

## RAA278840

LCD Video Processor with Decoder, LVDS, TTL, MIPI, Improved Upscaling Engine, and Video Integrity Diagnostic

The RAA278840 is a highly integrated LCD video processor that incorporates many of the features required to create a cost-effective multipurpose LCD system. The features include a high-quality 2D comb NTSC/PAL/SECAM video decoder that supports single-ended or differential composite video inputs, two TTL digital input interfaces, two LVDS Open LDI input interfaces, a MIPI-CSI2 input interface, and an EEPROM/SPI interface. The outputs include a dual-channel LVDS Open LDI panel interface and a separate MIPI-CSI2. This device can support input resolutions up to 1080p and can drive LCD panels up to 1920x1080. The video processing capabilities include arbitrary H/V scaling using a high-quality scaler and de-interlacer engine, panoramic scaling, image mirroring, image adjustment and enhancement using 10-bit per color processing, black and white stretch, a versatile OSD, and much more. Also, the RAA278840 has a multi-feature image integrity diagnostic capability to dynamically determine if the input video is corrupted. The feature set and versatility of this device make it an ideal solution for automotive LCD applications.

### Applications

- Automotive display
- Industrial/military displays
- Portable/consumer displays

### Related Literature

For a full list of related documents, visit our website:

- [RAA278840](#) device pages

### Features

#### Analog Video Decoder

- Supports NTSC (M, 4.43) and PAL (B, D, G, H, I, M, N, N combination), PAL (60), SECAM with automatic format detection
- High quality adaptive 2D comb filter for both NTSC and PAL inputs
- 10-bit ADC and analog clamping circuit
- Fully programmable static gain or automatic gain control for the CVBS channel
- Programmable white peak control for the CVBS channel
- Four single-ended or two differential CVBS input
- PAL delay line for color phase error correction
- Image enhancement with 2D dynamic peaking/CTI
- Digital subcarrier PLL for accurate color decoding
- Programmable hue, brightness, saturation, contrast, and sharpness
- Digital horizontal PLL and advanced synchronization processing for superior VCR playback and weak signal performance

#### Digital Input Support

- Supports two parallel digital input ports up to 32 bits total, with many combinations such as 24 + 8, 16 + 16
- Supports BT.656, 8-bit and 16-bit BT.601, and BT.1120 video formats
- Supports YCbCr/RGB 24-bit input up to 1080p resolution
- Dual channel LVDS open LDI inputs - up to 150MHz per channel or in Dual mode (75MHz per channel)
- MIPI-CSI2 input
  - One four lane single channel MIPI-CSI2 input port (1Gb/lane)
  - Dual two lane channel MIPI-CSI2 input port (1Gb/lane)
- Supports 1.8 ~ 3.3V logic thresholds

#### TFT Panel Support

- Supports 3, 4, 6, or 8 bits per pixel up to 16.8 million colors with built-in dithering engine

- Supports single channel LVDS panels up to 1920x1080 resolution (150MHz)
- Supports dual channel LVDS up to 1920x1080 resolution (150MHz)

#### **MIPI-CSI2 Output**

- Four lane MIPI-CSI2 output port (1.2Gb/lane)
- Supports YUV422 and 24-bit RGB data formats

#### **Font Based On-Screen Display**

- Four windows font OSD with bordering/shadow
- 13824 bytes programmable font RAM and 1024 characters display RAM
- 1/2/3/4 bits per pixel
- Supports variable width (12/16), height (2~32)

#### **SPI Flash Based On-Screen Display**

- Supports fast register initialization by SPI-DMA
- Nine bitmap-based OSD windows in two layers through SPI with alpha blending between layers
- Supports 4/6/8 bits/pixel
- Supports RLE decompression for two windows
- Shares pins with EEPROM interface

#### **EEPROM Interface**

- EEPROM interface for fast boot register initialization
- Shares pins with SPI Flash memory interface

#### **Image Processing**

- A high quality scaler with both up/down scaling support
- Built-in 2D de-interlacing function
- Supports programmable cropping of input video and graphics
- Independent RGB gain and offset controls
- 10-bit per color processing
- 10-bit image enhancement processing and 10-bit Gamma correction

#### **Clock Generation**

- Spread spectrum PLL integrated to each scaler path
- Programmable modulation frequency and spread width

