

# LH79524/LH79525 (A.1)

## System-on-Chip

### Product data sheet

#### FEATURES

- Highly Integrated System-on-Chip
- High Performance: 76.205 MHz CPU Speed, 50.803 MHz maximum AHB clock (HCLK)
- 32-bit ARM720T™ RISC Core
  - LH79524: 32-bit External Data Bus
    - 208 LFBGA package
  - LH79525: 16-bit External Data Bus
    - 176 LQFP package
- 8 kB Cache with Write Back Buffer
- MMU (Windows CE™ Enabled)
- 16 kB On-Chip SRAM
- Flexible, Programmable Memory Interface
  - SDRAM Interface
    - 512 MB External Address Space
    - 32-bit External Data Bus (LH79524)
    - 16-bit External Data Bus (LH79525)
  - SRAM/Flash/ROM Interface
    - 15-bit External Address Bus
    - 32-bit External Data Bus (LH79524)
    - 16-bit External Data Bus (LH79525)
- Multi-stream DMA Controller
  - Four 32-bit Burst-Based Data Streams
- Clock and Power Management
  - 32.768 kHz Oscillator for Real Time Clock
  - 10 MHz to 20 MHz Oscillator and On-chip PLL
  - Active, Standby, Sleep, Stop1, and Stop2 Modes
  - Externally-supplied Clock Options
- On-Chip Boot ROM
  - Allows Booting from 8-, 16-, or 32-bit Devices
  - NAND Flash Boot
- Low Power Modes
  - Active Mode: 85 mA (MAX.)
  - Standby Mode: 50 mA (MAX.)
  - Sleep Mode: 3.8 mA (TYP.)
  - Stop Mode 1: 420 µA (TYP.)
  - Stop Mode 2: 25 µA (TYP.)
- USB Device
  - Compliant with USB 2.0 Specifications (Full Speed)
  - Four Endpoints
- Ethernet MAC, with MII and MDIO Interfaces
  - IEEE 802.3 Compliant
  - 10 and 100 Mbit/s Operation
- Analog-to-Digital Converter/Brownout Detector
  - 10-bit ADC
  - Pen Sense Interrupt
  - Integrated Touch Screen Controller (TSC)
- I<sup>2</sup>C Module
- Integrated Codec Interface Support Features (I<sup>2</sup>S)
- Watchdog Timer
- Vectored Interrupt Controller
  - 16 Standard and 16 Vectored IRQ Interrupts
  - Interrupts Individually Configurable as IRQ or FIQ
- Three UARTs
  - 16-entry FIFOs for Rx and Tx
  - IrDA SIR Support on all UARTs
- Three 16-bit Timers with PWM capability
- Real Time Clock
  - 32-bit Up-counter with Programmable Load
  - Programmable 32-bit Match Compare Register
- Programmable General Purpose I/O Signals
  - LH79524: 108 available pins on 14 ports
  - LH79525: 86 available pins on 12 ports
- Programmable Color LCD Controller
  - 16 (LH79524) or 12 (LH79525) Bits-per-Pixel
  - Up to 800 × 600 resolution
  - STN, Color STN, HR-TFT, AD-TFT, TFT
  - TFT: Supports 64 k (LH79524) or 4 k (LH79525) Direct Colors or 256 colors selected from a Palette of 64 k Colors; 15 Shades of Gray
  - Color STN: Supports 3,375 Direct Colors or 256 Colors Selected from a Palette of 3,375 Colors
- Synchronous Serial Port
  - Supports Data Rates Up to 1.8452 Mbit/s
  - Compatible with Common Interface Schemes
- JTAG Debug Interface and Boundary Scan
- 5 V Tolerant Digital Inputs (excludes oscillator pins)
  - XTALIN and XTAL32IN pins are 1.8 V ± 10%
- On-Chip regulator allows single 3.3 V supply

#### DESCRIPTION

The LH79524/LH79525, powered by an ARM720T, is a complete System-on-Chip with a high level of integration to satisfy a wide range of requirements and applications. The SoC has a fully static design, power management unit, and low voltage operation (1.8 V Core, 3.3 V I/O). With the on-chip voltage regulator, a single 3.3 V supply can be used as well. Robust peripherals and a low-power RISC core provide high performance at a reasonable price.

**ORDERING INFORMATION****Table 1. Ordering information**

| Type number     | Package  |                                                                         | Version   |
|-----------------|----------|-------------------------------------------------------------------------|-----------|
|                 | Name     | Description                                                             |           |
| LH79524N0F100A0 | LFBGA208 | plastic low profile fine-pitch ball grid array package; 208 balls       | SOT1019-1 |
| LH79524N0F100A1 | LFBGA208 | plastic low profile fine-pitch ball grid array package; 208 balls       | SOT1019-1 |
| LH79525N0Q100A0 | LQFP176  | plastic low profile quad flat package; 176 leads; body 20 x 20 x 1.4 mm | SOT1017-1 |
| LH79525N0Q100A1 | LQFP176  | plastic low profile quad flat package; 176 leads; body 20 x 20 x 1.4 mm | SOT1017-1 |

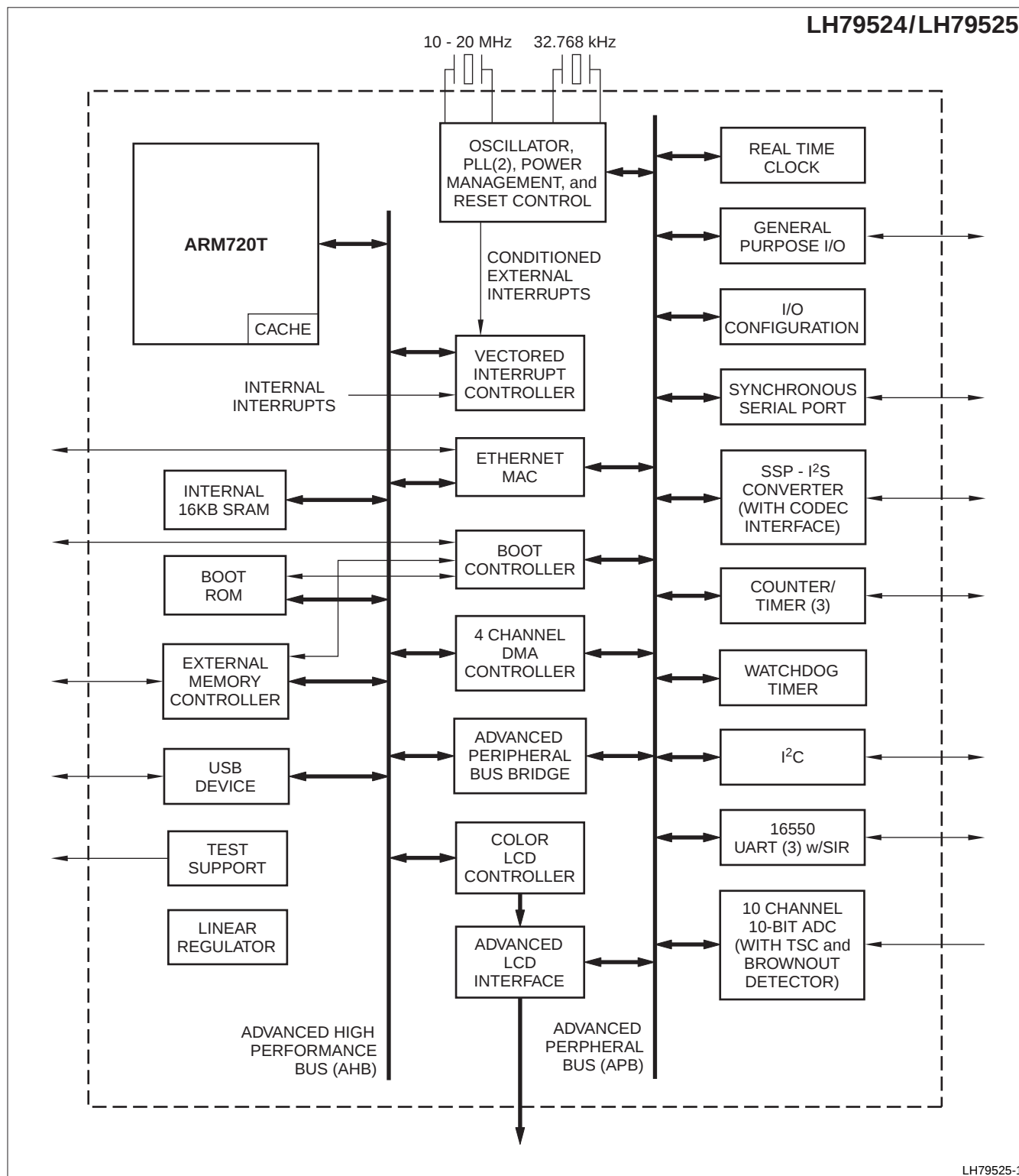


Figure 1. LH79524/LH79525 block diagram

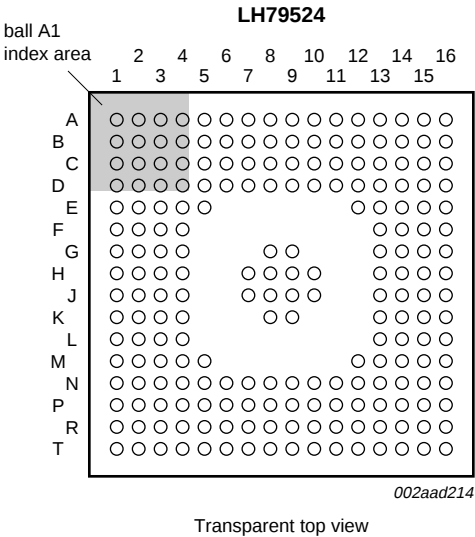


Figure 2. LH79524 pin configuration (LFBGA208)

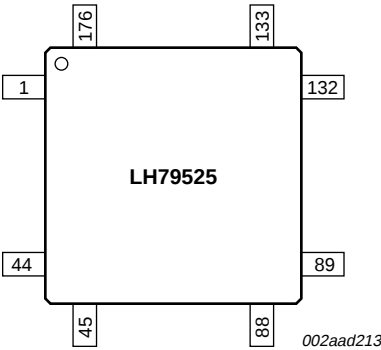


Figure 3. LH79525 pin configuration (LQFP176)

## SIGNAL DESCRIPTIONS

Table 2. LH79524 Pin Descriptions

| LFBGA PIN | SIGNAL NAME | TYPE | DESCRIPTION                                                                                         |
|-----------|-------------|------|-----------------------------------------------------------------------------------------------------|
| T12       | A0          | O    | External Address Bus                                                                                |
| R11       | A1          |      |                                                                                                     |
| T11       | A2          |      |                                                                                                     |
| P10       | A3          |      |                                                                                                     |
| R10       | A4          |      |                                                                                                     |
| T10       | A5          |      |                                                                                                     |
| P9        | A6          |      |                                                                                                     |
| R9        | A7          |      |                                                                                                     |
| T9        | A8          |      |                                                                                                     |
| T8        | A9          |      |                                                                                                     |
| R8        | A10         |      |                                                                                                     |
| P8        | A11         |      |                                                                                                     |
| T7        | A12         |      |                                                                                                     |
| R7        | A13         |      |                                                                                                     |
| P7        | A14         |      |                                                                                                     |
| T6        | A15         |      |                                                                                                     |
| M15       | D0          | I/O  | External Data Bus                                                                                   |
| N16       | D1          |      |                                                                                                     |
| L13       | D2          |      |                                                                                                     |
| M14       | D3          |      |                                                                                                     |
| N15       | D4          |      |                                                                                                     |
| P16       | D5          |      |                                                                                                     |
| M13       | D6          |      |                                                                                                     |
| N14       | D7          |      |                                                                                                     |
| F14       | SDCLK       | O    | SDRAM Clock                                                                                         |
| G15       | SDCKE       | O    | SDRAM Clock Enable                                                                                  |
| D13       | DQM0        | O    | Data Mask Output to SDRAMs                                                                          |
| E13       | DQM1        |      |                                                                                                     |
| E14       | DQM2        |      |                                                                                                     |
| G14       | DQM3        |      |                                                                                                     |
| G16       | nDCS0       | O    | SDRAM Chip Select                                                                                   |
| H14       | nDCS1       | O    | SDRAM Chip Select                                                                                   |
| H15       | nRAS        | O    | Row Address Strobe                                                                                  |
| H16       | nCAS        | O    | Column Address Strobe                                                                               |
| L16       | nCS0/PM0    | O    | Static Memory Chip Select; multiplexed with GPIO Port M[3:0] (output only)                          |
| L15       | nCS1/PM1    |      |                                                                                                     |
| M16       | nCS2/PM2    |      |                                                                                                     |
| L14       | nCS3/PM3    |      |                                                                                                     |
| J15       | nBLE0/PM4   | O    | Static Memory Byte Lane Enable / Byte Write Enable; multiplexed with GPIO Port M[7:4] (output only) |
| J14       | nBLE1/PM5   |      |                                                                                                     |
| K16       | nBLE2/PM6   |      |                                                                                                     |
| K15       | nBLE3/PM7   |      |                                                                                                     |

