

Simple Circuit Removes Sync or has Negative Going Sync Tip

As the digital world encroaches into analog territory, signal conditioning circuits are required to prepare analog signals for digital processing. The standard composite video signal is an analog signal and generally AC-coupled in video systems to prevent circulating DC currents. The following circuits demonstrate a method of conditioning a composite video signal for an analog to digital converter by clipping of the sync tip. CMOS ADCs may have a parasitic latch-up problem when subjected to negative input voltage levels. The sync is often clipped off applying just the video information to the full resolution of the ADC. The basic circuit consists of two main sections, a DC-restore amplifier and a clamping amplifier.

We used the ISL4089 and EL4581 as a simple solution to this application. The EL4581 pin 1 (Composite Sync) is normally used for the ISL4089 hold input for sync tip clamping as shown in Figure 1. The single supply ISL4089 REF has a 10mV offset to hold the sync tip at 10mV so the output will never go to 0V and lose feedback.

The video signal first goes to a sync separator, the EL4581 pin 2 (composite video in) and at the same time to a DC-restore amplifier, pin 2 of the ISL4089. The EL4581 pin 1 (composite sync out) outputs a CMOS logic low signal into hold control input of the ISL4089 during the sync tip section of the video signal. When the hold control input is low, the servo loop in the DC-restore amplifier forces its output to the reference level on REF (pin 3). Thus, you can set the clamp level to any positive level by simply biasing REF (pin 3) to the desired level (Refer to Figure 1).

For sync tip clipping, the back porch must be at a known level and the IRE standard defines this level to be ground. A key point to note is, the sync tip may not be at a defined level and the entire video signal amplitude may vary due to gain differences at the source. Thus, using the composite sync output as the input to hold the DC-restore amplifier may clamp the back porch at an incorrect level.

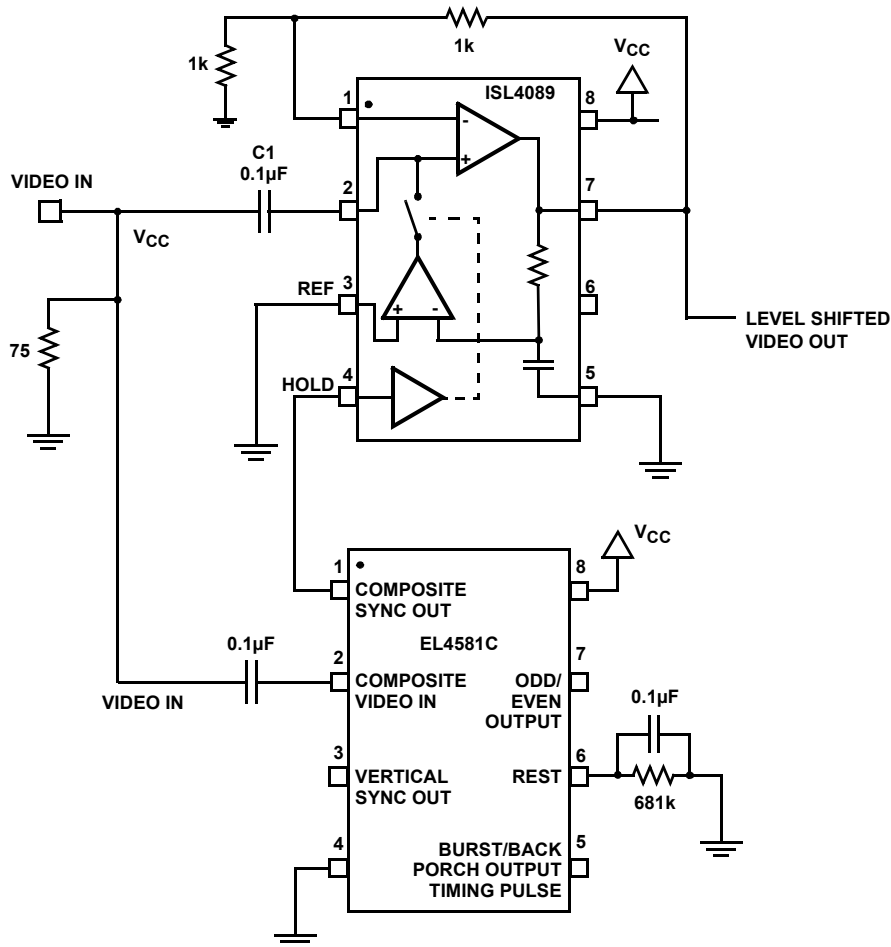


FIGURE 1.

