

Detecting the Absences of Video with HSYNC Present

TB471
Rev 0.00
August 28, 2007

Introduction

Security and professional video systems use remote video cameras that output just black screen while there is no activity in front of the camera. When activity is detected, these systems need to automatically switch over to the camera with activity.

Problem

How do you detect the start of active video on a NTSC/PAL composite video signal when the camera is already sending a black or blue screen with no active video present?

Detecting H_{SYNC} or V_{SYNC} for the presence of active video will not work. In this application, during non-active video, the video feed still supplies H_{SYNC} and V_{SYNC} but the active video field is black.

TV transmitters, up-link satellites and commercial video cameras can take advantage of this design. However, two subtle issues should be considered when working with

broadcast video. Broadcasters will typically combine the composite sync and the active video just before transmission and need to ensure the video channel is working. They need to detect the point in the video broadcast where video is lost and be notified immediately of the failure. A second issue you need to be aware of is that broadcast TV will insert a blank field just before and just after the inserted advertisement. The design must be able to allow for this without indicating a loss of active video.

Solution

Design a system which will detect active video above “blank” and generate a logic level indicating active video presence for the entire field.

This Technical Brief is a guide to assist in designing such a circuit to fit the designer’s objectives and not as an all-inclusive design. We also make the assumption the designer is familiar with standard video design.