Table 2. LH79524 Pin Descriptions (Cont'd)

| LFBGA PIN | SIGNAL NAME                                | TYPE | DESCRIPTION                                                                                                                                                       |
|-----------|--------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| K14       | nOE                                        | O    | Static Memory Output Enable                                                                                                                                       |
| J16       | nWE                                        | O    | Static Memory Write Enable                                                                                                                                        |
| A16       | USBDN                                      | I/O  | USB Data Negative (Differential Pair output, single ended and Differential pair input)                                                                            |
| A15       | USBDP                                      | I/O  | USB Data Positive (Differential Pair output, single ended and Differential pair input)                                                                            |
| E2        | AN0/UL/X+                                  | I    | ADC Input 0, 4-wire touch screen Upper Left, 5-wire touch screen X+                                                                                               |
| F2        | AN1/UR/X-                                  | I    | ADC Input 1, 4-wire touch screen Upper Right, 5-wire touch screen X-                                                                                              |
| G2        | AN2/LL/Y+/PJ3                              | I    | ADC Input 2, 4-wire touch screen Lower Left, 5-wire touch screen Y+; multiplexed with GPIO Port J3 (input only)                                                   |
| H2        | AN3/LR/Y-/PJ0                              | I    | ADC Input 3, 4-wire touch screen Upper Right, 5-wire touch screen Y-; multiplexed with GPIO Port J0 (input only)                                                  |
| H3        | AN4/WIPER/PJ1                              | I    | ADC Input 4, 5-wire touch screen Wiper input; multiplexed with GPIO Port J1 (input only)                                                                          |
| F1        | AN5/PJ5/INT5                               | I    | ADC Input 5; multiplexed with GPIO Port J5 (input only) and External Interrupt 5                                                                                  |
| F3        | AN6/PJ7/INT7                               | I    | ADC Input 6; multiplexed with GPIO Port J7 (input only) and External Interrupt 7                                                                                  |
| E1        | AN7/PJ6/INT6                               | I    | ADC Input 7; multiplexed with GPIO Port J6 (input only) and External Interrupt 6                                                                                  |
| G3        | AN8/PJ4                                    | I    | ADC Input 8; multiplexed with GPIO Port J4 (input only)                                                                                                           |
| G1        | AN9/PJ2                                    | I    | ADC Input 9; multiplexed with GPIO Port J2 (input only)                                                                                                           |
| J3        | CTCLK/INT4/BATCNTL                         | I/O  | Timer[2:0] External Clock input; muxed with External Int 4 and Battery Control                                                                                    |
| N1        | PA0/INT2/UARTRX2/<br>UARTIRRX2             | I/O  | General Purpose I/O Signal — Port A0; multiplexed with UART2 Received Serial Data Input, UART2 Infrared Received Serial Data In, and External Interrupt 2         |
| M2        | PA1/INT3/UARTTX2/<br>UARTIRTX2             | I/O  | General Purpose I/O Signal — Port A1; multiplexed with UART2 Transmitted Serial Data Output, UART2 Serial Transmit Data Out, and External Interrupt 3             |
| L3        | PA2/CTCAP0A/<br>CTCMP0A                    | I/O  | General Purpose I/O Signal — Port A2; multiplexed with Counter/Timer 0 Capture A input and Counter/Timer 0 Compare A output                                       |
| M1        | PA3/CTCAP0B/<br>CTCMP0B                    | I/O  | General Purpose I/O Signal — Port A3; multiplexed with Counter/Timer 0 Capture B input and Counter/Timer 0 Compare B output                                       |
| L2        | PA4/CTCAP1A/<br>CTCMP1A                    | I/O  | General Purpose I/O Signal — Port A4; multiplexed with Counter/Timer 1 Capture A input and Counter/Timer 1 Compare A output                                       |
| L1        | PA5/CTCAP1B/<br>CTCMP1B                    | I/O  | General Purpose I/O Signal — Port A5; multiplexed with Counter/Timer 1 Capture B input and Counter/Timer 1 Compare B output                                       |
| K3        | PA6/CTCAP2A/<br>CTCMP2A/SDA                | I/O  | General Purpose I/O Signal — Port A6; multiplexed with Counter/Timer 2 Capture A input, Counter/Timer 2 Compare A output, I <sup>2</sup> C Bus Data (open drain)  |
| K2        | PA7/CTCAP2B/<br>CTCMP2B/SCL                | I/O  | General Purpose I/O Signal — Port A7; multiplexed with Counter/Timer 2 Capture B input, Counter/Timer 2 Compare B output, I <sup>2</sup> C Bus Clock (open drain) |
| R2        | PB0/nDACK/<br>nUARTCTS0                    | I/O  | General Purpose I/O Signal — Port B0; multiplexed with DMA Acknowledge and UART0 CTS                                                                              |
| R1        | PB1/DREQ/<br>nUARTRTS0                     | I/O  | General Purpose I/O Signal — Port B1; multiplexed with DMA Request and UART0 RTS                                                                                  |
| P2        | PB2/SSPFRM/I2SWS                           | I/O  | General Purpose I/O Signal — Port B2; multiplexed with SSP Serial Frame Output and I <sup>2</sup> S Frame Output                                                  |
| N3        | PB3/SSPCLK/I2SCLK                          | I/O  | General Purpose I/O Signal — Port B3; multiplexed with SSP Clock and I <sup>2</sup> S Clock                                                                       |
| M4        | PB4/SSPRX/I2SRXD/<br>UARTRX1/<br>UARTIRRX1 | I/O  | General Purpose I/O Signal — Port B4; multiplexed with SSP Data In, I <sup>2</sup> S Data In, UART1 Serial Data In, and UART1 Infrared Data In                    |
| P1        | PB5/SSPTX/I2STXD/<br>UARTTX1/UARTIRTX1     | I/O  | General Purpose I/O Signal — Port B5; multiplexed with SSP Data Out, I <sup>2</sup> S Data Out, UART1 Data Out, and UART1 IR Data Out                             |
| N2        | PB6/INT0/UARTRX0/<br>UARTIRRX0             | I/O  | General Purpose I/O Signal — Port B6; multiplexed with UART0 Infrared Received Serial Data Input, UART0 Received Serial Data In, and External Interrupt 0         |

Table 2. LH79524 Pin Descriptions (Cont'd)

| LFBGA PIN | SIGNAL NAME                    | TYPE | DESCRIPTION                                                                                                                                                     |
|-----------|--------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| M3        | PB7/INT1/UARTTX0/<br>UARTIRTX0 | I/O  | General Purpose I/O Signal — Port B7; multiplexed with UART0 Infrared Transmitted Serial Data Output, UART0 Serial Transmit Data Out, and External Interrupt 1. |
| N7        | PC0/A16                        | I/O  | General Purpose I/O Signal — Port C0; multiplexed with Address A16                                                                                              |
| R6        | PC1/A17                        | I/O  | General Purpose I/O Signal — Port C1; multiplexed with Address A17                                                                                              |
| T5        | PC2/A18                        | I/O  | General Purpose I/O Signal — Port C2; multiplexed with Address A18                                                                                              |
| P6        | PC3/A19                        | I/O  | General Purpose I/O Signal — Port C3; multiplexed with Address A19                                                                                              |
| R5        | PC4/A20                        | I/O  | General Purpose I/O Signal — Port C4; multiplexed with Address A20                                                                                              |
| T4        | PC5/A21                        | I/O  | General Purpose I/O Signal — Port C5; multiplexed with Address A21                                                                                              |
| P5        | PC6/A22/nFWE                   | I/O  | General Purpose I/O Signal — Port C6; multiplexed with Address A22 and NAND Flash Write Enable                                                                  |
| R4        | PC7/A23/nFRE                   | I/O  | General Purpose I/O Signal — Port C7; multiplexed with Address A23 and NAND Flash Read Enable                                                                   |
| P15       | PD0/D8                         | I/O  | General Purpose I/O Signal — Port D0; multiplexed with Data D8                                                                                                  |
| P14       | PD1/D9                         | I/O  | General Purpose I/O Signal — Port D1; multiplexed with Data D9                                                                                                  |
| N13       | PD2/D10                        | I/O  | General Purpose I/O Signal — Port D2; multiplexed with Data D10                                                                                                 |
| T15       | PD3/D11                        | I/O  | General Purpose I/O Signal — Port D3; multiplexed with Data D11                                                                                                 |
| N12       | PD4/D12                        | I/O  | General Purpose I/O Signal — Port D4; multiplexed with Data D12                                                                                                 |
| T14       | PD5/D13                        | I/O  | General Purpose I/O Signal — Port D5; multiplexed with Data D13                                                                                                 |
| P12       | PD6/D14                        | I/O  | General Purpose I/O Signal — Port D6; multiplexed with Data D14                                                                                                 |
| T13       | PD7/D15                        | I/O  | General Purpose I/O Signal — Port D7; multiplexed with Data D15                                                                                                 |
| B12       | PE0/LCDLP/<br>LCDHRLP          | I/O  | General Purpose I/O Signals — Port E0; multiplexed with LCD Line Pulse and AD-TFT/HR-TFT Line Pulse                                                             |
| D11       | PE1/LCDDCLK                    | I/O  | General Purpose I/O Signals — Port E1; multiplexed with LCD Data Clock                                                                                          |
| B13       | PE2/LCDPS                      | I/O  | General Purpose I/O Signals — Port E2; multiplexed with LCD Power Save                                                                                          |
| C13       | PE3/LCDCLS                     | I/O  | General Purpose I/O Signals — Port E3; multiplexed with LCD Row Driver Clock                                                                                    |
| D12       | PE4/LCDDSPLEN/<br>LCDREV       | I/O  | General Purpose I/O Signals — Port E4; multiplexed with LCD Panel Power Enable and LCD Reverse                                                                  |
| B16       | PE5/LCDVDDEN                   | I/O  | General Purpose I/O Signals — Port E5; multiplexed with LCD VDD Enable                                                                                          |
| B15       | PE6/LCDVEEN/<br>LCDMOD         | I/O  | General Purpose I/O Signals — Port E6; multiplexed with LCD Analog Power Enable and MOD                                                                         |
| D14       | PE7/nWAIT/nDEOT                | I/O  | General Purpose I/O Signals — Port E7; multiplexed with nWAIT and DMA End of Transfer                                                                           |
| A8        | PF0/LCDVD6                     | I/O  | General Purpose I/O Signals — Port F0; multiplexed with LCD Video Data bit 6                                                                                    |
| A9        | PF1/LCDVD7                     | I/O  | General Purpose I/O Signals — Port F1; multiplexed with LCD Video Data bit 7                                                                                    |
| B9        | PF2/LCDVD8                     | I/O  | General Purpose I/O Signals — Port F2; multiplexed with LCD Video Data bit 8                                                                                    |
| C9        | PF3/LCDVD9                     | I/O  | General Purpose I/O Signals — Port F3; multiplexed with LCD Video Data bit 9                                                                                    |
| B10       | PF4/LCDVD10                    | I/O  | General Purpose I/O Signals — Port F4; multiplexed with LCD Video Data bit 10                                                                                   |
| A11       | PF5/LCDVD11                    | I/O  | General Purpose I/O Signals — Port F5; multiplexed with LCD Video Data bit 11                                                                                   |
| B11       | PF6/LCDEN/LCDSPL               | I/O  | General Purpose I/O Signals — Port F6; multiplexed with LCD Start Pulse Left                                                                                    |
| A12       | PF7/LCDFP/LCDSPS               | I/O  | General Purpose I/O Signals — Port F7; multiplexed with LCD Row Driver Counter reset                                                                            |
| A5        | PG0/ETHERTXEN                  | I/O  | General Purpose I/O Signals — Port G0; multiplexed with Ethernet TX Enable                                                                                      |
| B6        | PG1/ETHERTXCLK                 | I/O  | General Purpose I/O Signals — Port G1; multiplexed with Ethernet TX Clock                                                                                       |
| A6        | PG2/LCDVD0                     | I/O  | General Purpose I/O Signals — Port G2; multiplexed with LCD Video Data bit 0                                                                                    |
| C7        | PG3/LCDVD1                     | I/O  | General Purpose I/O Signals — Port G3; multiplexed with LCD Video Data bit 1                                                                                    |
| B7        | PG4/LCDVD2                     | I/O  | General Purpose I/O Signals — Port G4; multiplexed with LCD Video Data bit 2                                                                                    |

Table 2. LH79524 Pin Descriptions (Cont'd)