## Low Cost Sync Clip

The ISL4089 can make use of the back porch output of the EL4581C to generate the hold timing, but the ISL4089 can have a slower recovery time than needed by some high end applications. Also, the REF input has a 10mV fixed offset which would place the back porch at 10mV above ground. This 10mV offset will leave 10mV of sync tip on the output. Below 100mV, the DC Restore linearity is somewhat reduced. One method of improving the linearity at these low levels is to simply DC couple the output load to ground, which will also clamp the output to ground. Thus, the ISL4089 makes a good low cost sync tip stripper for removing Sync On Green (SOG) used in both consumer games and video products. Yet, a simple two-step solution will support both consumer video and high performance video requirements.

## High Performance Sync Clip that Removes Offsets

The EL4581 back porch output is used to set the sample and hold window of the DC-restore amp. When the back porch output goes low, the video signal will be clamped to a fixed offset reference on REF (pin 3) of the ISL4089. The single supply clipping amplifier with an offset will remove the sync portion of the video signal.

By applying a positive offset voltage to REF input (pin 3) and using back porch output of the EL4581, pin 5, to drive the HOLD input (pin 4 of the EL4089), the back porch is now at the proper voltage to prevent the sync tip from being clipped at the output. EL4089 pin 4 going low, forces the necessary offset voltage to be placed across the sample and hold capacitor to create the proper input to output voltage shift. In the design example, C1, the AC-coupling capacitor doubles as a sample and hold capacitor. Photo 1 shows the analog video input and the sync separator back porch output waveforms.

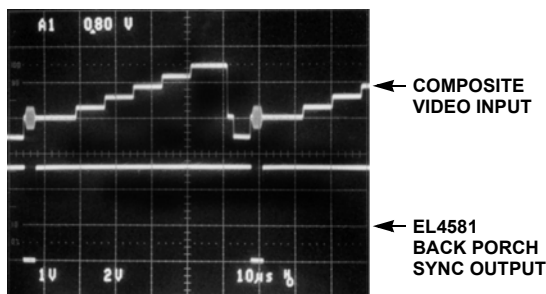


PHOTO 1. DC-RESTORE

## Setting the Offset Voltage

First, you need to offset the REF input to the ISL4089, such that the output back porch of the ISL4089 will be about 0.8V above ground to retain sync tip.

Second, you will need to offset the sync stripper. Resistor offsetting of the ISL4089 will have a residual offset resulting in

a 10mV sync tip. Yet, you can use an OpAmp to eliminate the offset and thus eliminate the residual sync tip. We use the EL8100 to remove both the 10mV offset and the addition 0.788V offset added at the input of the ISL4089.

## More Details

First, adding the offset - A simple resistor voltage divider tied to pin 3 of the ISL4089 will offset the input by the desired 0.8V. Tie a 4.22kΩ resistor from the +5V supply in series to ground with an 806Ω resistor. Connect the junction to pin 3 of the ISL4089. This offsets the input by 0.8V and thus the output will have the sync tip offset by +0.8V.

The ISL4089 as stated before, has a +10mV built-in offset on REF (pin 3) allowing for single 5V operation and will need additional offset adjustment to compensate for the +10mV offset. The addition of a 43kΩ in parallel with the 806Ω will compensate for the 10mV input offset. The final offset applied to pin 3 will be 0.79V (0.800V- 0.01V). Note the ISL4089 has an extra 1.2V offset built in to the pin 2 video input for better linearity so if probed this will show an extra 1.2V offset. This does not effect the overall performance.

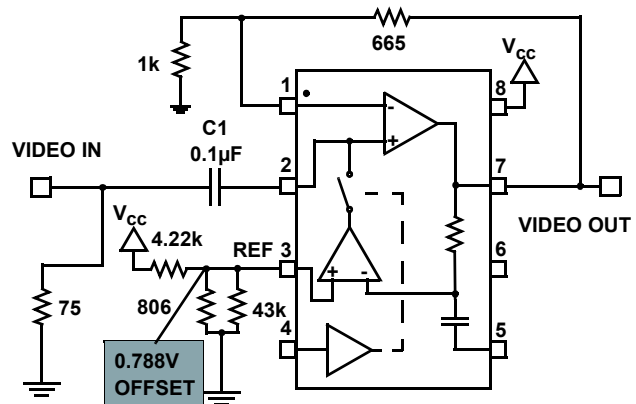


FIGURE 2.

Second, offset the sync stripper output - You need to compensate for the output offset of the ISL4089 to set the back porch at ground at the EL8100 output. Using the feedback path, place an 806Ω resistor from EL8100 pin 6 ( $V_{OUT}$ ) to pin 1 negative input and add a second resistor 4.22kΩ from pin 8 ( $V_{CC}$ ) to pin 2. This will offset the sync stripper output down by 0.8V. Thus, the EL8100 will return the back porch to ground reference and strip off the sync tip.