**Miscellaneous**

- Fast mode plus I<sup>2</sup>C interface up to 1.2Mbps with zero hold time
- Short diagnostics
  - Short to battery
  - Short to ground
- Up to four 10-bit PWMs
- GPIOs
- Programmable drive strength for LVTTTL and LVDS
- Pin swapping (MSB ↔ LSB)
- Two separate input measurement engines with continuous measurement and hardware interrupt capability
- Smooth input switching via shadow registers
- 1.2V internal operation
- 1.8/3.3V I/O support
- Single 27MHz crystal
- 128 Ld LQFP with exposed thermal pad
- The RAA2788403HFP#AA0 is [AEC-Q100](#) qualified

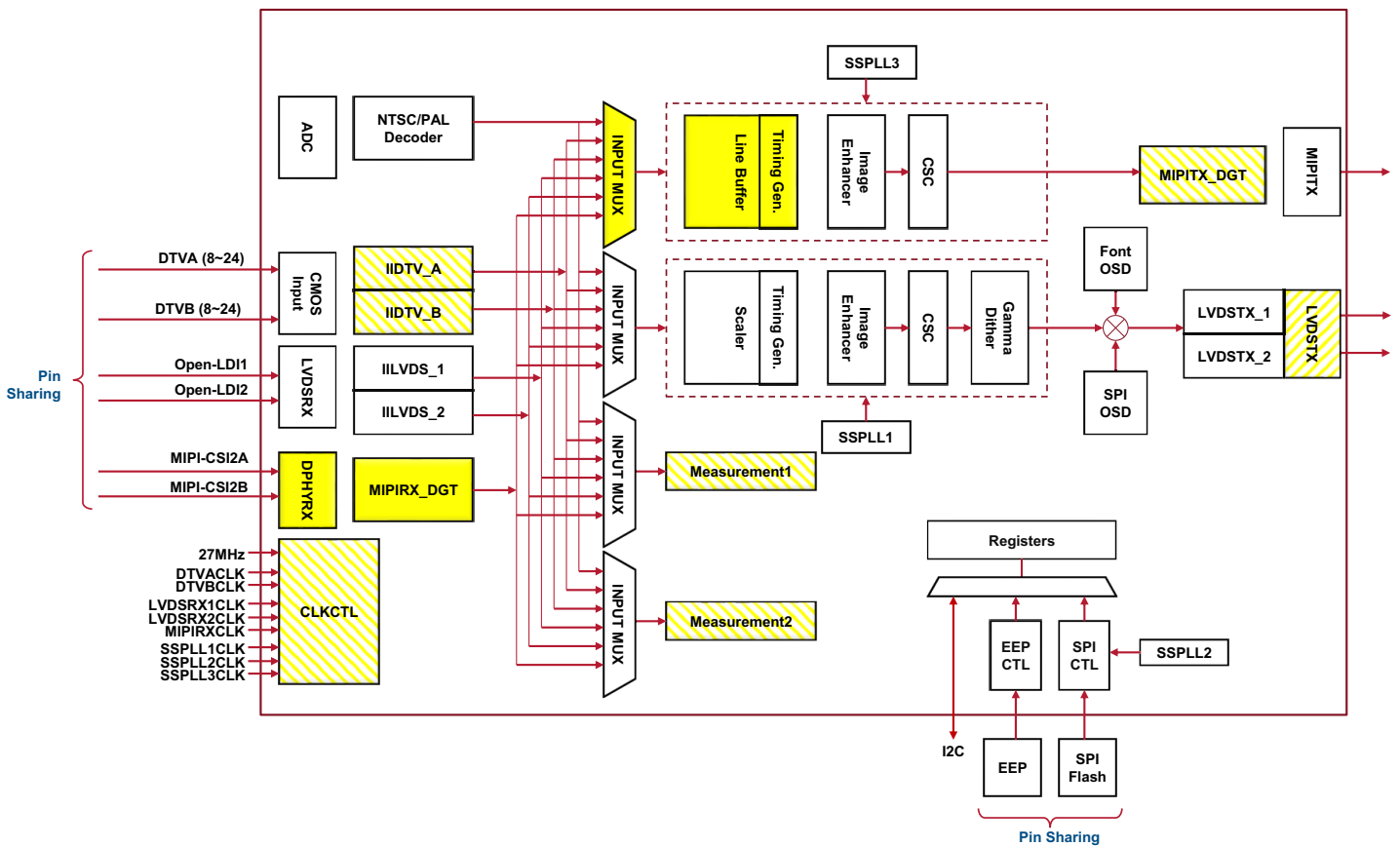


Figure 1. RAA278840 Functional Block Diagram

## 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 be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, 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 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.

7. No semiconductor 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 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.
10. 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.
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.  
(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. 4.0-2 April 2020)

### **Corporate Headquarters**

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://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/](http://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.