| LFBGA PIN | SIGNAL NAME    | TYPE | DESCRIPTION                                                                            |
|-----------|----------------|------|----------------------------------------------------------------------------------------|
| A7        | PG5/LCDVD3     | I/O  | General Purpose I/O Signals — Port G5; multiplexed with LCD Video Data bit 3           |
| C8        | PG6/LCDVD4     | I/O  | General Purpose I/O Signals — Port G6; multiplexed with LCD Video Data bit 4           |
| B8        | PG7/LCDVD5     | I/O  | General Purpose I/O Signals — Port G7; multiplexed with LCD Video Data bit 5           |
| C4        | PH0/ETHERRX3   | I/O  | General Purpose I/O Signals — Port H0; multiplexed with Ethernet Receive Channel 3     |
| A3        | PH1/ETHERRXDV  | I/O  | General Purpose I/O Signals — Port H1; multiplexed with Ethernet Data Valid            |
| B4        | PH2/ETHERRXCLK | I/O  | General Purpose I/O Signals — Port H2; multiplexed with Ethernet Receive Clock         |
| C5        | PH3/ETHERTXER  | I/O  | General Purpose I/O Signals — Port H3; multiplexed with Ethernet Transmit Error        |
| D6        | PH4/ETHERTX0   | I/O  | General Purpose I/O Signals — Port H4; multiplexed with Ethernet Transmit Channel 0    |
| A4        | PH5/ETHERTX1   | I/O  | General Purpose I/O Signals — Port H5; multiplexed with Ethernet Transmit Channel 1    |
| B5        | PH6/ETHERTX2   | I/O  | General Purpose I/O Signals — Port H6; multiplexed with Ethernet Transmit Channel 2    |
| C6        | PH7/ETHERTX3   | I/O  | General Purpose I/O Signals — Port H7; multiplexed with Ethernet Transmit Channel 3    |
| D3        | PI0/ETHERMDC   | I/O  | General Purpose I/O Signals — Port I0; multiplexed with Ethernet Management Data Clock |
| B1        | PI1/ETHERMDIO  | I/O  | General Purpose I/O Signals — Port I1; multiplexed with Ethernet Management Data I/O   |
| B2        | PI2/ETHERCOL   | I/O  | General Purpose I/O Signals — Port I2; multiplexed with Ethernet Collision Detect      |
| D4        | PI3/ETHERCRS   | I/O  | General Purpose I/O Signals — Port I3; multiplexed with Ethernet Carrier Sense         |
| C3        | PI4/ETHERRXER  | I/O  | General Purpose I/O Signals — Port I4; multiplexed with Ethernet Receive Error         |
| A1        | PI5/ETHERRX0   | I/O  | General Purpose I/O Signals — Port I5; multiplexed with Ethernet Receive Channel 0     |
| A2        | PI6/ETHERRX1   | I/O  | General Purpose I/O Signals — Port I6; multiplexed with Ethernet Receive Channel 1     |
| B3        | PI7/ETHERRX2   | I/O  | General Purpose I/O Signals — Port I7; multiplexed with Ethernet Receive Channel 2     |
| R16       | PK0/D16        | I/O  | General Purpose I/O Signals — Port K0; multiplexed with data bit D16                   |
| M12       | PK1/D17        | I/O  | General Purpose I/O Signals — Port K1; multiplexed with data bit D17                   |
| T16       | PK2/D18        | I/O  | General Purpose I/O Signals — Port K2; multiplexed with data bit D18                   |
| R15       | PK3/D19        | I/O  | General Purpose I/O Signals — Port K3; multiplexed with data bit D19                   |
| P13       | PK4/D20        | I/O  | General Purpose I/O Signals — Port K4; multiplexed with data bit D20                   |
| R14       | PK5/D21        | I/O  | General Purpose I/O Signals — Port K5; multiplexed with data bit D21                   |
| R13       | PK6/D22        | I/O  | General Purpose I/O Signals — Port K6; multiplexed with data bit D22                   |
| N11       | PK7/D23        | I/O  | General Purpose I/O Signals — Port K7; multiplexed with data bit D23                   |
| C1        | PL0/LCDVD14    | I/O  | General Purpose I/O Signals — Port L0; multiplexed with LCD Video Data bit 14          |
| C2        | PL1/LCDVD15    | I/O  | General Purpose I/O Signals — Port L1; multiplexed with LCD Video Data bit 15          |
| A10       | PL2/LCDVD12    | I/O  | General Purpose I/O Signals — Port L2; multiplexed with LCD Video Data bit 12          |
| C10       | PL3/LCDVD13    | I/O  | General Purpose I/O Signals — Port L3; multiplexed with LCD Video Data bit 13          |
| C12       | PL4/D28        | I/O  | General Purpose I/O Signals — Port L4; multiplexed with Data bit D28                   |
| A14       | PL5/D29        | I/O  | General Purpose I/O Signals — Port L5; multiplexed with Data bit D29                   |
| B14       | PL6/D30        | I/O  | General Purpose I/O Signals — Port L6; multiplexed with Data bit D30                   |
| C14       | PL7/D31        | I/O  | General Purpose I/O Signals — Port L7; multiplexed with Data bit D31                   |
| C11       | PN0/D26        | I/O  | General Purpose I/O Signals — Port N0; multiplexed with Data bit D26                   |
| A13       | PN1/D27        | I/O  | General Purpose I/O Signals — Port N1; multiplexed with Data bit D27                   |
| R12       | PN2/D24        | I/O  | General Purpose I/O Signals — Port N2; multiplexed with Data bit D24                   |

Table 2. LH79524 Pin Descriptions (Cont'd)

| LFBGA PIN                                                                           | SIGNAL NAME | TYPE   | DESCRIPTION                                                               |
|-------------------------------------------------------------------------------------|-------------|--------|---------------------------------------------------------------------------|
| P11                                                                                 | PN3/D25     | I/O    | General Purpose I/O Signals — Port N3; multiplexed with Data bit D25      |
| J2                                                                                  | nRESETIN    | I      | Reset Input                                                               |
| H1                                                                                  | nRESETOUT   | O      | Reset Output                                                              |
| C16                                                                                 | XTALIN      | I      | Crystal Input                                                             |
| C15                                                                                 | XTALOUT     | O      | Crystal Output                                                            |
| D16                                                                                 | XTAL32IN    | I      | 32.768 kHz Crystal Oscillator Input                                       |
| D15                                                                                 | XTAL32OUT   | O      | 32.768 kHz Crystal Oscillator Output                                      |
| K1                                                                                  | CLKOUT      | O      | Clock Out (selectable from the internal bus clock or 32.768 kHz crystal)  |
| D2                                                                                  | nTRST       | I      | JTAG Test Reset Input                                                     |
| P4                                                                                  | TMS         | I      | JTAG Test Mode Select Input                                               |
| T3                                                                                  | TCK         | I      | JTAG Test Clock Input                                                     |
| T1                                                                                  | TDI         | I      | JTAG Test Serial Data Input                                               |
| P3                                                                                  | TDO         | O      | JTAG Test Data Serial Output                                              |
| T2                                                                                  | TEST1       | I      | Tie HIGH for Normal Operation; pull LOW to enable Embedded ICE Debugging  |
| R3                                                                                  | TEST2       | I      | Tie HIGH for Normal Operation; pull HIGH to enable Embedded ICE Debugging |
| E3                                                                                  | LINREGEN    | I      | Linear Regulator Enable                                                   |
| D5, E4,<br>E5, H13,<br>N5                                                           | VDDC        | Power  | Core Power Supply                                                         |
| D10, F4,<br>J13, N4                                                                 | VSSC        | Ground | Core GND                                                                  |
| D7, D8,<br>D9, F13,<br>G4,<br>G13, H4,<br>J4, K4,<br>K13, L4,<br>N6, N8,<br>N9, N10 | VDD         | Power  | Input/Output Power Supply                                                 |
| E12, G8,<br>G9, H7,<br>H8, H9,<br>H10, J7,<br>J8, J9,<br>J10, K8,<br>K9, M5         | VSS         | Ground | Input/Output GND                                                          |
| D1                                                                                  | VDDA0       | Power  | Analog Power Supply for Analog-to-Digital Converter                       |
| F16                                                                                 | VDDA1       | Power  | Analog Power Supply for the USB PLL                                       |
| E16                                                                                 | VDDA2       | Power  | Analog Power Supply for System PLL                                        |
| J1                                                                                  | VSSA0       | Ground | Analog GND for Analog-to-Digital Converter                                |
| F15                                                                                 | VSSA1       | Ground | Analog GND for the USB PLL                                                |
| E15                                                                                 | VSSA2       | Ground | Analog GND for System PLL                                                 |

Table 3. LH79524 Numerical Pin List

| LFBGA NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|-----------|-------------------|-------------------------|--------------|-------|
| A1        | PI5               | ETHERRX0                | 8 mA         | 1     |
| A2        | PI6               | ETHERRX1                | 8 mA         | 1     |
| A3        | PH1               | ETHERRXDV               | 8 mA         | 1     |
| A4        | PH5               | ETHERTX1                | 8 mA         | 1     |
| A5        | PG0               | ETHERTXEN               | 8 mA         | 1     |
| A6        | PG2               | LCDVD0                  | 8 mA         | 1     |
| A7        | PG5               | LCDVD3                  | 8 mA         | 1     |
| A8        | PF0               | LCDVD6                  | 8 mA         | 1     |
| A9        | PF1               | LCDVD7                  | 8 mA         | 1     |
| A10       | PL2               | LCDVD12                 | 8 mA         | 1     |
| A11       | PF5               | LCDVD11                 | 8 mA         | 2     |
| A12       | PF7               | LCDFP/LCDSPS            | 8 mA         | 1     |
| A13       | PN1               | D27                     | 8 mA         | 1     |
| A14       | PL5               | D29                     | 8 mA         | 1     |
| A15       | USBDP             |                         |              | 3     |
| A16       | USBDN             |                         |              | 3     |
| B1        | PI1               | ETHERMDIO               | 8 mA         | 2     |
| B2        | PI2               | ETHERCOL                | 8 mA         | 1     |
| B3        | PI7               | ETHERRX2                | 8 mA         | 1     |
| B4        | PH2               | ETHERRXCLK              | 8 mA         | 1     |
| B5        | PH6               | ETHERTX2                | 8 mA         | 1     |
| B6        | PG1               | ETHERTXCLK              | 8 mA         | 1     |
| B7        | PG4               | LCDVD2                  | 8 mA         | 1     |
| B8        | PG7               | LCDVD5                  | 8 mA         | 1     |
| B9        | PF2               | LCDVD8                  | 8 mA         | 2     |
| B10       | PF4               | LCDVD10                 | 8 mA         | 2     |
| B11       | PF6               | LCDEN/LCDSPL            | 8 mA         | 1     |
| B12       | PE0               | LCDLP/LCDHRLP           | 8 mA         | 1     |
| B13       | PE2               | LCDPS                   | 8 mA         | 1     |
| B14       | PL6               | D30                     | 8 mA         | 1     |
| B15       | PE6               | LCDVEEN/<br>LCDMOD      | 8 mA         | 1     |
| B16       | PE5               | LCDVDDEN                | 8 mA         | 1     |
| C1        | PL0               | LCDVD14                 | 8 mA         | 1     |
| C2        | PL1               | LCDVD15                 | 8 mA         | 1     |
| C3        | PI4               | ETHERRXER               | 8 mA         | 1     |
| C4        | PH0               | ETHERRX3                | 8 mA         | 1     |
| C5        | PH3               | ETHERTXER               | 8 mA         | 1     |
| C6        | PH7               | ETHERTX3                | 8 mA         | 1     |
| C7        | PG3               | LCDVD1                  | 8 mA         | 1     |
| C8        | PG6               | LCDVD4                  | 8 mA         | 1     |
| C9        | PF3               | LCDVD9                  | 8 mA         | 2     |
| C10       | PL3               | LCDVD13                 | 8 mA         | 1     |
| C11       | PN0               | D26                     | 8 mA         | 1     |
| C12       | PL4               | D28                     | 8 mA         | 1     |

Table 3. LH79524 Numerical Pin List (Cont'd)

| LFBGA NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|-----------|-------------------|-------------------------|--------------|-------|
| C13       | PE3               | LCDCLS                  | 8 mA         | 1     |
| C14       | PL7               | D31                     | 8 mA         | 1     |
| C15       | XTALOUT           |                         |              | 4     |
| C16       | XTALIN            |                         |              | 5     |
| D1        | VDDA0             |                         |              |       |
| D2        | nTRST             |                         |              | 2, 6  |
| D3        | PI0               | ETHERMDC                | 8 mA         | 1     |
| D4        | PI3               | ETHERCRS                | 8 mA         | 1     |
| D5        | VDDC              |                         |              |       |
| D6        | PH4               | ETHERTX0                | 8 mA         | 1     |
| D7        | VDD               |                         |              |       |
| D8        | VDD               |                         |              |       |
| D9        | VDD               |                         |              |       |
| D10       | VSSC              |                         |              |       |
| D11       | PE1               | LCDDCLK                 | 8 mA         | 1     |
| D12       | PE4               | LCDDSPLEN/<br>LCDREV    | 8 mA         | 1     |
| D13       | DQM0              |                         | 8 mA         |       |
| D14       | PE7               | nWAIT/nDEOT             | 8 mA         | 2, 6  |
| D15       | XTAL32OUT         |                         |              | 4     |
| D16       | XTAL32IN          |                         |              | 5     |
| E1        | AN7               | PJ6/INT6                |              |       |
| E2        | AN0/UL/X+         |                         |              |       |
| E3        | LINREGEN          |                         |              |       |
| E4        | VDDC              |                         |              |       |
| E5        | VDDC              |                         |              |       |
| E12       | VSS               |                         |              |       |
| E13       | DQM1              |                         | 8 mA         |       |
| E14       | DQM2              |                         | 8 mA         |       |
| E15       | VSSA2             |                         |              |       |
| E16       | VDDA2             |                         |              |       |
| F1        | AN5               | PJ5/INT5                |              |       |
| F2        | AN1/UR/X-         |                         |              |       |
| F3        | AN6               | PJ7/INT7                |              |       |
| F4        | VSSC              |                         |              |       |
| F13       | VDD               |                         |              |       |
| F14       | SDCLK             |                         | 12 mA        |       |
| F15       | VSSA1             |                         |              |       |
| F16       | VDDA1             |                         |              |       |
| G1        | AN9               | PJ2                     |              |       |
| G2        | AN2/LL/Y+         | PJ3                     |              |       |
| G3        | AN8               | PJ4                     |              |       |
| G4        | VDD               |                         |              |       |
| G8        | VSS               |                         |              |       |
| G9        | VSS               |                         |              |       |

