
<td>20</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Forward Voltage (OFF)</td>
<td>V_F(Off)</td>
<td>0</td>
<td>0.8</td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

Notes: *1. Forward current at T_A = 115 °C or more should not exceed absolute maximum ratings.
ELECTRICAL CHARACTERISTICS (TA = -40 to +135 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward Voltage</td>
<td>$V_F$</td>
<td>$I_F = 10 , mA$</td>
<td>1.18</td>
<td>1.65</td>
<td>1.98</td>
<td>V</td>
</tr>
<tr>
<td>Reverse Current</td>
<td>$I_R$</td>
<td>$V_R = 3 , V$</td>
<td>0.1</td>
<td>0.6</td>
<td>1.0</td>
<td>µA</td>
</tr>
<tr>
<td>Detector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Level Output Current</td>
<td>$I_{OH}$</td>
<td>$I_F = 0 , mA$, $V_{CC} = V_O = 20 , V$</td>
<td>0.01</td>
<td>50</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Low Level Output Voltage</td>
<td>$V_{OL}$</td>
<td>$I_F = 5 , mA$, $I_O = 2 , mA$, $V_{CC} = 15 , V$</td>
<td>0.1</td>
<td>0.6</td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td>High Level Supply Current</td>
<td>$I_{CCH}$</td>
<td>$I_F = 0 , mA$, $V_{CC} = 15 , V$</td>
<td>0.9</td>
<td>2.0</td>
<td>1.6</td>
<td>mA</td>
</tr>
<tr>
<td>Low Level Supply Current</td>
<td>$I_{CCL}$</td>
<td>$I_F = 10 , mA$, $V_{CC} = 15 , V$</td>
<td>0.9</td>
<td>1.6</td>
<td>1.6</td>
<td>mA</td>
</tr>
<tr>
<td>Coupled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threshold Input Current</td>
<td>$I_{THL}$</td>
<td>$V_{CC} = 15 , V$, $V_O = 0.6 , V$, $I_O = 2 , mA$</td>
<td>3.5</td>
<td>10</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Isolation Resistance</td>
<td>$R_{IO}$</td>
<td>$V_{IO} = 500 , V_{CC}$, $R_H = 40 \sim 60 , %$</td>
<td>$10^{10}$</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Isolation Capacitance</td>
<td>$C_{IO}$</td>
<td>$V = 0 , V$, $f = 1 , MHz$</td>
<td>0.5</td>
<td>1.0</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Propagation Delay Time</td>
<td>$t_{PHL}$</td>
<td>$I_F = 10 , mA$, $V_{CC} = 15 , V$, $V_{THHL} = 1.5 , V$, $V_{THLH} = 2.0 , V$, $R_L = 20 , k\Omega$, $C_L = 100 , pF$</td>
<td>100</td>
<td>300</td>
<td>700</td>
<td>ns</td>
</tr>
<tr>
<td>Propagation Delay Time</td>
<td>$t_{PLH}$</td>
<td>$L \rightarrow H$</td>
<td>400</td>
<td>550</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Pulse Width Distortion</td>
<td>$PWD = \frac{t_{PHL}}{t_{PLH}}$</td>
<td>220</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Mode Transient Immunity at High Level Output</td>
<td>$C_{MII}$</td>
<td>$TA = 25 , ^\circ C$, $I_F = 0 , mA$, $V_{CM} = 1.5 , kV$, $V_{CC} = 15 , V$, $R_L = 20 , k\Omega$, $V_O &gt; 3.0 , V$, $C_L = 100 , pF$</td>
<td>15</td>
<td></td>
<td></td>
<td>kV/µs</td>
</tr>
<tr>
<td>Common Mode Transient Immunity at Low Level Output</td>
<td>$C_{ML}$</td>
<td>$TA = 25 , ^\circ C$, $I_F = 10 , mA$, $V_{CM} = 1.5 , kV$, $V_{CC} = 15 , V$, $R_L = 20 , k\Omega$, $V_O &lt; 1.0 , V$, $C_L = 100 , pF$</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:  
*1. Typical values at $TA = 25 \, ^\circ C$  
*2. Test circuit for propagation delay time  
*3. Test circuit for common mode transient immunity

Remark $C_L$ includes probe and stray wiring capacitance.

