Driving Color STN Displays with the LH79525

Although the LH79525 MCU only supports 4-bit monochrome STN LCD panels and color TFT, a workaround is available that allows interfacing to color STN panels. This workaround provides a way to drive color STN panels from the LH79525 with minimal performance impact and straightforward hardware connection.

STN CAPABILITY ON THE LH79525

The LH79525 was designed primarily for low-cost applications. As such, color LCD support is limited to TFT panels. When using STN panels, full support exists for 4-bit monochrome only.

However, it is possible to drive color displays with the LH79525 if a bit of performance loss is acceptable in the application.

Hardware Connection

The basic issue is that all eight color STN bits are not available on the external pins; bits 2, 3, 4, and 5 are not available. However, these bits *are* available on the upper panel interface when in dual-panel mode.

Therefore, if bits 0, 1, 6, and 7 are taken from the Lower Panel interface, and bits 2, 3, 4, and 5 are taken from the Upper Panel interface, all 8 color STN bits are then available. It is a simple process to use the same frame buffer for both Upper and Lower interfaces, thus providing the full eight bits of color STN data. The downside to this method is that twice the number of fetches are required since four bits are fetched from the Lower Panel frame buffer, and the other four are subsequently fetched from the Upper Panel frame buffer (even though they are physically identical).

Table 1 shows the connection between the LH79525 and an 8-bit color STN panel. Some explanation is appropriate to clarify the mapping in the table.

The first two colums show the LH79525 pin number and pin name. These are unchanged. The third column shows the mapping of the pin to the Lower (C**L**STN) or Upper (C**U**STN) panel for a normal dual-panel application. For example, pin 147 normally maps to Lower Panel, Data 7 pin on the lower STN panel; pin 158 normally maps to Upper Panel, Data 3 connection on the upper STN panel. The third column shows the mapping used for this workaround.

Thus, the first and last columns show the pin on the LH79525 to match with the particular data connection on the (single) STN panel.

Table 1. Color STN Panel Connection

PIN NO.	PIN NAME	DUAL-PANEL COLOR STN MAPPING	COLOR STN PANEL CONNECTION
147	LCDVD[9]	CLSTN[7]	DATA 7
149	LCDVD[8]	CLSTN[6]	DATA 6
154	LCDVD[5]	CLSTN[1]	DATA 1
155	LCDVD[4]	CLSTN[0]	DATA 0
156	LCDVD[3]	CUSTN[5]	DATA 5
157	LCDVD[2]	CUSTN[4]	DATA 4
158	LCDVD[1]	CUSTN[3]	DATA 3
159	LCDVD[0]	CUSTN[2]	DATA 2

Programming Requirements

Once the hardware is properly connected, the programming is quite simple. The LH79525's Color LCD Controller (CLCDC) is programmed for Dual Panel Color STN Mode.

- First, program the CTRL Register.
  - Program bit 7 (DUAL) to 1, selecting Dual Panel
  - Program bit 6 (MONO8L) to 0, selecting 'all other types of displays'
  - Program bit 5 (TFT) to 0, selecting STN
  - Program bit 4 (BW) to 0, selecting Color
  - Program field 3:1 (BPP) to 0b011 for 8-BPP
- Next, program the Frame Buffer pointers, LPBASE and UPBASE. Since one frame buffer is used, program *both* registers to the same address value.
- Follow the User's Guide instructions for interfacing to 8-bit, single-panel color STN for all other programming, palette usage, and power sequencing.

CONCLUSION

Although the LH79525 is not specified to drive color STN displays, use of this workaround makes this possible with an acceptable compromise in performance.

ANNEX A: Disclaimers (11)

1. t001dis100.fm: General (DS, AN, UM, errata)

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

2. t001dis101.fm: Right to make changes (DS, AN, UM, errata)

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

3. t001dis102.fm: Suitability for use (DS, AN, UM, errata)

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of a NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

4. t001dis103.fm: Applications (DS, AN, UM, errata)

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

5. t001dis104.fm: Limiting values (DS)

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

6. t001dis105.fm: Terms and conditions of sale (DS)

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

7. t001dis106.fm: No offer to sell or license (DS)

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

8. t001dis107.fm: Hazardous voltage (DS, AN, UM, errata; if applicable)

Hazardous voltage — Although basic supply voltages of the product may be much lower, circuit voltages up to 60 V may appear when operating this product, depending on settings and application. Customers incorporating or otherwise using these products in applications where such high voltages may appear during operation, assembly, test etc. of such application, do so at their own risk. Customers agree to fully indemnify NXP Semiconductors for any damages resulting from or in connection with such high voltages. Furthermore, customers are drawn to safety standards (IEC 950, EN 60 950, CENELEC, ISO, etc.) and other (legal) requirements applying to such high voltages.

9. t001dis108.2.fm: Bare die (DS; if applicable)

Bare die (if applicable) — Products indicated as Bare Die are subject to separate specifications and are not tested in accordance with standard testing procedures. Product warranties and guarantees as stated in this document are not applicable to Bare Die Products unless such warranties and guarantees are explicitly stated in a valid separate agreement entered into by NXP Semiconductors and customer.

10. t001dis109.fm: AEC unqualified products (DS, AN, UM, errata; if applicable)

AEC unqualified products — This product has not been qualified to the appropriate Automotive Electronics Council (AEC) standard Q100 or Q101 and should not be used in automotive critical applications, including but not limited to applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is for the customer’s own risk.

11. t001dis110.fm: Suitability for use in automotive applications only (DS, AN, UM, errata; if applicable)

Suitability for use in automotive applications only — This NXP Semiconductors product has been developed for use in automotive applications only. The product is not designed, authorized or warranted to be suitable for any other use, including medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer’s own risk.