Table 3. LH79524 Numerical Pin List (Cont'd)

| LFBGA NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|-----------|-------------------|-------------------------|--------------|-------|
| G13       | VDD               |                         |              |       |
| G14       | DQM3              |                         | 8 mA         |       |
| G15       | SDCKE             |                         | 8 mA         |       |
| G16       | nDCS0             |                         | 8 mA         |       |
| H1        | nRESETOUT         |                         | 8 mA         |       |
| H2        | AN3/LR/Y-         | PJ0                     |              |       |
| H3        | AN4/WIPER         | PJ1                     |              |       |
| H4        | VDD               |                         |              |       |
| H7        | VSS               |                         |              |       |
| H8        | VSS               |                         |              |       |
| H9        | VSS               |                         |              |       |
| H10       | VSS               |                         |              |       |
| H13       | VDDC              |                         |              |       |
| H14       | nDCS1             |                         | 8 mA         |       |
| H15       | nRAS              |                         | 8 mA         |       |
| H16       | nCAS              |                         | 8 mA         |       |
| J1        | VSSA0             |                         |              |       |
| J2        | nRESETIN          |                         |              | 2, 6  |
| J3        | CTCLK             | INT4/BATCNTL            | 8 mA         | 2, 6  |
| J4        | VDD               |                         |              |       |
| J7        | VSS               |                         |              |       |
| J8        | VSS               |                         |              |       |
| J9        | VSS               |                         |              |       |
| J10       | VSS               |                         |              |       |
| J13       | VSSC              |                         |              |       |
| J14       | nBLE1             | PM5                     | 8 mA         |       |
| J15       | nBLE0             | PM4                     | 8 mA         |       |
| J16       | nWE               |                         | 8 mA         |       |
| K1        | CLKOUT            |                         | 8 mA         |       |
| K2        | PA7               | CTCAP2B/<br>CTCMP2B/SCL | 8 mA         | 2, 6  |
| K3        | PA6               | CTCAP2A/<br>CTCMP2A/SDA | 8 mA         | 2, 6  |
| K4        | VDD               |                         |              |       |
| K8        | VSS               |                         |              |       |
| K9        | VSS               |                         |              |       |
| K13       | VDD               |                         |              |       |
| K14       | nOE               |                         | 8 mA         |       |
| K15       | nBLE3             | PM7                     | 8 mA         |       |
| K16       | nBLE2             | PM6                     | 8 mA         |       |
| L1        | PA5               | CTCAP1B/<br>CTCMP1B     | 8 mA         | 1, 6  |
| L2        | PA4               | CTCAP1A/<br>CTCMP1A     | 8 mA         | 1, 6  |
| L3        | PA2               | CTCAP0A/<br>CTCMP0A     | 8 mA         | 1, 6  |

Table 3. LH79524 Numerical Pin List (Cont'd)

| LFBGA NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S)                | OUTPUT DRIVE | NOTES |
|-----------|-------------------|----------------------------------------|--------------|-------|
| L4        | VDD               |                                        |              |       |
| L13       | D2                |                                        | 8 mA         | 1     |
| L14       | nCS3              | PM3                                    | 8 mA         |       |
| L15       | nCS1              | PM1                                    | 8 mA         |       |
| L16       | nCS0              | PM0                                    | 8 mA         |       |
| M1        | PA3               | CTCAP0B/<br>CTCMP0B                    | 8 mA         | 1, 6  |
| M2        | PA1               | INT3/UARTTX2/<br>UARTIRTX2             | 8 mA         | 1, 6  |
| M3        | PB7               | INT1/UARTTX0/<br>UARTIRTX0             | 8 mA         | 1, 6  |
| M4        | PB4               | SSPRX/I2SRXD/<br>UARTRX1/<br>UARTIRRX1 | 8 mA         | 2     |
| M5        | VSS               |                                        |              |       |
| M12       | PK1               | D17                                    | 8 mA         | 1     |
| M13       | D6                |                                        | 8 mA         | 1     |
| M14       | D3                |                                        | 8 mA         | 1     |
| M15       | D0                |                                        | 8 mA         | 1     |
| M16       | nCS2              | PM2                                    | 8 mA         |       |
| N1        | PA0               | INT2/UARTRX2/<br>UARTIRRX2             | 8 mA         | 1, 6  |
| N2        | PB6               | INT0/UARTRX0/<br>UARTIRRX0             | 8 mA         | 1, 6  |
| N3        | PB3               | SSPCLK/I2SCLK                          | 8 mA         | 1     |
| N4        | VSSC              |                                        |              |       |
| N5        | VDDC              |                                        |              |       |
| N6        | VDD               |                                        |              |       |
| N7        | PC0               | A16                                    | 8 mA         | 1     |
| N8        | VDD               |                                        |              |       |
| N9        | VDD               |                                        |              |       |
| N10       | VDD               |                                        |              |       |
| N11       | PK7               | D23                                    | 8 mA         | 1     |
| N12       | PD4               | D12                                    | 8 mA         | 1     |
| N13       | PD2               | D10                                    | 8 mA         | 1     |
| N14       | D7                |                                        | 8 mA         | 1     |
| N15       | D4                |                                        | 8 mA         | 1     |
| N16       | D1                |                                        | 8 mA         | 1     |
| P1        | PB5               | SSPTX/I2STXD/<br>UARTTX1/<br>UARTIRTX1 | 8 mA         | 1     |
| P2        | PB2               | SSPFRM/I2SWS                           | 8 mA         | 2     |
| P3        | TDO               |                                        | 4 mA         |       |
| P4        | TMS               |                                        |              | 2, 6  |
| P5        | PC6               | A22/nFWE                               | 8 mA         | 1     |
| P6        | PC3               | A19                                    | 8 mA         | 1     |
| P7        | A14               |                                        | 8 mA         |       |

Table 3. LH79524 Numerical Pin List (Cont'd)

| LFBGA NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|-----------|-------------------|-------------------------|--------------|-------|
| P8        | A11               |                         | 8 mA         |       |
| P9        | A6                |                         | 8 mA         |       |
| P10       | A3                |                         | 8 mA         |       |
| P11       | PN3               | D25                     | 8 mA         | 1     |
| P12       | PD6               | D14                     | 8 mA         | 1     |
| P13       | PK4               | D20                     | 8 mA         | 1     |
| P14       | PD1               | D9                      | 8 mA         | 1     |
| P15       | PD0               | D8                      | 8 mA         | 1     |
| P16       | D5                |                         | 8 mA         | 1     |
| R1        | PB1               | DREQ/<br>nUARTRTS0      | 8 mA         | 2     |
| R2        | PB0               | nDACK/<br>nUARTCTS0     | 8 mA         | 2     |
| R3        | TEST2             |                         |              | 2, 6  |
| R4        | PC7               | A23/nFRE                | 8 mA         | 1     |
| R5        | PC4               | A20                     | 8 mA         | 1     |
| R6        | PC1               | A17                     | 8 mA         | 1     |
| R7        | A13               |                         | 8 mA         |       |
| R8        | A10               |                         | 8 mA         |       |
| R9        | A7                |                         | 8 mA         |       |
| R10       | A4                |                         | 8 mA         |       |
| R11       | A1                |                         | 8 mA         |       |
| R12       | PN2               | D24                     | 8 mA         | 1     |
| R13       | PK6               | D22                     | 8 mA         | 1     |
| R14       | PK5               | D21                     | 8 mA         | 1     |
| R15       | PK3               | D19                     | 8 mA         | 1     |
| R16       | PK0               | D16                     | 8 mA         | 1     |
| T1        | TDI               |                         |              | 2, 6  |
| T2        | TEST1             |                         |              | 2, 6  |
| T3        | TCK               |                         |              | 2, 6  |

Table 3. LH79524 Numerical Pin List (Cont'd)

| LFBGA NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|-----------|-------------------|-------------------------|--------------|-------|
| T4        | PC5               | A21                     | 8 mA         | 1     |
| T5        | PC2               | A18                     | 8 mA         | 1     |
| T6        | A15               |                         | 8 mA         |       |
| T7        | A12               |                         | 8 mA         |       |
| T8        | A9                |                         | 8 mA         |       |
| T9        | A8                |                         | 8 mA         |       |
| T10       | A5                |                         | 8 mA         |       |
| T11       | A2                |                         | 8 mA         |       |
| T12       | A0                |                         | 8 mA         |       |
| T13       | PD7               | D15                     | 8 mA         | 1     |
| T14       | PD5               | D13                     | 8 mA         | 1     |
| T15       | PD3               | D11                     | 8 mA         | 1     |
| T16       | PK2               | D18                     | 8 mA         | 1     |

**NOTES:**

1. Internal pull-down. The internal pullup and pulldown resistance on all digital I/O pins is 50K $\Omega$ .
2. Internal pull-up. The internal pullup and pulldown resistance on all digital I/O pins is 50K $\Omega$ .
3. USB Inputs/outputs are tristated.
4. Output is for crystal oscillator only, no drive capability.
5. Crystal Oscillator Inputs should be driven to a maximum of 1.8 V  $\pm$  10%.
6. Input with Schmitt Trigger.
7. Output Drive Values are MAX. See 'DC Specifications'.
8. All unused analog pins, and XTAL32IN (if unused) should be tied to ground through a 33K $\Omega$  resistor.

Table 4. TESTx PIN FUNCTION

| MODE         | TEST1 | TEST2 | nBLE0 |
|--------------|-------|-------|-------|
| Embedded ICE | 0     | 1     | 1     |
| Normal       | 1     | 1     | x     |

Table 5. LH79525 Pin Descriptions

| PIN NO. | SIGNAL NAME   | TYPE | DESCRIPTION                                                                                                     |
|---------|---------------|------|-----------------------------------------------------------------------------------------------------------------|
| 80      | A0            | O    | External Address Bus                                                                                            |
| 79      | A1            |      |                                                                                                                 |
| 78      | A2            |      |                                                                                                                 |
| 77      | A3            |      |                                                                                                                 |
| 76      | A4            |      |                                                                                                                 |
| 74      | A5            |      |                                                                                                                 |
| 73      | A6            |      |                                                                                                                 |
| 72      | A7            |      |                                                                                                                 |
| 71      | A8            |      |                                                                                                                 |
| 70      | A9            |      |                                                                                                                 |
| 69      | A10           |      |                                                                                                                 |
| 67      | A11           |      |                                                                                                                 |
| 65      | A12           |      |                                                                                                                 |
| 63      | A13           |      |                                                                                                                 |
| 62      | A14           |      |                                                                                                                 |
| 61      | A15           |      |                                                                                                                 |
| 99      | D0            | I/O  | External Data Bus                                                                                               |
| 98      | D1            |      |                                                                                                                 |
| 97      | D2            |      |                                                                                                                 |
| 96      | D3            |      |                                                                                                                 |
| 95      | D4            |      |                                                                                                                 |
| 94      | D5            |      |                                                                                                                 |
| 93      | D6            |      |                                                                                                                 |
| 91      | D7            |      |                                                                                                                 |
| 117     | SDCLK         | O    | SDRAM Clock                                                                                                     |
| 116     | SDCKE         | O    | SDRAM Clock Enable                                                                                              |
| 119     | DQM0          | O    | Data Mask Output to SDRAMs                                                                                      |
| 118     | DQM1          |      |                                                                                                                 |
| 115     | nDCS0         | O    | SDRAM Chip Select                                                                                               |
| 114     | nDCS1         | O    | SDRAM Chip Select                                                                                               |
| 113     | nRAS          | O    | Row Address Strobe                                                                                              |
| 112     | nCAS          | O    | Column Address Strobe                                                                                           |
| 104     | nCS0/PM0      | O    | Static Memory Chip Select; multiplexed with GPO Port M[3:0]                                                     |
| 103     | nCS1/PM1      |      |                                                                                                                 |
| 102     | nCS2/PM2      |      |                                                                                                                 |
| 100     | nCS3/PM3      |      |                                                                                                                 |
| 110     | nBLE0/PM4     | O    | Static Memory Byte Lane Enable / Byte Write Enable; multiplexed with GPIO Port M[5:4]                           |
| 109     | nBLE1/PM5     |      |                                                                                                                 |
| 106     | nOE           | O    | Static Memory Output Enable                                                                                     |
| 111     | nWE           | O    | Static Memory Write Enable                                                                                      |
| 130     | USBDN         | I/O  | USB Data Negative (Differential Pair output, single ended and Differential input)                               |
| 131     | USBDP         | I/O  | USB Data Positive (Differential Pair output, single ended and Differential input)                               |
| 11      | AN0/UL/X+     | I    | ADC Input 0, 4 wire touch screen Upper Left, 5 wire touch screen X+                                             |
| 14      | AN1/UR/X-     | I    | ADC Input 1, 4 wire touch screen Upper Right, 5 wire touch screen X-                                            |
| 17      | AN2/LL/Y+/PJ3 | I    | ADC Input 2, 4 wire touch screen Lower Left, 5 wire touch screen Y+; multiplexed with GPIO Port J3 (input only) |

Table 5. LH79525 Pin Descriptions (Cont'd)