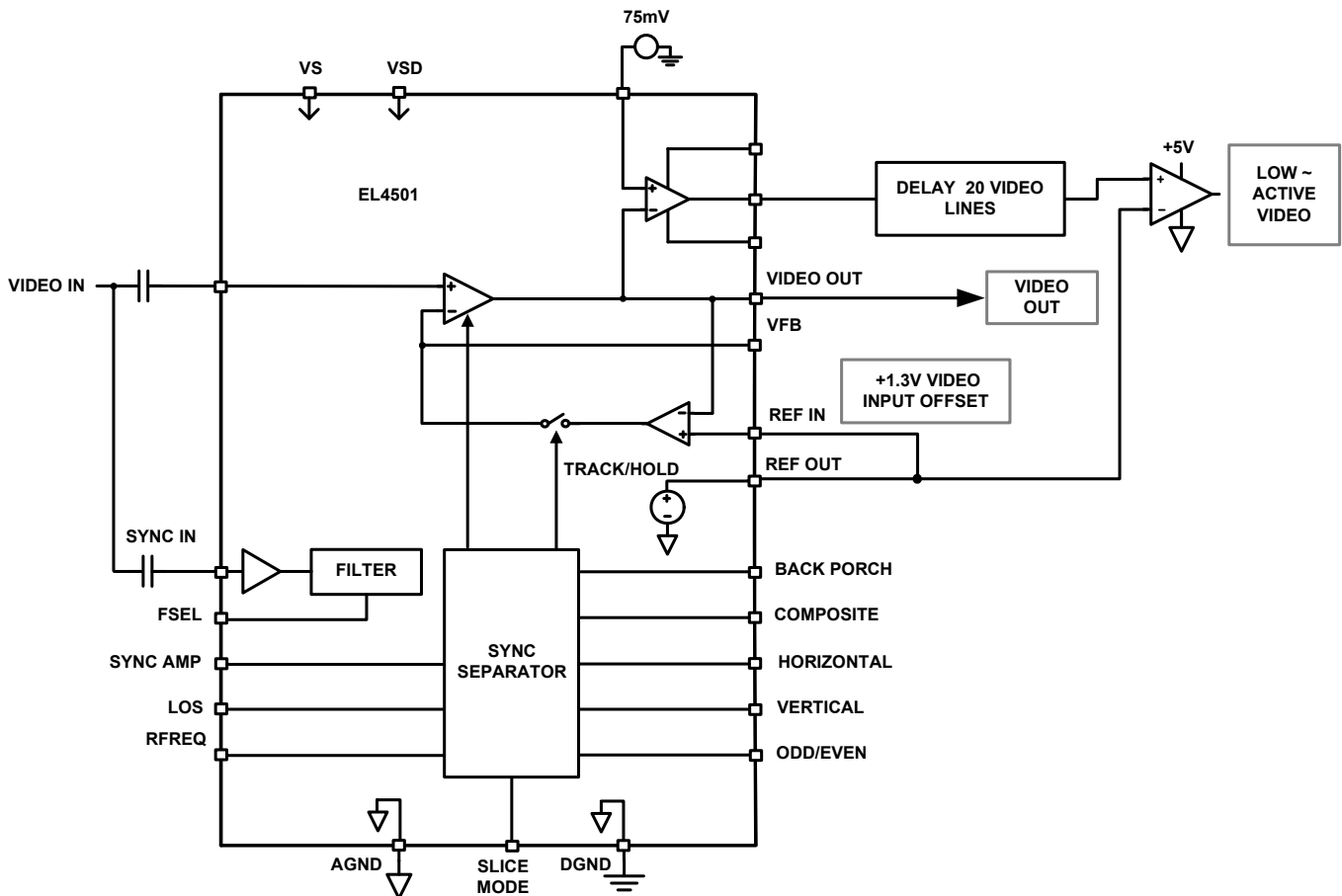


FIGURE 1. BLOCK DIAGRAM

Design Outline

1. Compensate for un-terminated and double-terminated video feeds
2. Monitor the video for active content and generate a logic level when detected
3. Operate from a single 5V supply
4. Blue vs Black screen detect

Component Selection Design Requirements

1. **Level shifter** – shift the negative H_{SYNC} tip levels above ground
2. **Video buffer** – reduce the input impedances' influence on the active video detector
3. **Level detector** – detect the active video field and signal active video presence
4. **Delay timer** – set the active video detect window

Keeping the IC count to a minimum, we selected the EL4501 to fill the roles of level shifter, video buffer and basic interface to the incoming video feed. The delay timer is a combination of the EL4501 and the EL8100. The EL8100 also doubles as the logic signal indicator of active video. As an added advantage, the EL4501 also has a LOS (Loss of Sync) output that goes high if there is no video sync signal and has a video amp output that can direct drive a video cable.

Complete Design

Compensation for Different Terminations

Video feeds can be un-terminated or double-terminated, both having an impact on the H_{SYNC} tip negative level. Since we are limited to a single supply 5V, we need to take into account the impact of the termination and adjust for negative H_{SYNC} tip levels (Refer to Figure 2, NTSC Standard Video Wave Form).

The key to this overall design is using the single supply EL4501 and its internal $V_{\text{REF}} = 1.3\text{V}$ to offset the incoming video. Doing so will allow the EL4501 to support a negative incoming H_{SYNC} tip (-40IRE or approximately -300mV) by adding +1.3V offset on the back porch. Now the EL4501 will support an un-terminated video feed which will have a 2x H_{SYNC} tip and it will also accommodate a double-terminated video cable with a 0.5x H_{SYNC} tip. We set the gain of the video input buffer to 2x to recover the losses from a back-terminated output video feed.

The un-terminated video sync tip will be approximately -600mV times an amp gain of 2 and will output a sync tip of approximately -1.2V. The +1.3V offset raises the -1.2V sync tip to +0.1V above ground for the sync tip. More on the actual circuitry can be found in "Termination and detecting reference level" on page 3.

Monitor for Active Video

Reviewing the NTSC/PAL standards, you will find that not all lines will contain active video and some of the lines are reserved for functions other than active video. The filter needs to be designed to not trigger on these non-video functions even though this small amount of data on the lines might be detected as active video. If we delay the detection for about the first 20 lines in the vertical interval, the detector will be monitoring the correct active video lines. Also, TV stations normally have 1 field that is black before and after advertisements so the filter may need to have enough delay to not detect approximately 20ms black level video (one field).

The video black level is 7.5IRE or approximately 54mV for NTSC. Thus, the video detector will have to be set to some value above 54mV.

