RL78

Troubleshooting of the LCD controller/driver

R01AN3996EJ0100
Rev.1.00
2017.11.17

Introduction

In this application note, troubleshooting of the LCD controller/driver installed in the RL78/L1x is explained.

Target Device

RL78/L1x

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Contents

1. Troubleshooting the LCD Controller/Driver

1.1 Nothing at All Displayed on the LCD Panel

When the LCD panel displays nothing at all, check (1) through (3) below.

(1) LCD port function register (PFSEG)

The PFSEG register sets whether pins are to be used as ports (other than segment output) or for segment output. In the initial settings, check that the PFSEG bits corresponding to the segment pins to be used are set to "segment output" (PFSEGxx = 1). When pins are used for segment output, the PUmn bits of the PUm register, the POMmn bits of the POMm register, and the PIMmn bits of the PIMm register must all be set to "0".

LCD Port Function Registers

Symbol	7	6	5	4	3	2	1	0
PFSEGx	PFSEGxx	PFSEGxx	PFSEGxx	PFSEGxx	PFSEGxx	PFSEGxx	PFSEGxx	PFSEGxx

PFSEGxx	Specification of port (other than segment output)/segment output for Pmn pins
0	Used as port (other than segment output)
1	**Used as segment output**

(2) External circuit

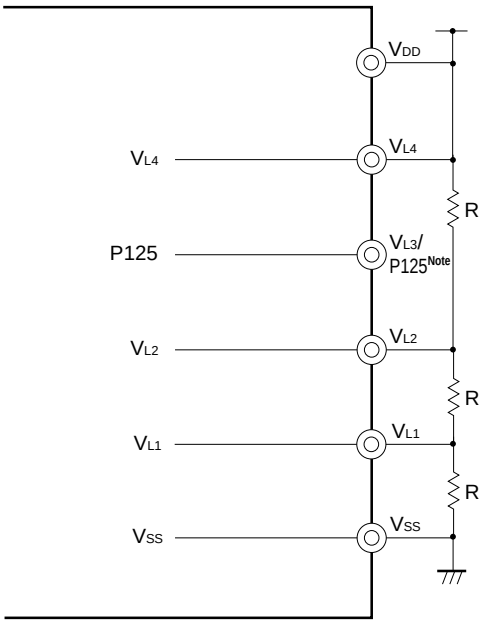
In the LCD controller/driver installed in the RL78, the LCD drive voltage generator can be switched between external resistance division, internal voltage boosting, and capacitor split methods. The external circuit must be modified according to the method used and the bias method for LCD display. The external circuit must be confirmed to be compatible with the method set in LCD mode register 0 (LCDM0). An example of the external circuit is described in the "Supplying LCD Drive Voltages VL1, VL2, VL3, and VL4" section of the user's manual.

LCD mode register 0（LCDM0）(Excerpt)

Symbol	7	6	5	4	3	2	1	0
LCDM0	MDSET1	MDSET0	LWAVE	LDTY2	LDTY1	LDTY0	LBAS1	LBAS0

MDSET1	MDSET0	LCD drive voltage generator selection
0	0	External resistance division method
0	1	Internal voltage boosting method
1	0	Capacitor split method
1	1	Setting prohibited

LBAS1	LBAS0	LCD display bias mode selection
0	0	1/2 bias method
0	1	1/3 bias method
1	0	1/4 bias method
1	1	Setting prohibited



$V_{L4} = V_{DD}$

Figure 1-1 Examples of LCD Drive Power Connections

(External Resistance Division Method, 1/3 bias method)

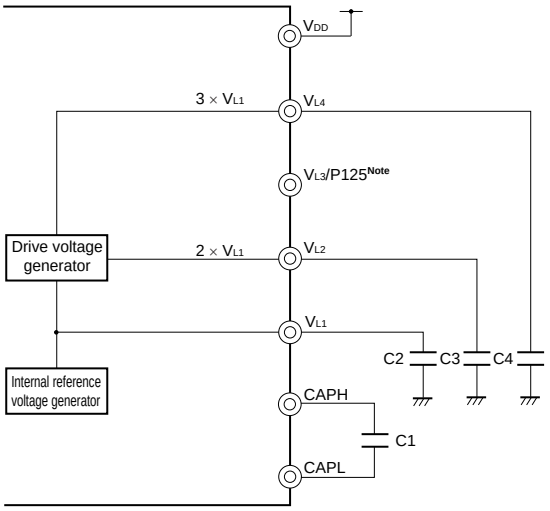


Figure 1-2 Examples of LCD Drive Power Connections

(Internal Voltage Boosting Method, 1/3 bias method)