| PIN NO. | SIGNAL NAME                                | TYPE | DESCRIPTION                                                                                                                                                           |
|---------|--------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20      | AN3/LR/Y-/PJ0                              | I    | ADC Input 3, 4 wire touch screen Upper Right, 5 wire touch screen Y-; multiplexed with GPIO Port J0 (input only)                                                      |
| 19      | AN4/WIPER/PJ1                              | I    | ADC Input 4, 5 wire touch screen Wiper input; multiplexed with Port J1 (input only)                                                                                   |
| 15      | AN5/PJ5/INT5                               | I    | ADC Input 5; multiplexed with GPIO Port J5 (input only) and External Interrupt 5                                                                                      |
| 12      | AN6/PJ7/INT7                               | I    | ADC Input 6; multiplexed with GPIO Port J7 (input only) and External Interrupt 7                                                                                      |
| 13      | AN7/PJ6/INT6                               | I    | ADC Input 7; multiplexed with GPIO Port J6 (input only) and External Interrupt 6                                                                                      |
| 16      | AN8/PJ4                                    | I    | ADC Input 8; multiplexed with GPIO Port J4 (input only)                                                                                                               |
| 18      | AN9/PJ2                                    | I    | ADC Input 9; multiplexed with GPIO Port J2 (input only)                                                                                                               |
| 25      | CTCLK/INT4/<br>BATCNTL                     | I/O  | Timer[2:0] External Clock input; multiplexed with Battery Control and Interrupt 4                                                                                     |
| 36      | PA0/UARTRX2/<br>UARTIRRX2/INT2             | I/O  | General Purpose I/O Signal — Port A0; multiplexed with UART2 Received Serial Data Input, UART2 Infrared Received Serial Data In, and External Interrupt 2             |
| 35      | PA1/UARTTX2/<br>UARTIRRX2/INT3             | I/O  | General Purpose I/O Signal — Port A1; multiplexed with UART2 Transmitted Serial Data Output, UART2 Serial Transmit Data Out, and External Interrupt 3                 |
| 34      | PA2/CTCAP0A/<br>CTCMP0A                    | I/O  | General Purpose I/O Signal — Port A2; multiplexed with Counter/Timer 0 Capture A input and Counter/Timer 0 Compare A output                                           |
| 32      | PA3/CTCAP0B/<br>CTCMP0B                    | I/O  | General Purpose I/O Signal — Port A3; multiplexed with Counter/Timer 0 Capture B input and Counter/Timer 0 Compare B output                                           |
| 31      | PA4/CTCAP1A/<br>CTCMP1A                    | I/O  | General Purpose I/O Signal — Port A4; multiplexed with Counter/Timer 1 Capture A input and Counter/Timer 1 Compare A output                                           |
| 30      | PA5/CTCAP1B/<br>CTCMP1B                    | I/O  | General Purpose I/O Signal — Port A5; multiplexed with Counter/Timer 1 Capture B input and Counter/Timer 1 Compare B output                                           |
| 29      | PA6/CTCAP2A/<br>CTCMP2A/SDA                | I/O  | General Purpose I/O Signal — Port A6; multiplexed with Counter/Timer 2 Capture A input, Counter/Timer 2 Compare A output, and I <sup>2</sup> C Bus Data (open drain)  |
| 28      | PA7/CTCAP2B/<br>CTCMP2B/SLC                | I/O  | General Purpose I/O Signal — Port A7; multiplexed with Counter/Timer 2 Capture B input, Counter/Timer 2 Compare B output, and I <sup>2</sup> C Bus Clock (open drain) |
| 44      | PB0/nDACK/<br>nUARTCTS0                    | I/O  | General Purpose I/O Signal — Port B0; multiplexed with DMA Acknowledge and UART0 CTS                                                                                  |
| 43      | PB1/DREQ/<br>nUARTRTS0                     | I/O  | General Purpose I/O Signal — Port B1; multiplexed with DMA Request and UART0 RTS                                                                                      |
| 42      | PB2/SSPFRM/<br>I2SWS                       | I/O  | General Purpose I/O Signal — Port B2; multiplexed with SSP Serial Frame Output and I <sup>2</sup> S Frame Output                                                      |
| 41      | PB3/SSPCLK/<br>I2SCLK                      | I/O  | General Purpose I/O Signal — Port B3; multiplexed with SSP Clock and I <sup>2</sup> S Clock                                                                           |
| 40      | PB4/SSPRX/<br>I2SRXD/UARTRX1/<br>UARTIRRX1 | I/O  | General Purpose I/O Signal — Port B4; multiplexed with SSP Data In, I <sup>2</sup> S Data In, UART1 Serial Data In, and UART1 Infrared Data In                        |
| 39      | PB5/SSPTX/<br>I2STXD/UARTTX1/<br>UARTIRTX1 | I/O  | General Purpose I/O Signal — Port B5; multiplexed with SSP Data Out, I <sup>2</sup> S Data Out, UART1 Data Out, and UART1 IR Data Out                                 |
| 38      | PB6/INT0/<br>UARTRX0/<br>UARTIRRX0         | I/O  | General Purpose I/O Signal — Port B6; multiplexed with UART0 Infrared Received Serial Data Input, UART0 Received Serial Data In, and External Interrupt 0             |
| 37      | PB7/INT1/<br>UARTTX0/<br>UARTIRTX0         | I/O  | General Purpose I/O Signal — Port B7; multiplexed with UART0 Infrared Transmitted Serial Data Output, UART0 Serial Transmit Data Out, and External Interrupt 1        |
| 60      | PC0/A16                                    | I/O  | General Purpose I/O Signal — Port C0; multiplexed with Address A16                                                                                                    |
| 59      | PC1/A17                                    | I/O  | General Purpose I/O Signal — Port C1; multiplexed with Address A17                                                                                                    |
| 58      | PC2/A18                                    | I/O  | General Purpose I/O Signal — Port C2; multiplexed with Address A18                                                                                                    |
| 56      | PC3/A19                                    | I/O  | General Purpose I/O Signal — Port C3; multiplexed with Address A19                                                                                                    |
| 55      | PC4/A20                                    | I/O  | General Purpose I/O Signal — Port C4; multiplexed with Address A20                                                                                                    |
| 54      | PC5/A21                                    | I/O  | General Purpose I/O Signal — Port C5; multiplexed with Address A21                                                                                                    |

Table 5. LH79525 Pin Descriptions (Cont'd)

| PIN NO. | SIGNAL NAME              | TYPE | DESCRIPTION                                                                                         |
|---------|--------------------------|------|-----------------------------------------------------------------------------------------------------|
| 53      | PC6/A22/nFWE             | I/O  | General Purpose I/O Signal — Port C6; multiplexed with Address A22 and NAND Flash Write Enable      |
| 52      | PC7/A23/nFRE             | I/O  | General Purpose I/O Signal — Port C7; multiplexed with Address A23 and NAND Flash Read Enable       |
| 90      | PD0/D8                   | I/O  | General Purpose I/O Signal — Port D0; multiplexed with Data D8                                      |
| 89      | PD1/D9                   | I/O  | General Purpose I/O Signal — Port D1; multiplexed with Data D9                                      |
| 88      | PD2/D10                  | I/O  | General Purpose I/O Signal — Port D2; multiplexed with Data D10                                     |
| 87      | PD3/D11                  | I/O  | General Purpose I/O Signal — Port D3; multiplexed with Data D11                                     |
| 85      | PD4/D12                  | I/O  | General Purpose I/O Signal — Port D4; multiplexed with Data D12                                     |
| 84      | PD5/D13                  | I/O  | General Purpose I/O Signal — Port D5; multiplexed with Data D13                                     |
| 83      | PD6/D14                  | I/O  | General Purpose I/O Signal — Port D6; multiplexed with Data D14                                     |
| 82      | PD7/D15                  | I/O  | General Purpose I/O Signal — Port D7; multiplexed with Data D15                                     |
| 141     | PE0/LCDLP/<br>LCDHRLP    | I/O  | General Purpose I/O Signals — Port E0; multiplexed with LCD Line Pulse and AD-TFT/HR-TFT Line Pulse |
| 139     | PE1/LCDDCLK              | I/O  | General Purpose I/O Signals — Port E1; multiplexed with LCD Data Clock                              |
| 138     | PE2/LCDPS                | I/O  | General Purpose I/O Signals — Port E2; multiplexed with LCD Power Save                              |
| 137     | PE3/LCDCLS               | I/O  | General Purpose I/O Signals — Port E3; multiplexed with LCD Row Driver Clock                        |
| 136     | PE4/LCDDSPLEN/<br>LCDREV | I/O  | General Purpose I/O Signals — Port E4; multiplexed with LCD Panel Power Enable and LCD Reverse      |
| 134     | PE5/LCDVDDEN             | I/O  | General Purpose I/O Signals — Port E5; multiplexed with LCD VDD Enable                              |
| 133     | PE6/LCDVEEN/<br>LCDMOD   | I/O  | General Purpose I/O Signals — Port E6; multiplexed with LCD Analog Power Enable and MOD             |
| 120     | PE7/nWAIT/nDEOT          | I/O  | General Purpose I/O Signals — Port E7; multiplexed with nWAIT and DMA End of Transfer               |
| 153     | PF0/LCDVD6               | I/O  | General Purpose I/O Signals — Port F0; multiplexed with LCD Video Data bit 6                        |
| 151     | PF1/LCDVD7               | I/O  | General Purpose I/O Signals — Port F1; multiplexed with LCD Video Data bit 7                        |
| 149     | PF2/LCDVD8               | I/O  | General Purpose I/O Signals — Port F2; multiplexed with LCD Video Data bit 8                        |
| 147     | PF3/LCDVD9               | I/O  | General Purpose I/O Signals — Port F3; multiplexed with LCD Video Data bit 9                        |
| 146     | PF4/LCDVD10              | I/O  | General Purpose I/O Signals — Port F4; multiplexed with LCD Video Data bit 10                       |
| 145     | PF5/LCDVD11              | I/O  | General Purpose I/O Signals — Port F5; multiplexed with LCD Video Data bit 11                       |
| 143     | PF6/LCDEN/<br>LCDSPL     | I/O  | General Purpose I/O Signals — Port F6; multiplexed with LCD Start Pulse Left                        |
| 142     | PF7/LCDFP/<br>LCDSPS     | I/O  | General Purpose I/O Signals — Port F7; multiplexed with LCD Row Driver Counter reset                |
| 162     | PG0/ETHERTXEN            | I/O  | General Purpose I/O Signals — Port G0; multiplexed with Ethernet Transmit Enable                    |
| 161     | PG1/ETHERTXCLK           | I/O  | General Purpose I/O Signals — Port G1; multiplexed with Ethernet Clock                              |
| 159     | PG2/LCDVD0               | I/O  | General Purpose I/O Signals — Port G2; multiplexed with LCD Video Data bit 0                        |
| 158     | PG3/LCDVD1               | I/O  | General Purpose I/O Signals — Port G3; multiplexed with LCD Video Data bit 1                        |
| 157     | PG4/LCDVD2               | I/O  | General Purpose I/O Signals — Port G4; multiplexed with LCD Video Data bit 2                        |
| 156     | PG5/LCDVD3               | I/O  | General Purpose I/O Signals — Port G5; multiplexed with LCD Video Data bit 3                        |
| 155     | PG6/LCDVD4               | I/O  | General Purpose I/O Signals — Port G6; multiplexed with LCD Video Data bit 4                        |
| 154     | PG7/LCDVD5               | I/O  | General Purpose I/O Signals — Port G7; multiplexed with LCD Video Data bit 5                        |
| 171     | PH0/ETHERRX3             | I/O  | General Purpose I/O Signals — Port H0; multiplexed with Ethernet Receive Channel 3                  |
| 170     | PH1/ETHERRXDV            | I/O  | General Purpose I/O Signals — Port H1; multiplexed with Ethernet Data Valid                         |
| 169     | PH2/ETHERRXCLK           | I/O  | General Purpose I/O Signals — Port H2; multiplexed with Ethernet Receive Clock                      |
| 167     | PH3/ETHERTXER            | I/O  | General Purpose I/O Signals — Port H3; multiplexed with Ethernet Transmit Error                     |
| 166     | PH4/ETHERTX0             | I/O  | General Purpose I/O Signals — Port H4; multiplexed with Ethernet Transmit Channel 0                 |
| 165     | PH5/ETHERTX1             | I/O  | General Purpose I/O Signals — Port H5; multiplexed with Ethernet Transmit Channel 1                 |
| 164     | PH6/ETHERTX2             | I/O  | General Purpose I/O Signals — Port H6; multiplexed with Ethernet Transmit Channel 2                 |

Table 5. LH79525 Pin Descriptions (Cont'd)

| PIN NO.                                                    | SIGNAL NAME   | TYPE   | DESCRIPTION                                                                            |
|------------------------------------------------------------|---------------|--------|----------------------------------------------------------------------------------------|
| 163                                                        | PH7/ETHERTX3  | I/O    | General Purpose I/O Signals — Port H7; multiplexed with Ethernet Transmit Channel 3    |
| 4                                                          | PI0/ETHERMDC  | I/O    | General Purpose I/O Signals — Port I0; multiplexed with Ethernet Management Data Clock |
| 2                                                          | PI1/ETHERMDIO | I/O    | General Purpose I/O Signals — Port I1; multiplexed with Ethernet Management Data I/O   |
| 1                                                          | PI2/ETHERCOL  | I/O    | General Purpose I/O Signals — Port I2; multiplexed with Ethernet Collision Detect      |
| 176                                                        | PI3/ETHERCRS  | I/O    | General Purpose I/O Signals — Port I3; multiplexed with Ethernet Carrier Sense         |
| 175                                                        | PI4/ETHERRXER | I/O    | General Purpose I/O Signals — Port I4; multiplexed with Ethernet Receive Error         |
| 174                                                        | PI5/ETHERRX0  | I/O    | General Purpose I/O Signals — Port I5; multiplexed with Ethernet Receive Channel 0     |
| 173                                                        | PI6/ETHERRX1  | I/O    | General Purpose I/O Signals — Port I6; multiplexed with Ethernet Receive Channel 1     |
| 172                                                        | PI7/ETHERRX2  | I/O    | General Purpose I/O Signals — Port I7; multiplexed with Ethernet Receive Channel 2     |
| 24                                                         | nRESETIN      | I      | Reset Input                                                                            |
| 22                                                         | nRESETOUT     | O      | Reset Output                                                                           |
| 127                                                        | XTALIN        | I      | Crystal Input, or external clock input                                                 |
| 128                                                        | XTALOUT       | O      | Crystal Output                                                                         |
| 125                                                        | XTAL32IN      | I      | 32.768 kHz Crystal Oscillator Input, or external clock input,                          |
| 126                                                        | XTAL32OUT     | O      | 32.768 kHz Crystal Oscillator Output                                                   |
| 23                                                         | CLKOUT        | O      | Clock Out (selectable from the internal bus clock or 32.768 MHz)                       |
| 8                                                          | nTRST         | I      | JTAG Test Reset Input                                                                  |
| 50                                                         | TMS           | I      | JTAG Test Mode Select Input                                                            |
| 51                                                         | TCK           | I      | JTAG Test Clock Input                                                                  |
| 46                                                         | TDI           | I      | JTAG Test Serial Data Input                                                            |
| 45                                                         | TDO           | O      | JTAG Test Data Serial Output                                                           |
| 47                                                         | TEST1         | I      | Tie HIGH for Normal Operation; pull LOW to enable embedded ICE Debugging               |
| 48                                                         | TEST2         | I      | Tie HIGH for Normal Operation; pull HIGH to enable embedded ICE Debugging              |
| 9                                                          | LINREGEN      | I      | Linear Regulator Enable (Requires pull-up. See User's Guide)                           |
| 6, 66,<br>107, 150                                         | VDDC          | Power  | Core Power Supply                                                                      |
| 7, 64,<br>105, 148                                         | VSSC          | Ground | Core GND                                                                               |
| 3, 26, 33,<br>57, 75,<br>86, 101,<br>129, 135,<br>144, 160 | VDD           | Power  | Input/Output Power Supply                                                              |
| 5, 27, 49,<br>68, 81,<br>92, 108,<br>132, 140,<br>152, 168 | VSS           | Ground | Input/Output GND                                                                       |
| 10                                                         | VDDA0         | Power  | Analog Power Supply for Analog-to-Digital Converter                                    |
| 122                                                        | VDDA1         | Power  | Analog Power Supply for the USB PLL                                                    |
| 123                                                        | VDDA2         | Power  | Analog Power Supply for System PLL                                                     |
| 21                                                         | VSSA0         | Ground | Analog GND for Analog-to-Digital Converter                                             |
| 121                                                        | VSSA1         | Ground | Analog GND for the USB PLL                                                             |
| 124                                                        | VSSA2         | Ground | Analog GND for System PLL                                                              |