*3. Test circuit for common mode transient immunity

Remark $C_L$ includes probe and stray wiring capacitance.
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise specified)

**MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE**

**DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**

**FORWARD CURRENT vs. FORWARD VOLTAGE**

**LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE**

**HIGH LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE**

**THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE**

Remark The graphs indicate nominal characteristics.
**Remark** The graphs indicate nominal characteristics.
TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

Outline and Dimensions (Reel)

Packing: 2 500 pcs/reel
RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)

Remark All dimensions in this figure must be evaluated before use.
NOTES ON HANDLING

1. Recommended soldering conditions

(1) Infrared reflow soldering

- Peak reflow temperature: 260 °C or below (package surface temperature)
- Time of peak reflow temperature: -5 °C (255 °C) 30 s or less
- Time of temperature higher than 217 °C: 60 ~ 150 s
- Time to preheat temperature from 150 to 200 °C: 60 ~ 120 s
- Number of reflows: 3
- Flux: Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

(2) Wave soldering

- Temperature: 260 °C or below (molten solder temperature)
- Time: 10 s or less
- Preheating conditions: 120 °C or below (package surface temperature)
- Number of times: One (Allowed to be dipped in solder including plastic mold portion.)
- Flux: Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

(3) Soldering by Soldering Iron

- Peak temperature (lead part temperature): 350 °C or below
- Time (per one side): 3 s or less
- Flux: Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)
- Place: 1.5 to 2.0 mm or more away from the root of the lead

(4) Cautions

- Flux cleaning: Avoid cleaning with Freon- or halogen-based (chlorinated etc.) solvents.
- Fixing/Coating: Do not use fixing agents or coatings containing halogen-based substances.
USAGE CAUTIONS

1. Be aware that when voltage is applied suddenly between the photocoupler's input and output or between VCC and GND at startup, the output transistor may turn on, even if the voltage is within the absolute maximum ratings.

2. By-pass capacitor of more than 0.1 µF is used between VCC and GND near the device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.

3. This product is weak for static electricity due to the design of high-speed integrated circuit so protect against static electricity when handling.

4. Avoid storage at a high temperature and high humidity.
| **Caution** GaAs Products | This product uses gallium arsenide (GaAs). GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points.  
1. Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below.  
   1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials.  
   2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal.  
2. Do not burn, destroy, cut, crush, or chemically dissolve the product.  
3. Do not lick the product or in any way allow it to enter the mouth. |

All trademarks and registered trademarks are the property of their respective owners.
Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products
and are not intended to illustrate the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.

2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights,
or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this
document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.

3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics
or others.

4. You shall be responsible for determining which licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sale, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.

5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any
and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.

6. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for
each Renesas Electronics product depends on the product’s quality grade, as indicated below.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home
   electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key
   financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas
Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human
life or bodily injury (artificial life support devices or systems; surgical implants; etc.); or may cause serious property damage (space
system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics
disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product
that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.

7. No product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics
hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but
not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS
ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING
RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE,
HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("VULNERABILITY Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND
ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY Issues. FURTHERMORE, TO THE EXTENT
PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH
RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO
THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.

8. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, "General Notes for
Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by
Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas
Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such
specified ranges.

9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific
characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability
product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics
products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily
injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as
safety designs for hardware and software products, including, but not limited to redundancy, fire control and malfunction prevention, appropriate treatment
for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are
responsible for evaluating the safety of the final products or systems manufactured by you.

10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas
Electronics product. Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard
against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas
Electronics products, such as safety designs for hardware and software products, including, but not limited to redundancy, fire control and malfunction prevention, appropriate treatment
for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are
responsible for evaluating the safety of the final products or systems manufactured by you.

11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is
prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations
promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.

12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or
transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.

13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.

14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas
Electronics products.

(Note1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled
subsidiaries.

(Note2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

Corporate Headquarters
TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact information
For further information on a product, technology, the most up-to-date
version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks
Renesas and the Renesas logo are trademarks of Renesas Electronics
Corporation. All trademarks and registered trademarks are the property
of their respective owners.

© 2023 Renesas Electronics Corporation. All rights reserved.