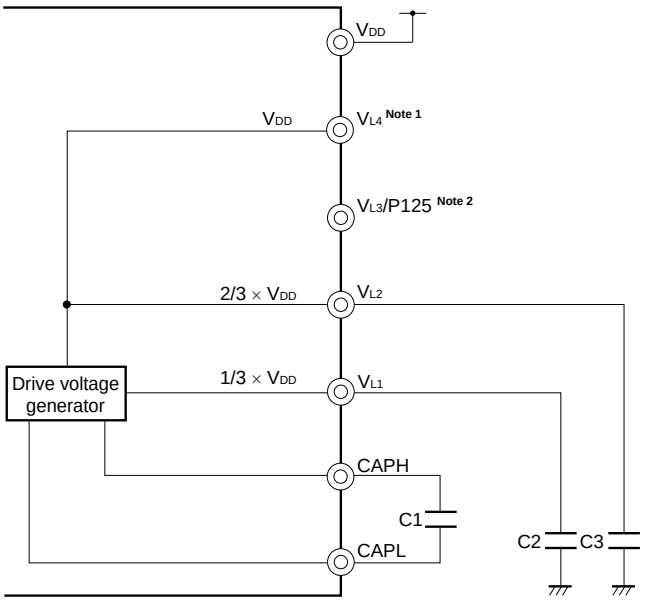


Figure 1-3 Examples of LCD Drive Power Connections
(Capacitor Split Method, 1/3 bias method)

(3) LCD panel

The number of time divisions for LCD display, the bias method, and the frame frequency differ depending on the LCD panel specifications. The LCD controller/driver should be set according to the specifications of the LCD panel to be used. Regarding compatibility of the LCD panel and the LCD controller/driver, refer to the datasheets for each.

1.2 No Display in Specific Places of the LCD Panel

When there is no display in specific places of the LCD panel, check (1) and (2) below.

(1) Check that the LCD port function register (PFSEG) is set correctly.

Refer to the preceding section "1.1, Nothing at All Displayed on the LCD Panel".

(2) COM/SEM pin connections

If the PFSEG register settings are correct, there may be a problem with the COM/SEM pin connections. Check the state of the physical connections on the board. In particular, check the connection of the COM/SEM pin that controls the specific place at which there is no display.

1.3 LCD Panel Display Is Faint

When the LCD panel display is faint, check ① through ③ below.

(1) Check the LCD driving voltages

The LCD driving voltages VL1 to VL4 should be checked to ensure they are being supplied normally. Measure the voltage at each pin, and confirm that they are within the voltage ranges stipulated in the "LCD Characteristics" in the "Electrical Specifications" section of the user's manual.

When a voltage drop is observed in the waveforms of the driving voltages VL1 to VL4, it is possible that the capacitance values of the capacitors connected to the external circuit for driving voltage supply are not appropriate. After evaluations, change the capacitance values.

External capacitance division method: Capacitors connected between the VL1 to VL4 pins and GND for reference voltage stabilization(note 1)

Internal voltage boosting method, capacitor split method: Capacitors connected for drive voltage generator operation (0.47 µF ±30%).

Note 1: The capacitance value given in the user's manual for capacitors connected to an external circuit (0.22 µF) is a reference value. The appropriate value depends on the LCD panel used, the number of segment pins, the number of common pins, the frame frequency, and other parameters of the usage environment. The value should be adjusted and determined after thorough evaluations according to the system characteristics.

(2) COM/SEM pin connections

It is possible that there may be a problem with COM/SEM pin connections. Check the state of physical connections on the board. For example, with the PFSEG register, change one pin set to "used as segment output" at a time to an output port (low-level output or high-level output), and check whether there is any improvement in the LCD panel display.

To change to an output port, set a bit in the port mode register (PMxx) to "output mode (output buffer on)" (PMxx = 0), and in the PFSEG register, change the bit to "used as port (other than segment output)".

(3) Frame frequency

Check whether the frame frequency setting is compatible with the LCD panel specifications.

Further, there are constraints on the combinations of display modes (display waveforms, number of time slices, bias method), driving voltage generation method, and frame frequencies that can be used with the LCD controller/driver installed in the RL78. Refer to "Combinations of Display Waveform, Time Slices, Bias Method, and Frame Frequency" in the user's manual for the RL78 product to be used.

Combinations of Display Waveform, Time Slices, Bias Method, and Frame Frequency(RL78/L13)

Display Mode			Set Value						Driving Voltage Generation Method		
Display Waveform	Number of Time Slices	Bias Mode	LWAVE	LDTY2	LDTY1	LDTY0	LBAS1	LBAS0	External Resistance Division	Internal Voltage Boosting	Capacitor Split
Waveform A	8	1/4	0	1	0	1	1	0	○ (24 to 128 Hz)	○ (24 to 64 Hz)	×
Waveform A	4	1/3	0	0	1	1	0	1	○ (24 to 128 Hz)	○ (24 to 128 Hz)	○ (24 to 128 Hz)
Waveform A	3	1/3	0	0	1	0	0	1	○ (32 to 128 Hz)	○ (32 to 128 Hz)	○ (32 to 128 Hz)
Waveform A	3	1/2	0	0	1	0	0	0	○ (32 to 128 Hz)	×	×
Waveform A	2	1/2	0	0	0	1	0	0	○ (24 to 128 Hz)	×	×
Waveform A	Static		0	0	0	0	0	0	○ (24 to 128 Hz)	×	×
Waveform B	8	1/4	1	1	0	1	1	0	○ (24 to 128 Hz)	○ (24 to 64 Hz)	×
Waveform B	4	1/3	1	0	1	1	0	1	○ (24 to 128 Hz)	○ (24 to 128 Hz)	○ (24 to 128 Hz)

Remark ○: Supported
×: Not supported

(4) Contrast adjustment (case of internal voltage boosting method)

When the internal voltage boosting method is selected, with the LCD boost level control register (VLCD), the contrast can be adjusted in 16 levels. For details, refer to the user's manual for the RL78 product to be used.