Table 6. LH79525 Numerical Pin List

| PIN NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|---------|-------------------|-------------------------|--------------|-------|
| 1       | PI2               | ETHERCOL                | 8 mA         | 1     |

Table 6. LH79525 Numerical Pin List (Cont'd)

| PIN NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|---------|-------------------|-------------------------|--------------|-------|
| 2       | PI1               | ETHERMDIO               | 8 mA         | 2     |

Table 6. LH79525 Numerical Pin List (Cont'd)

| PIN NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S)        | OUTPUT DRIVE | NOTES |
|---------|-------------------|--------------------------------|--------------|-------|
| 3       | VDD               |                                |              |       |
| 4       | PI0               | ETHERMDC                       | 8 mA         | 1     |
| 5       | VSS               |                                |              |       |
| 6       | VDDC              |                                |              |       |
| 7       | VSSC              |                                |              |       |
| 8       | nTRST             |                                |              | 2, 3  |
| 9       | LINREGEN          |                                |              |       |
| 10      | VDDA0             |                                |              |       |
| 11      | AN0/UL/X+         |                                |              |       |
| 12      | AN6               | PJ7/INT7                       |              |       |
| 13      | AN7               | PJ6/INT6                       |              |       |
| 14      | AN1/UR/X-         |                                |              |       |
| 15      | AN5               | PJ5/INT5                       |              |       |
| 16      | AN8               | PJ4                            |              |       |
| 17      | AN2/LL/Y+         | PJ3                            |              |       |
| 18      | AN9               | PJ2                            |              |       |
| 19      | AN4/WIPER         | PJ1                            |              |       |
| 20      | AN3/LR/Y-         | PJ0                            |              |       |
| 21      | VSSA0             |                                |              |       |
| 22      | nRESETOUT         |                                | 8 mA         |       |
| 23      | CLKOUT            |                                | 8 mA         |       |
| 24      | nRESETIN          |                                |              | 2, 3  |
| 25      | CTCLK             | INT4/BATCNTL                   | 8 mA         | 2, 3  |
| 26      | VDD               |                                |              |       |
| 27      | VSS               |                                |              |       |
| 28      | PA7               | CTCAP2B/CTCMP2B/SCL            | 8 mA         | 2, 3  |
| 29      | PA6               | CTCAP2A/CTCMP2A/SDA            | 8 mA         | 2, 3  |
| 30      | PA5               | CTCAP1B/CTCMP1B                | 8 mA         | 1, 3  |
| 31      | PA4               | CTCAP1A/CTCMP1A                | 8 mA         | 1, 3  |
| 32      | PA3               | CTCAP0B/CTCMP0B                | 8 mA         | 1, 3  |
| 33      | VDD               |                                |              |       |
| 34      | PA2               | CTCAP0A/CTCMP0A                | 8 mA         | 1, 3  |
| 35      | PA1               | INT3/UARTTX2/UARTIRTX2         | 8 mA         | 1, 3  |
| 36      | PA0               | INT2/UARTRX2/UARTIRRX2         | 8 mA         | 1, 3  |
| 37      | PB7               | INT1/UARTTX0/UARTIRTX0         | 8 mA         | 1, 3  |
| 38      | PB6               | INT0/UARTRX0/UARTIRRX0         | 8 mA         | 1, 3  |
| 39      | PB5               | SSPTX/I2STXD/UARTTX1/UARTIRTX1 | 8 mA         | 1     |
| 40      | PB4               | SSPRX/I2SRXD/UARTRX1/UARTIRRX1 | 8 mA         | 2     |
| 41      | PB3               | SSPCLK/I2SCLK                  | 8 mA         | 1     |
| 42      | PB2               | SSPFRM/I2SWS                   | 8 mA         | 2     |
| 43      | PB1               | DREQ/nUARTRTS0                 | 8 mA         | 2     |
| 44      | PB0               | nDACK/nUARTCTS0                | 8 mA         | 2     |
| 45      | TDO               |                                | 4 mA         |       |
| 46      | TDI               |                                |              | 2, 3  |

Table 6. LH79525 Numerical Pin List (Cont'd)

| PIN NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|---------|-------------------|-------------------------|--------------|-------|
| 47      | TEST1             |                         |              | 2, 3  |
| 48      | TEST2             |                         |              | 2, 3  |
| 49      | VSS               |                         |              |       |
| 50      | TMS               |                         |              | 2, 3  |
| 51      | TCK               |                         |              | 2, 3  |
| 52      | PC7               | A23/nFRE                | 8 mA         | 1     |
| 53      | PC6               | A22/nFWE                | 8 mA         | 1     |
| 54      | PC5               | A21                     | 8 mA         | 1     |
| 55      | PC4               | A20                     | 8 mA         | 1     |
| 56      | PC3               | A19                     | 8 mA         | 1     |
| 57      | VDD               |                         |              |       |
| 58      | PC2               | A18                     | 8 mA         | 1     |
| 59      | PC1               | A17                     | 8 mA         | 1     |
| 60      | PC0               | A16                     | 8 mA         | 1     |
| 61      | A15               |                         | 8 mA         |       |
| 62      | A14               |                         | 8 mA         |       |
| 63      | A13               |                         | 8 mA         |       |
| 64      | VSSC              |                         |              |       |
| 65      | A12               |                         | 8 mA         |       |
| 66      | VDDC              |                         |              |       |
| 67      | A11               |                         | 8 mA         |       |
| 68      | VSS               |                         |              |       |
| 69      | A10               |                         | 8 mA         |       |
| 70      | A9                |                         | 8 mA         |       |
| 71      | A8                |                         | 8 mA         |       |
| 72      | A7                |                         | 8 mA         |       |
| 73      | A6                |                         | 8 mA         |       |
| 74      | A5                |                         | 8 mA         |       |
| 75      | VDD               |                         |              |       |
| 76      | A4                |                         | 8 mA         |       |
| 77      | A3                |                         | 8 mA         |       |
| 78      | A2                |                         | 8 mA         |       |
| 79      | A1                |                         | 8 mA         |       |
| 80      | A0                |                         | 8 mA         |       |
| 81      | VSS               |                         |              |       |
| 82      | PD7               | D15                     | 8 mA         | 1     |
| 83      | PD6               | D14                     | 8 mA         | 1     |
| 84      | PD5               | D13                     | 8 mA         | 1     |
| 85      | PD4               | D12                     | 8 mA         | 1     |
| 86      | VDD               |                         |              |       |
| 87      | PD3               | D11                     | 8 mA         | 1     |
| 88      | PD2               | D10                     | 8 mA         | 1     |
| 89      | PD1               | D9                      | 8 mA         | 1     |
| 90      | PD0               | D8                      | 8 mA         | 1     |
| 91      | D7                |                         | 8 mA         | 1     |
| 92      | VSS               |                         |              |       |
| 93      | D6                |                         | 8 mA         | 1     |
| 94      | D5                |                         | 8 mA         | 1     |
| 95      | D4                |                         | 8 mA         | 1     |
| 96      | D3                |                         | 8 mA         | 1     |

Table 6. LH79525 Numerical Pin List (Cont'd)

| PIN NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|---------|-------------------|-------------------------|--------------|-------|
| 97      | D2                |                         | 8 mA         | 1     |
| 98      | D1                |                         | 8 mA         | 1     |
| 99      | D0                |                         | 8 mA         | 1     |
| 100     | nCS3              | PM3                     | 8 mA         |       |
| 101     | VDD               |                         |              |       |
| 102     | nCS2              | PM2                     | 8 mA         |       |
| 103     | nCS1              | PM1                     | 8 mA         |       |
| 104     | nCS0              | PM0                     | 8 mA         |       |
| 105     | VSSC              |                         |              |       |
| 106     | nOE               |                         | 8 mA         |       |
| 107     | VDDC              |                         |              |       |
| 108     | VSS               |                         |              |       |
| 109     | nBLE1             | PM5                     | 8 mA         |       |
| 110     | nBLE0             | PM4                     | 8 mA         |       |
| 111     | nWE               |                         | 8 mA         |       |
| 112     | nCAS              |                         | 8 mA         |       |
| 113     | nRAS              |                         | 8 mA         |       |
| 114     | nDCS1             |                         | 8 mA         |       |
| 115     | nDCS0             |                         | 8 mA         |       |
| 116     | SDCKE             |                         | 8 mA         |       |
| 117     | SDCLK             |                         | 12 mA        |       |
| 118     | DQM1              |                         | 8 mA         |       |
| 119     | DQM0              |                         | 8 mA         |       |
| 120     | PE7               | nWAIT/nDEOT             | 8 mA         | 2, 3  |
| 121     | VSSA1             |                         |              |       |
| 122     | VDDA1             |                         |              |       |
| 123     | VDDA2             |                         |              |       |
| 124     | VSSA2             |                         |              |       |
| 125     | XTAL32IN          |                         |              | 5     |
| 126     | XTAL32OUT         |                         |              | 6     |
| 127     | XTALIN            |                         |              | 5     |
| 128     | XTALOUT           |                         |              | 6     |
| 129     | VDD               |                         |              |       |
| 130     | USBDN             |                         |              | 4     |
| 131     | USBDP             |                         |              | 4     |
| 132     | VSS               |                         |              |       |
| 133     | PE6               | LCDVEEN/<br>LCDMOD      | 8 mA         | 1     |
| 134     | PE5               | LCDVDDEN                | 8 mA         | 1     |
| 135     | VDD               |                         |              |       |
| 136     | PE4               | LCDDSPLEN/LCDREV        | 8 mA         | 1     |
| 137     | PE3               | LCDCLS                  | 8 mA         | 1     |
| 138     | PE2               | LCDPS                   | 8 mA         | 1     |
| 139     | PE1               | LCDDCLK                 | 8 mA         | 1     |
| 140     | VSS               |                         |              |       |
| 141     | PE0               | LCDLP/LCDHRLP           | 8 mA         | 1     |
| 142     | PF7               | LCDFP/LCDSPS            | 8 mA         | 1     |
| 143     | PF6               | LCDEN/LCDSPL            | 8 mA         | 1     |
| 144     | VDD               |                         |              |       |
| 145     | PF5               | LCDVD11                 | 8 mA         | 2     |

Table 6. LH79525 Numerical Pin List (Cont'd)

| PIN NO. | FUNCTION AT RESET | MULTIPLEXED FUNCTION(S) | OUTPUT DRIVE | NOTES |
|---------|-------------------|-------------------------|--------------|-------|
| 146     | PF4               | LCDVD10                 | 8 mA         | 2     |
| 147     | PF3               | LCDVD9                  | 8 mA         | 2     |
| 148     | VSSC              |                         |              |       |
| 149     | PF2               | LCDVD8                  | 8 mA         | 2     |
| 150     | VDDC              |                         |              |       |
| 151     | PF1               | LCDVD7                  | 8 mA         | 1     |
| 152     | VSS               |                         |              |       |
| 153     | PF0               | LCDVD6                  | 8 mA         | 1     |
| 154     | PG7               | LCDVD5                  | 8 mA         | 1     |
| 155     | PG6               | LCDVD4                  | 8 mA         | 1     |
| 156     | PG5               | LCDVD3                  | 8 mA         | 1     |
| 157     | PG4               | LCDVD2                  | 8 mA         | 1     |
| 158     | PG3               | LCDVD1                  | 8 mA         | 1     |
| 159     | PG2               | LCDVD0                  | 8 mA         | 1     |
| 160     | VDD               |                         |              |       |
| 161     | PG1               | ETHERTXCLK              | 8 mA         | 1     |
| 162     | PG0               | ETHERTXEN               | 8 mA         | 1     |
| 163     | PH7               | ETHERTX3                | 8 mA         | 1     |
| 164     | PH6               | ETHERTX2                | 8 mA         | 1     |
| 165     | PH5               | ETHERTX1                | 8 mA         | 1     |
| 166     | PH4               | ETHERTX0                | 8 mA         | 1     |
| 167     | PH3               | ETHERTXER               | 8 mA         | 1     |
| 168     | VSS               |                         |              |       |
| 169     | PH2               | ETHERRXCLK              | 8 mA         | 1     |
| 170     | PH1               | ETHERRXDV               | 8 mA         | 1     |
| 171     | PH0               | ETHERRX3                | 8 mA         | 1     |
| 172     | PI7               | ETHERRX2                | 8 mA         | 1     |
| 173     | PI6               | ETHERRX1                | 8 mA         | 1     |
| 174     | PI5               | ETHERRX0                | 8 mA         | 1     |
| 175     | PI4               | ETHERRXER               | 8 mA         | 1     |
| 176     | PI3               | ETHERCRS                | 8 mA         | 1     |

**NOTES:**

1. Internal pull-down. The internal pullup and pulldown resistance on all digital I/O pins is 50K $\Omega$ .
2. Internal pull-up. The internal pullup and pulldown resistance on all digital I/O pins is 50K $\Omega$ .
3. Input with Schmitt Trigger.
4. USB Inputs/outputs are tristated.
5. Crystal Inputs should be driven to a maximum of 1.8 V  $\pm$  10%.
6. Output is for crystal oscillator only, no drive capability.
7. Output Drive Values shown are MAX. See 'DC Specifications'.
8. All unused analog pins, and XTAL32IN (if unused) should be tied to ground through a 33K $\Omega$  resistor.