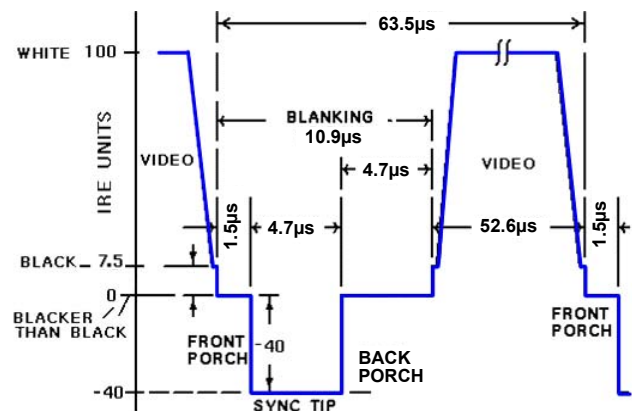


FIGURE 2. NTSC STANDARD VIDEO WAVEFORM

We selected about 80mV for the active video detect level. This gives us about 25mV of noise margin over the typical black level. To set this level on the EL4501, we use the Data Slicer comparator reference input (DS REF) to fix the threshold by simply adding a resistor divider from V_{CC} to V_{REF} as shown in Figure 3.

The 30k Ω resistor and the 680 Ω resistor will set DS REF to about 80mV with respect to the BACK PORCH. The comparator will now detect levels about 26mV above Black and thus detect active video. You can also use this technique to monitor for non-blue screens by setting the threshold above the blue level.

Note: For standard and double cable termination, use 680 Ω . For the remainder of this tech brief, we will assume standard cable termination and will use the 680 Ω resistor

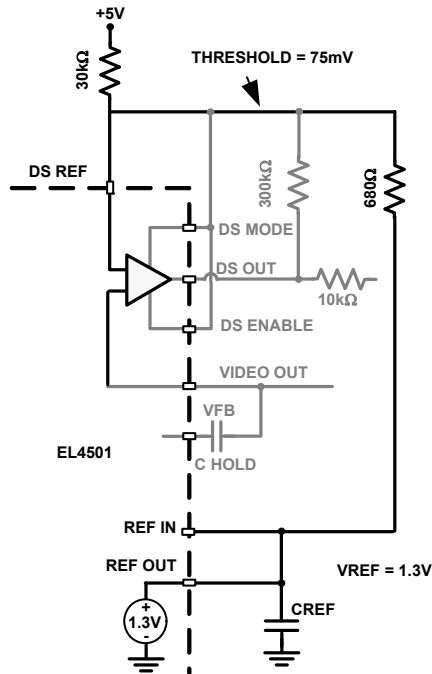


FIGURE 3. BLACK LEVEL THRESHOLD

HYSTERESIS FOR SLOW RAMP EDGES

We want to ensure the detection circuitry is not responding to noise during a slow edge. We need to design-in some level of hysteresis to help prevent false triggering.

The video detector senses the output level of a filter with slow edges. The series 10kΩ output resistor and 0.33μF capacitor to ground controls how fast the DS output transits to ground. If some of the blanking lines contain digital data, such as TTY, the 10kΩ resistor will slow the response and reject this digital data and noise. We need to insure a smooth transition through the DS comparator's transition point. This can be accomplished by adding about 6.8mV offset to the DS comparator output. Adding a 300kΩ resistor feedback to the DS REF input pin will help prevent jitter from occurring at the DS OUT due to slow changing video transitions through the DS comparator's switching point.

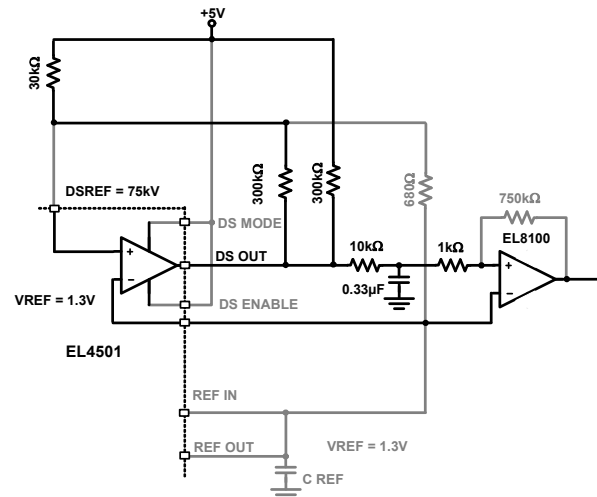


FIGURE 4. HYSTERESIS

The EL8100 is a fast recovery amp (see Figure 4) and can be used as a comparator to detect the level of the DS output filter, the series 10kΩ resistor and 0.33μF capacitor to ground. The filter will have slow rise and fall edges so hysteresis is needed. We add about 10mV offset to DS OUT by adding a 300kΩ resistor feedback to the DS REF pin. The EL8100 has a 750kΩ resistor from the output to the non-inverting input to generate the needed hysteresis. The EL8100 may be set up to give the reversed logic output by reversing the inputs to the 1.3V VREF and filter output. The 1kΩ resistor in series between the non-inverting input and DS OUT allows for hysteresis.