The 4.22kΩ and 806Ω resistors should be 0.1% tolerance for offset cancellation to be only 1.6mV error max or they can be 1% with a max error of 16mV. By using the same type resistors for both offsetting networks, the ratio match of 1% resistors will be about 4 to 5 times better than 1%, so the error will typically be about 3mV to 4mV. The 43kΩ at 1% gives an error of 0.1mV plus 0.5mV for 5% supply change.

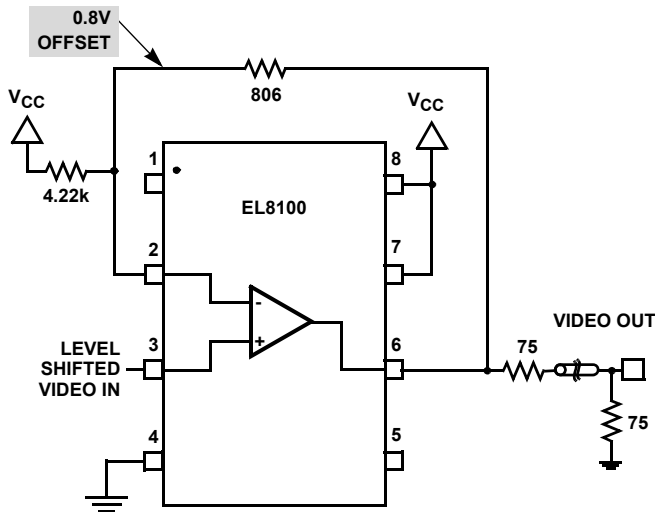


FIGURE 3.

This feedback circuit also changes the gain of the EL8100 to about  $A_V = 1.2$ . The overall circuit gain of the ISL4089 and ISL8100 must be a gain of 2 to recover from the double termination losses.

The EL8100 has a gain of 1.2. Thus, the ISL4089 will need a gain of 1.6 to give the overall circuit a gain of 2.0. The feedback circuit, to have a gain of 1.6, computes to be  $625\Omega$  in the feedback loop and  $1k\Omega$  to ground. The closest standard 1% resistor is  $665\Omega$ .

The EL8100 stage limits the negative excursion to the ground level. The input range of the EL8100 is 0V to 3.5V and output is 0V to 5V. Its fast 7ns of negative over-drive recovery makes it ideal for clamping applications (see Figure 5).

Photo 2 shows the incoming video signal whose back porch is clamped to the ground level and the amplifier output signal with negative going portion of the sync tip clipped off.

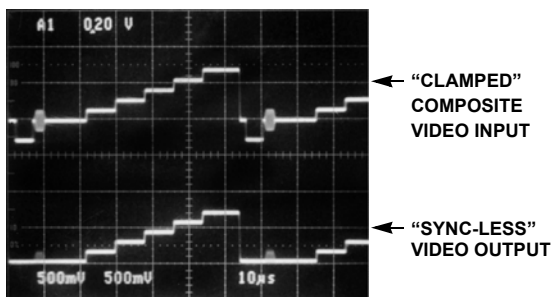


PHOTO 2. "SYNC-LESS" VIDEO SIGNAL

A gain of 1 is needed for some cases so the ISL4089 gain can be set to 1 by removing the 1k gain resistor and changing the feedback resistor to  $0\Omega$ . This will give an overall gain of 1.2. If the gain must be 1, then use an output divider on the EL8100 output of  $200\Omega$  series with  $1k\Omega$  to ground and their junction is the output.

### DC-Restore with Back Porch at Ground and Minus Sync Tip

This circuit may be converted to provide video output with minus sync tip. Changing the clamp amp EL8100 to a dual supply,  $\pm 5V$  amp, such as the EL5160, will keep the back porch at ground with minus going sync tip (see Figure 4).

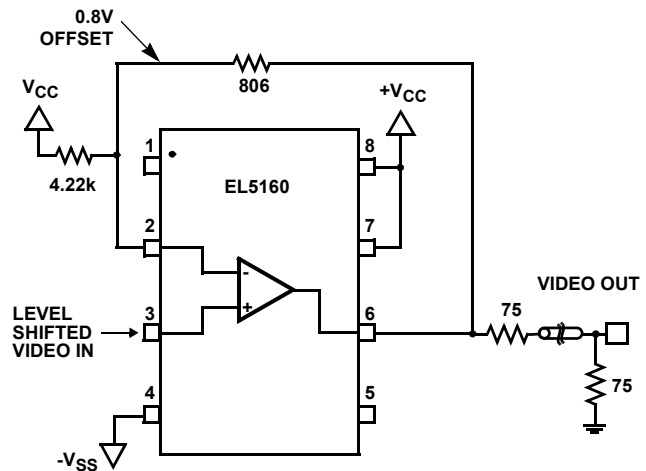


FIGURE 4. DC-RESTORE WITH NEGATIVE SYNC TIP OUTPUT

The Final Design:

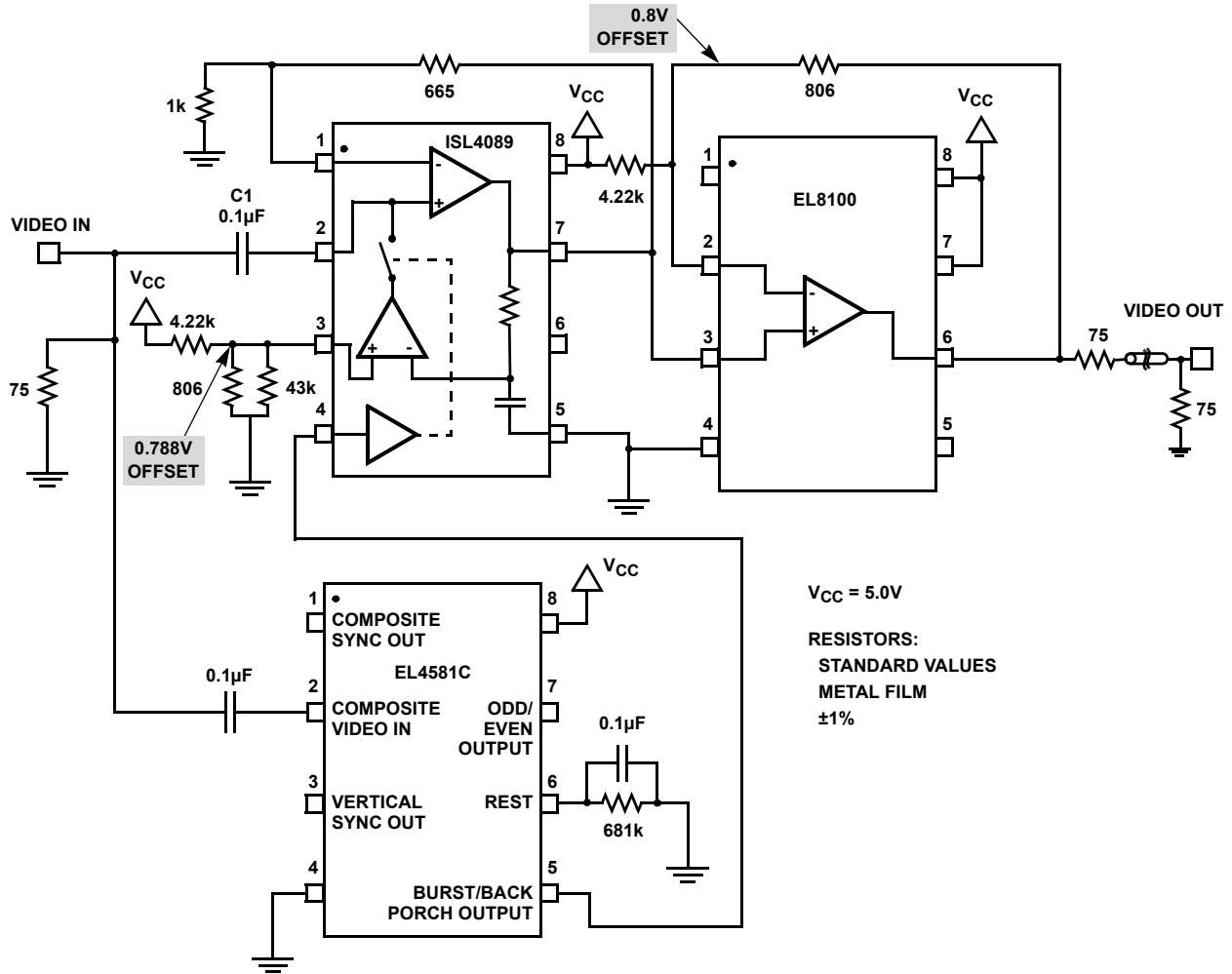


FIGURE 5.

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in 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 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.
5. 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 implantations; 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.
6. 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.
7. 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 design for hardware and software, 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.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. 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.
10. 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.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.  
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.  
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)



### SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

**Renesas Electronics America Inc.**  
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.  
Tel: +1-408-432-8888, Fax: +1-408-434-5351

**Renesas Electronics Canada Limited**  
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
Tel: +1-905-237-2004

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852-2886-9022

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics India Pvt. Ltd.**  
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

**Renesas Electronics Korea Co., Ltd.**  
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5338