Table 7. TESTx PIN FUNCTION

| MODE         | TEST1 | TEST2 | nBLE0 |
|--------------|-------|-------|-------|
| Embedded ICE | 0     | 1     | 1     |
| Normal       | 1     | 1     | x     |

Table 8. LH79524 LCD Data Multiplexing

| LFBGA BALL NO. | LFBGA BALL NAME | STN          |            |              |            |              |            | TFT          |
|----------------|-----------------|--------------|------------|--------------|------------|--------------|------------|--------------|
|                |                 | MONO 4-BIT   |            | MONO 8-BIT   |            | COLOR        |            | COLOR        |
|                |                 | SINGLE PANEL | DUAL PANEL | SINGLE PANEL | DUAL PANEL | SINGLE PANEL | DUAL PANEL | SINGLE PANEL |
| C2             | LCDVD15         | MUSTN0       | MUSTN0     | MUSTN0       | MUSTN0     | CUSTN0       | CUSTN0     | INTENSITY    |
| C1             | LCDVD14         | X            | X          | X            | MLSTN4     | X            | CLSTN4     | BLUE4        |
| C10            | LCDVD13         | X            | X          | MUSTN6       | MUSTN6     | CUSTN6       | CUSTN6     | BLUE3        |
| A10            | LCDVD12         | X            | X          | X            | MLSTN7     | X            | CLSTN7     | BLUE2        |
| A11            | LCDVD11         | X            | X          | X            | MLSTN6     | X            | CLSTN6     | BLUE1        |
| B10            | LCDVD10         | X            | X          | X            | MLSTN5     | X            | CLSTN5     | BLUE0        |
| C9             | LCDVD9          | X            | MLSTN3     | X            | MLSTN3     | X            | CLSTN3     | GREEN4       |
| B9             | LCDVD8          | X            | MLSTN2     | X            | MLSTN2     | X            | CLSTN2     | GREEN3       |
| A9             | LCDVD7          | X            | MLSTN1     | X            | MLSTN1     | X            | CLSTN1     | GREEN2       |
| A8             | LCDVD6          | X            | MLSTN0     | X            | MLSTN0     | X            | CLSTN0     | GREEN1       |
| B8             | LCDVD5          | X            | X          | MUSTN7       | MUSTN7     | CUSTN7       | CUSTN7     | GREEN0       |
| C8             | LCDVD4          | X            | X          | MUSTN5       | MUSTN5     | CUSTN5       | CUSTN5     | RED4         |
| A7             | LCDVD3          | X            | X          | MUSTN4       | MUSTN4     | CUSTN4       | CUSTN4     | RED3         |
| B7             | LCDVD2          | MUSTN3       | MUSTN3     | MUSTN3       | MUSTN3     | CUSTN3       | CUSTN3     | RED2         |
| C7             | LCDVD1          | MUSTN2       | MUSTN2     | MUSTN2       | MUSTN2     | CUSTN2       | CUSTN2     | RED1         |
| A6             | LCDVD0          | MUSTN1       | MUSTN1     | MUSTN1       | MUSTN1     | CUSTN1       | CUSTN1     | RED0         |

**NOTES:**

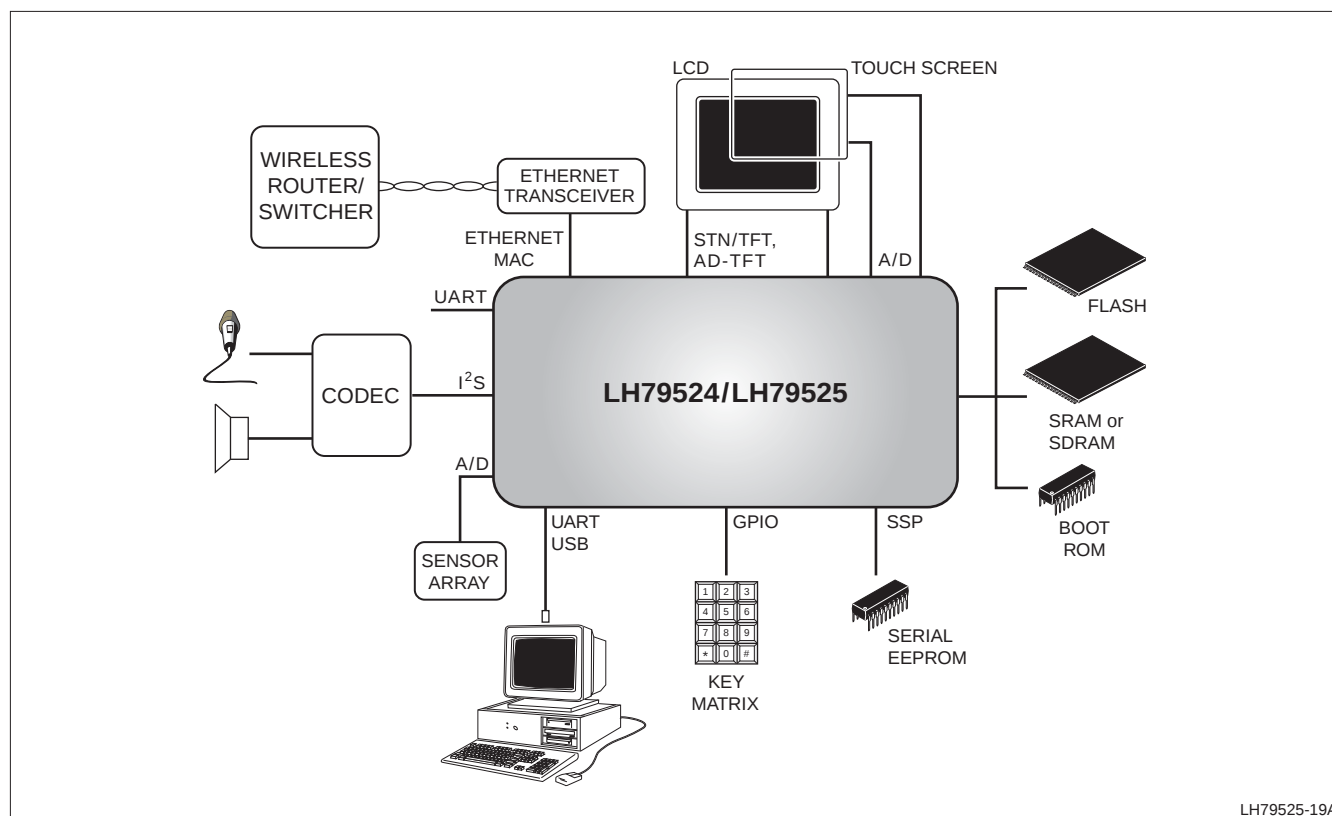
1. Recommended hookups for TFT 5:5:5 + Intensity and 5:6:5 are shown.
2. The Intensity bit is identically generated for all three colors.
3. Connect to the LSB of the Red, Green, and Blue inputs of a 6:6:6 panel.
4. CLSTN = Color Lower data bit for STN panel.
5. CUSTN = Color Upper data bit for STN panel.
6. MLSTN = Monochrome Lower data bit for STN panel.
7. MUSTN = Monochrome Upper data bit for STN panel.

Table 9. LH79525 LCD Data Multiplexing

| PIN NO. | PIN NAME | STN MONO 4-BIT |            |
|---------|----------|----------------|------------|
|         |          | SINGLE PANEL   | DUAL PANEL |
| 145     | LCDVD11  | MUSTN1         | MUSTN1     |
| 146     | LCDVD10  | MUSTN0         | MUSTN0     |
| 147     | LCDVD9   |                |            |
| 149     | LCDVD8   |                |            |
| 151     | LCDVD7   |                | MLSTN3     |
| 153     | LCDVD6   |                | MLSTN2     |
| 154     | LCDVD5   |                | MLSTN1     |
| 155     | LCDVD4   |                | MLSTN0     |
| 156     | LCDVD3   |                |            |

Table 9. LH79525 LCD Data Multiplexing

| PIN NO. | PIN NAME | STN MONO 4-BIT |            |
|---------|----------|----------------|------------|
|         |          | SINGLE PANEL   | DUAL PANEL |
| 157     | LCDVD2   |                |            |
| 158     | LCDVD1   | MUSTN3         | MUSTN3     |
| 159     | LCDVD0   | MUSTN2         | MUSTN2     |



LH79525-19A

Figure 4. LH79524/LH79525 Application Diagram Example

## SYSTEM DESCRIPTIONS

### ARM720T Processor

The LH79524/LH79525 microcontrollers feature the ARM720T cached core with an Advanced High-Performance Bus (AHB) interface. The ARM720T features:

- 32-bit ARM720T RISC Core
- 8 kB Cache
- MMU (Windows CE enabled)

The core processor for both is a member of the ARM7T family of processors. For more information, see the ARM document, 'ARM720T (Rev 3) Technical Reference Manual', available on ARM's website at [www.ARM.com](http://www.ARM.com).

The LH79524/LH79525 MMU allows mapping Physical Memory (PA) addresses to virtual memory addresses. This allows physical memory, which is constrained by hardware to specific addresses, to be reorganized at addresses identified by the user. These user identified locations are called Virtual Addresses (VA). When the MMU is enabled, Code and Data must be built, loaded, and executed using Virtual Addresses which the MMU translates to Physical Addresses. In addition, the user may implement a memory protection scheme by using the features of the MMU. Address translation and memory protection services provided by the MMU are controlled by the user. The MMU is directly controlled through the System Control Coprocessor, Coprocessor 15 (CP15). The MMU is indirectly controlled by a Translation Table (TT) and Page Tables (PT) prepared by the user and established using a portion of physical memory dedicated by the user to storing the TT and PT's.

External Memory Controller

An integrated External Memory Controller (EMC) provides a glueless interface to external SDRAM, Low Power SDRAM, Flash, SRAM, ROM, and burst ROM. Three remap options for the physical memory are selectable by software, as shown in Figure 5 through Figure 8.

The EMC supports six banks of external memory. Two chip selects for synchronous memory, and either two (LH79525) or four (LH79524) static memory chip selects are available. The static interface also includes two (LH79525) or four (LH79524) byte lane enable signals.

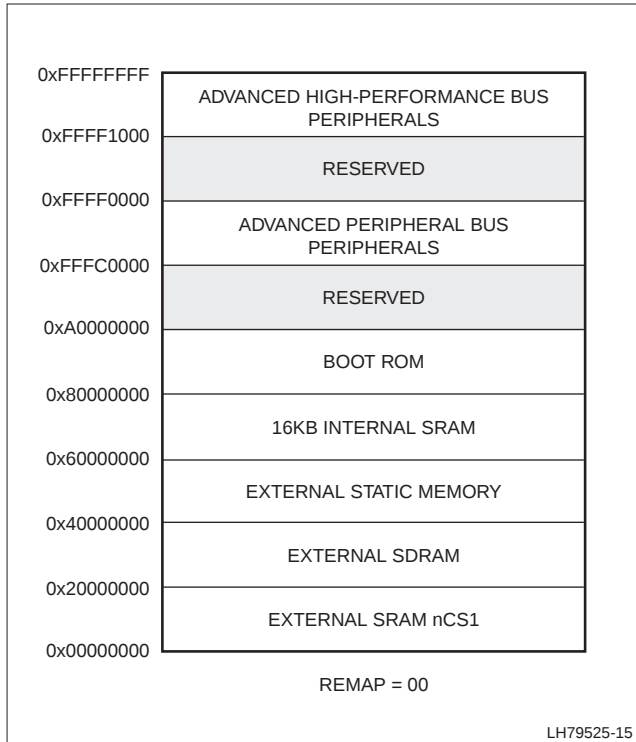


Figure 5. Memory Remap '00'

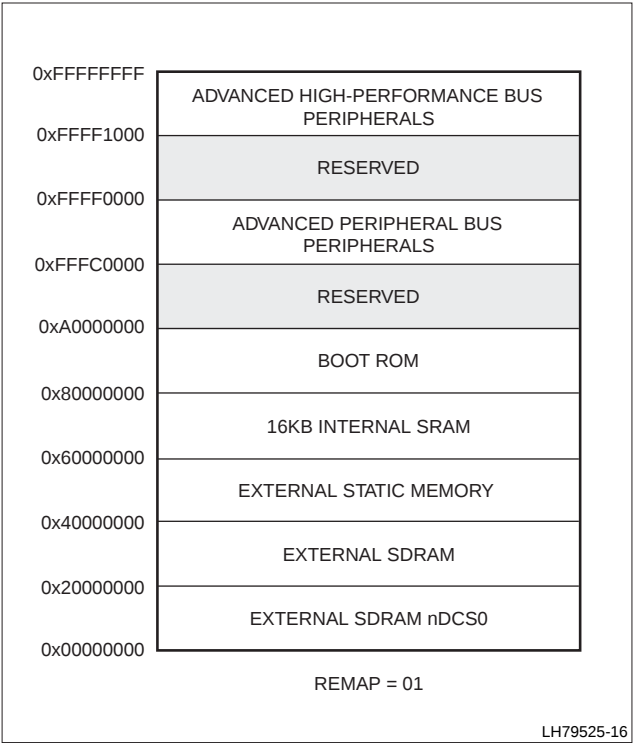


Figure 6. Memory Remap '01'