TERMINATION AND DETECTING REFERENCE LEVEL

The incoming video may come from a cable source with standard, double or no termination. This will cause the H_{SYNC} tip to change from 286mV to double or reduce to 2/3. The back porch is always at 0V, so it is the most stable reference point. The back porch pulse is from the sync separator to the DC restore to set the back porch to 1.3V. The 1.3V allows the sync double level of 572mV times an amplifier gain of 2 to have a 1.14V H_{SYNC} tip and 160mV above ground so not to induce clipping. The black level can be 54mV x 2 for no termination and x 2 for amp gain to give 216mV. The video from the amp output is internally connected to the Data Slicer (DS) inverting input. The data slice detector can have the DS Ref set to approximately 250mV. If the EL4501 amp gain is 1, the DS REF can be approximately 145mV. Figure 5 is for an amplifier gain of 1.

Video Detect

The Data Slicer (DS) inverts the video. The output will be high (open drain) with no video. If data is present in the vertical blanking intervals, then the DS output will go low and the filter input resistor value can be set to be fast enough to detect the data or slow enough to reject the data. When the filter is set to be slow, it will take longer to detect video. The large pull-up resistor (300kΩ) on the filter prevents dark video pictures from generating false outputs.

Non-Active Video Delay Time

We need to design the input filter into the EL8100 to be slow enough to delay any detection for a number of non-active video lines. 1.3ms is the time necessary to wait for 20 video lines added to the 1 field time of 16.6ms (the advertisement black field), for a total of 18ms or more. When video is not present (no active video luminance above 75mV) the DS output is open drain. Since the DS OUT becomes an open drain, you can conclude the charge path is basically the sum of two paths; 300k Ω from 5V and the parallel 310k Ω from the approximately 2V node. We can make this simplification because the current through the 30k Ω and 680 Ω resistors is large as compared to the current through the 300k Ω from 5V supply rail. Thus, the node at the junction of 30k Ω and 680 Ω can be viewed as approximately 2V supply regardless of the charge on the capacitor. Also, the EL8100 trip point is at 1.3V or about 1 RC time constant for the 2V charge path. So, the total current to charge the 0.33 μ F capacitor to 1.3V is essentially 22 μ A.

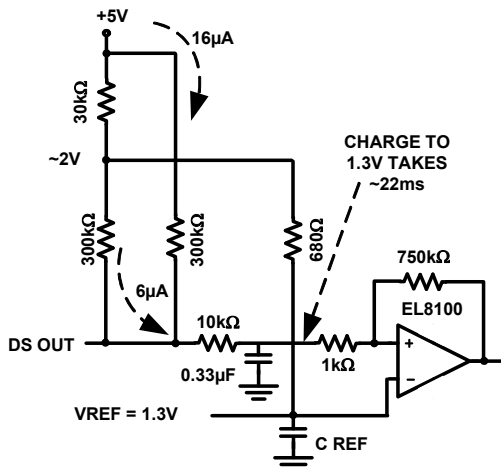


FIGURE 5. NON-VIDEO DELAY CIRCUITRY

A first order approximation of the delay time can be determined from $I = C(dv/dt)$. So the time it takes to charge to 1.3V is about 22ms or the delay time. If video is present, then DS OUT would be at ground, not allowing the RC network to charge. Thus, the output of the EL8100 would be low for active video. This 22ms delay is one field (16.6ms) plus 1.3ms into the second field to ensure we are looking at an active video field and also ignore the black field before and after an advertisement.

We have added a simple video switch (ISL43110 switch) to isolate any loading of the video on the next stage when no active video is present.