Format of LCD Boost Level Control Register (VLCD)(RL78/L13)

Symbol	7	6	5	4	3	2	1	0
VLCD	0	0	0	VLCD4	VLCD3	VLCD2	VLCD1	VLCD0

VLCD4	VLCD3	VLCD2	VLCD1	VLCD0	Reference voltage selection (contrast adjustment)	VL4 Voltage	
						1/3 bias method	1/4 bias method
0	0	1	0	0	1.00 V (default)	3.00 V	4.00 V
0	0	1	0	1	1.05 V	3.15 V	4.20 V
0	0	1	1	0	1.10 V	3.30 V	4.40 V
0	0	1	1	1	1.15 V	3.45 V	4.60 V
0	1	0	0	0	1.20 V	3.60 V	4.80 V
0	1	0	0	1	1.25 V	3.75 V	5.00 V
0	1	0	1	0	1.30 V	3.90 V	5.20 V
0	1	0	1	1	1.35 V	4.05 V	Setting prohibited
0	1	1	0	0	1.40 V	4.20 V	Setting prohibited
0	1	1	0	1	1.45 V	4.35 V	Setting prohibited
0	1	1	1	0	1.50 V	4.50 V	Setting prohibited
0	1	1	1	1	1.55 V	4.65 V	Setting prohibited
1	0	0	0	0	1.60 V	4.80 V	Setting prohibited
1	0	0	0	1	1.65 V	4.95 V	Setting prohibited
1	0	0	1	0	1.70 V	5.10 V	Setting prohibited
1	0	0	1	1	1.75 V	5.25 V	Setting prohibited
Other than above					Setting prohibited		

2. Frequently Asked Questions

Question 1

In the internal voltage boosting method, is there any problem with setting "display on" without waiting for the reference voltage setup time and the voltage boosting wait time,?

Answer 1

Yes, there would be problems. "display on" is set before the LCD driving voltage reaches the voltage setting, and so the LCD panel display would become unstable. Always be sure to wait for the stipulated time.

Question 2

When using the internal voltage boosting method, on setting the LCD boost level control register (VLCD), would it be alright if the VL4 voltage were higher than the power supply voltage of the RL78 product?

Answer 2

No, this would not cause a problem because the LCD driving voltage is generated within the RL78 product, and does not depend on the power supply voltage.

Question 3

Can the LCD driving voltage be supplied externally?

Answer 3

No, the LCD driving voltage for the LCD controller/driver installed in the RL78 cannot be supplied from an external device.
The LCD driving voltage is supplied from an LCD drive voltage generator within the RL78 product.

Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/contact/

Revision History

		Description	
Rev.	Date	Page	Summary
1.00	2017.11.17		First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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 disputes 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, drawing, chart, program, algorithm, 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 otherwise misappropriate 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, copy or otherwise misappropriation of Renesas Electronics products.
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; and 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.

   Renesas Electronics products are neither intended nor 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 damages (space and 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 third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. When using the 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 radiation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions or failure or accident arising out of the use of Renesas Electronics products beyond 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. Further, Renesas Electronics products are not subject to radiation resistance design. Please ensure to implement safety measures to guard them against the possibility of bodily injury, injury or damage caused by fire, and social damage in the event of 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 by your own responsibility as warranty for your products/system. Because the evaluation of microcomputer software alone is very difficult and not practical, please evaluate 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. Please investigate applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive carefully and sufficiently and use 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 not use Renesas Electronics products or technologies for (1) any purpose relating to the development, design, manufacture, use, stockpiling, etc., of weapons of mass destruction, such as nuclear weapons, chemical weapons, or biological weapons, or missiles (including unmanned aerial vehicles (UAVs)) for delivering such weapons, (2) any purpose relating to the development, design, manufacture, or use of conventional weapons, or (3) any other purpose of disturbing international peace and security, and you shall not sell, export, lease, transfer, or release Renesas Electronics products or technologies to any third party whether directly or indirectly with knowledge or reason to know that the third party or any other party will engage in the activities described above. When exporting, selling, transferring, etc., Renesas Electronics products or technologies, you shall comply with any applicable export control laws and regulations promulgated and administered by the governments of the countries asserting jurisdiction over the parties or transactions.
10. Please acknowledge and agree that you shall bear all the losses and damages which are incurred from the misuse or violation of the terms and conditions described in this document, including this notice, and hold Renesas Electronics harmless, if such misuse or violation results from your resale or making Renesas Electronics products available any third party.
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 majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.3.0-1 November 2016)

RENESAS

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.
2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

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: +44-1628-585-100, Fax: +44-1628-585-900

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, P. R. China 200333
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 II Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

© 2017 Renesas Electronics Corporation. All rights reserved.

Colophon 6.0