VCR/DVD BLUE SCREEN DETECT

The 680 Ω or 1.5k Ω DS REF set resistors would be set to a value to sense blue screen the same as non-video. NTSC Blue luminance is 18.5IRE. By setting the threshold to 150mV (Blue luminance is 132mV), we added 18mV of noise margin. Thus, using a 1.5k Ω in place of the 680 Ω resistor will set the threshold at 150mV. The circuit will now detect blue screen as

non-video. Note: The blue detect level may not detect some dark video pictures as the average voltage level for the active video maybe too low.

TEST PERFORMANCE

The results of testing the actual circuit were:

1. Loss of video to output high for no video was ~25ms
2. New video input to output low for video active was ~3ms

These agree with the design goals.

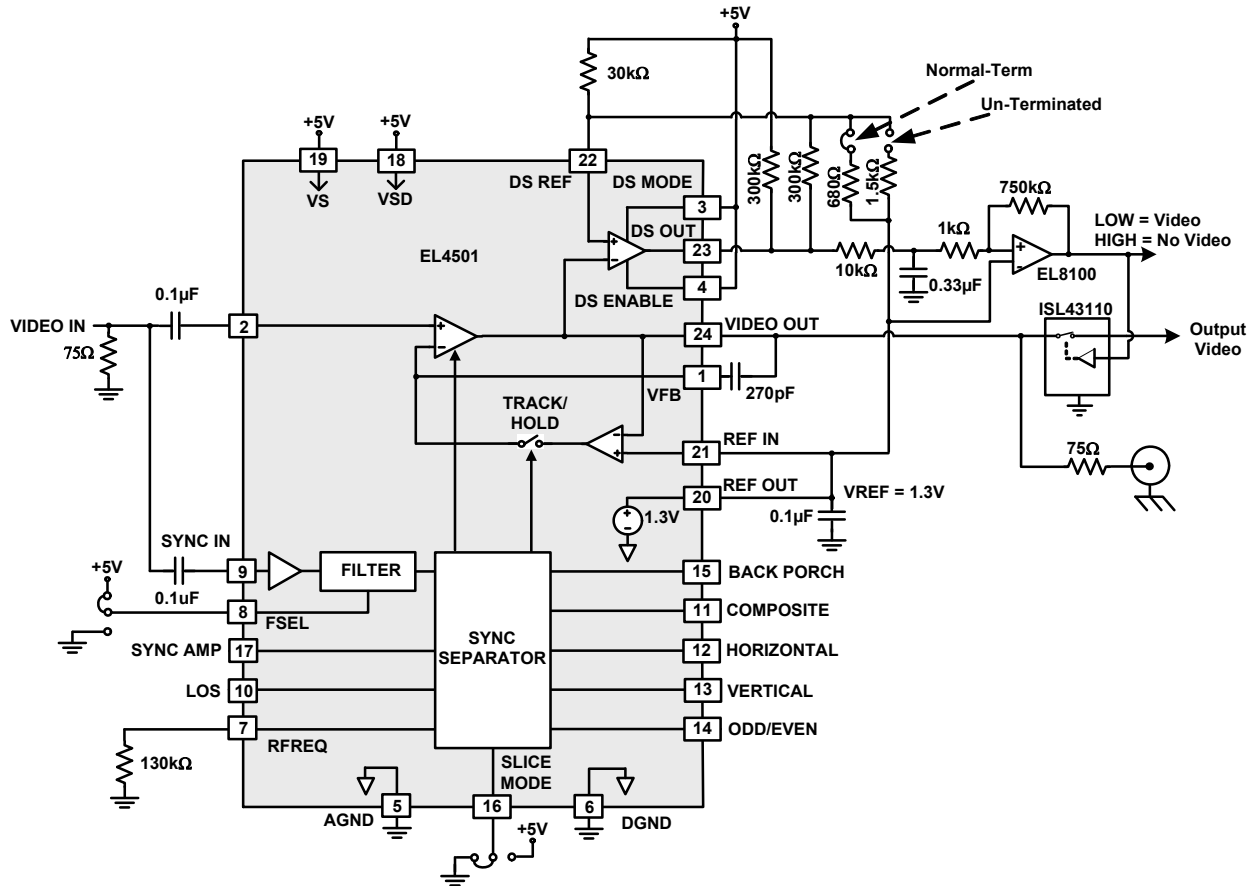


FIGURE 6. COMPLETE SYSTEM DIAGRAM

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