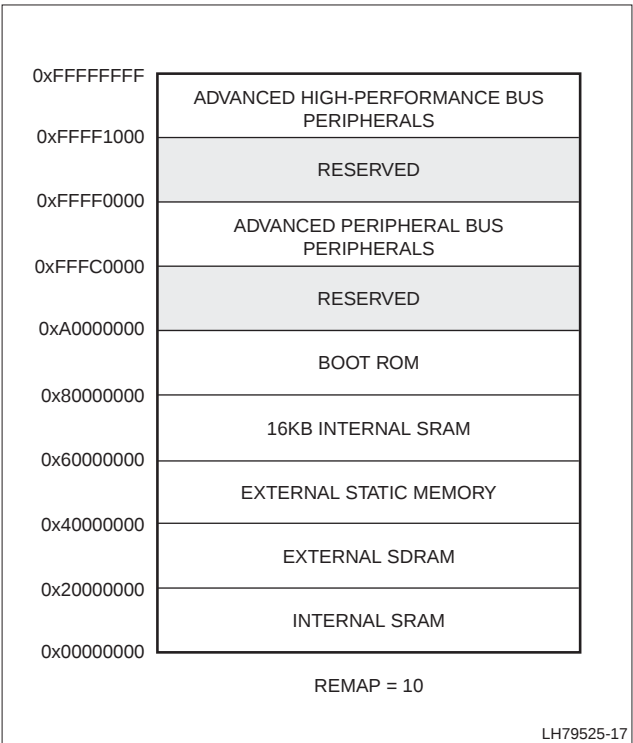


Figure 7. Memory Remap '10'

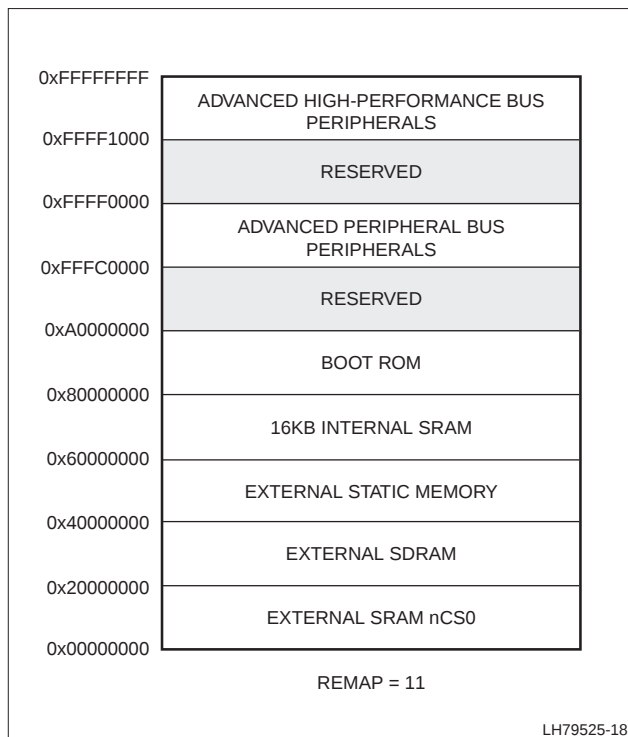


Figure 8. Memory Remap '11'

## DMA Controller

The DMA Controller provides support for DMA-capable peripherals. The LCD controller uses its own DMA port, connecting directly to memory for retrieving display data.

- Simultaneous servicing of up to 4 data streams
- Three transfer modes are supported:
  - Memory to Memory
  - Peripheral to Memory
  - Memory to Peripheral
- Identical source and destination capabilities
- Transfer Size Programmable (byte, half-word, word)
- Burst Size Programmable
- Address Increment or Address Freeze
- Transfer Error interrupt for each stream
- 16-word FIFO array with pack and unpack logic

Handles all combinations of byte, half-word or word transfers from input to output.

## Color LCD Controller (CLCDC)

The CLCDC provides all the necessary control and drive signals to interface directly with a variety of color and monochrome LCD panels.

- LH79524 has 16 LCD Data bits; LH79525 has 12 LCD Data bits.
- Supports single and dual scan color and monochrome Super Twisted Nematic (STN) displays with 4- or 8-bit interfaces (LH79524 only)

- Supports Thin Film Transistor (TFT) color displays
- Programmable resolution up to 1,024 × 1,024
- 15 gray-level mono, 3,375 color STN, and 64 k color TFT support
- 1, 2, or 4 bits-per-pixel (BPP) for monochrome STN
- 1-, 2-, 4-, or 8-BPP palettized color displays for color STN and TFT (1-, 2-, or 4-bit only on LH79525)
- True-color non-palettized, for color STN and TFT
- Programmable timing for different display panels
- 256-entry, 16-bit palette fast-access RAM
- Frame, line and pixel clock signals
- AC bias signal for STN or data enable signal for TFT panels
- Patented grayscale algorithm
- Interrupt Generation Events
- Dual 16-deep programmable 32-bit wide FIFOs for buffering incoming data.

## ADVANCED LCD INTERFACE

The Advanced LCD Interface (ALI) allows for direct connection to ultra-thin panels that do not include a timing ASIC. It converts TFT signals from the Color LCD controller to provide the proper signals, timing and levels for direct connection to a panel's Row and Column drivers for AD-TFT, HR-TFT, or any technology of panel that allows for a connection of this type. The Advanced LCD Interface peripheral also provides a bypass mode that allows the LH79524/LH79525 to interface to the built-in timing ASIC in standard TFT and STN panels.

## Synchronous Serial Port (SSP)

The SSP is a master or slave interface for synchronous serial communication with master or slave peripheral devices that support protocols for Motorola SPI, National Semiconductor MICROWIRE, or Texas Instruments Synchronous Serial Interface.

- Master or slave operation
- Programmable clock rate
- Separate transmit FIFO and receive FIFO buffers, 16 bits wide, 8 locations deep
- DMA for transmit and receive
- Programmable interface protocols: Motorola SPI, National Semiconductor MICROWIRE, or Texas Instruments Synchronous Serial Port
- Programmable data frame size from 4 to 16 bits
- Independent masking of transmit FIFO, receive FIFO and receive overrun interrupts
- Available internal loopback test mode.

## Universal Asynchronous Receiver Transmitter (UART)

The LH79524/LH79525 incorporates three UARTs. UART0, UART1, and UART2 offer similar functionality to the industry-standard 16C550. They perform serial-to-parallel conversion on data received from a peripheral device and parallel-to-serial conversion on data transmitted to the UART. The CPU reads and writes data and control status information through the AMBA APB interface. The transmit and receive paths are buffered with internal FIFO memories that support programmable-service 'trigger levels', and overrun protection. These FIFO memories enable up to 32 characters to be stored independently in both transmit and receive modes.

- Programmable bits-per-character (5, 6, 7, or 8)
- Optional nine-bit mode to tag and recognize characters as either data or address
- Nine-bit Transmit FIFO and 12-bit Receive FIFO
- Programmable FIFO trigger points
- DMA support for UART0
- Programmable IrDA SIR input/output for each UART
- Separate 16-byte transmit and receive FIFOs to reduce CPU interrupts
- Programmable FIFO disabling for 1-byte depth
- Programmable baud rate generator
- Independent masking of transmit FIFO, receive FIFO, receive timeout and modem status interrupts
- False start bit detection
- Line break generation and detection
- Fully-programmable serial interface characteristics:
  - 5-, 6-, 7-, or 8-bit data word length
  - Even-, odd-, or no-parity bit generation and detection
  - 1 or 2 stop bit generation
- IrDA SIR Encode/Decode block, providing:
  - Programmable use of IrDA SIR or UART input/output
  - Supports data rates up to 115.2 kbit/s half-duplex
  - Programmable internal clock generator, allowing division of the Reference clock in increments of 1 to 512 for low-power mode bit durations.
  - Loopback for testing

## Vectored Interrupt Controller (VIC)

The Vectored Interrupt Controller combines the interrupt request signals from 20 internal and eight external interrupt sources and applies them, after masking and prioritization, to the IRQ and FIQ interrupt inputs of the ARM7TDMI processor core.

The Interrupt Controller incorporates a hardware

interrupt vector logic with programmable priority for up to 16 interrupt sources. This logic reduces the interrupt response time for IRQ type interrupts compared to solutions using software polling to determine the highest priority interrupt source. This significantly improves the real-time capabilities of the LH79524/LH79525 in embedded control applications.

- 20 internal and eight external interrupt sources
  - Individually maskable
  - Status accessible for software polling
- IRQ interrupt vector logic for up to 16 channels with programmable priorities
- All of the interrupt channels, with the exception of the Watchdog Timer interrupt, can be programmed to generate:
  - FIQ interrupt request
  - Non-vectored IRQ interrupt request (software to poll IRQ source)
  - Vectored IRQ interrupt request (up to 16 channels total)
- The Watchdog timer can only generate FIQ interrupt requests
- External interrupt inputs programmable
  - Edge triggered or level triggered
  - Rising edge/active HIGH or falling edge/active LOW

The 32 interrupt channels are shown in Table 10.

**Table 10. Interrupt Channels**

| CHANNEL | INTERRUPT SOURCE        |
|---------|-------------------------|
| 0       | WDT                     |
| 1       | Not Used                |
| 2       | COMRX (used for debug)  |
| 3       | COMTX (used for debug)  |
| 4       | Counter/Timer0 Combined |
| 5       | Counter/Timer1 Combined |
| 6       | Counter/Timer2 Combined |
| 7       | External Interrupt 0    |
| 8       | External Interrupt 1    |
| 9       | External Interrupt 2    |
| 10      | External Interrupt 3    |
| 11      | External Interrupt 4    |
| 12      | External Interrupt 5    |
| 13      | External Interrupt 6    |
| 14      | External Interrupt 7    |
| 15      | RTC_ALARM               |
| 16      | ACD TSIRQ Combined      |
| 17      | ADC Brown Out INTR      |

Table 10. Interrupt Channels (Cont'd)

| CHANNEL | INTERRUPT SOURCE               |
|---------|--------------------------------|
| 18      | ADC Pen IRQ                    |
| 19      | CLCD Combined Interrupt        |
| 20      | DMA Stream 0                   |
| 21      | DMA Stream 1                   |
| 22      | DMA Stream 2                   |
| 23      | DMA Stream 3                   |
| 24      | SSP I <sup>2</sup> S Interrupt |
| 25      | Ethernet Interrupt             |
| 26      | USB Interrupt                  |
| 27      | UART 0 Interrupt               |
| 28      | UART 1 Interrupt               |
| 29      | UART 2 Interrupt               |
| 30      | USB DMA Interrupt              |
| 31      | I <sup>2</sup> C Interrupt     |

## Reset, Clock, and Power Controller (RCPC)

The RCPC generates the various clock signals for the operation of the LH79524/LH79525 and provides for an orderly start-up after power-on and during a wake-up from one of the power saving operating modes. The RCPC allows the software to individually select the frequency of the various on-chip clock signals as required to operate the chip in the most power-efficient mode. The maximum speeds of the various clocks in the SoC are shown in Table 11. More detailed descriptions of each clock appear in the User's Guide.

The RCPC features:

- 10 - 20 MHz crystal oscillator and PLL for on-chip Clock generation (11.2896 MHz recommended)
- External Clock input if on-chip oscillator and PLL are not used
- 32.768 kHz crystal oscillator generating 1 Hz clock for Real Time Clock
- Individually controlled clocks for peripherals and CPU
- Programmable clock prescalers for UARTs and PWMs
- Five global power control modes are available:
  - Active
  - Standby
  - Sleep
  - Stop1
  - Stop2
- CPU/Bus clock frequency can be changed on the fly
- Selectable clock output
- Hardware reset (nRESETIN) and software reset.

Table 11. Maximum Clock Speeds

| NAME                             | FREQUENCY (MAX.) |
|----------------------------------|------------------|
| Oscillator Clock (CLK OSC)       | 20.0 MHz         |
| PLL System Clock (CLK PLL)       | 304.819 MHz      |
| PLL USB Clock                    | 48.0 MHz         |
| 32.768 kHz Oscillator Clock      | 32.768 kHz       |
| AHB Clock (HCLK)                 | 50.803 MHz       |
| AHB Fast CPU Clock (FCLK CPU)    | 76.205 MHz       |
| Ethernet Clock                   | 50.803 MHz       |
| DMA Clock                        | 50.803 MHz       |
| External Memory Controller Clock | 50.803 MHz       |
| SSP Clock                        | 50.803 MHz       |
| CLCD Clock                       | 50.803 MHz       |
| UART[2:0] Clock                  | 20.0 MHz         |
| RTC Clock                        | 1.0 Hz           |

Table 12. Clock Activity for Different Power Modes

| DEVICE                 | ACTIVE | STANDBY | SLEEP | STOP1 | STOP2 |
|------------------------|--------|---------|-------|-------|-------|
| RTC 32 kHz Oscillator  | ON     | ON      | ON    | ON    | ON    |
| 10 - 20 MHz Oscillator | ON     | ON      | ON    | ON    | OFF   |
| PLL                    | ON     | ON      | ON    | OFF   | OFF   |
| Peripheral Clock       | ON     | ON      | OFF   | OFF   | OFF   |
| CPU Clock              | ON     | OFF     | OFF   | OFF   | OFF   |

## Real Time Clock

The RTC provides an alarm or long time base counter. An interrupt is generated following counting a programmed number of one-second periods. The 1 Hz RTC clock is internally derived. The RTC features:

- 32-bit up counter with programmable load
- Programmable 32-bit match compare register
- Software maskable interrupt when counter and compare registers are identical.

RTC input clock sources:

- PLL clock
- 32.768 kHz clock
- 1 Hz clock (default).

## Watchdog Timer

The Watchdog Timer provides hardware protection against malfunctions. It is a programmable timer to be reset by software at regular intervals. Failure to reset the timer will cause a FIQ interrupt. Failure to service the FIQ interrupt will then generate a System Reset. The features of the Watchdog Timer are:

- Driven by the bus clock
- 16 programmable time-out periods:  $2^{16}$  through  $2^{31}$  clock cycles
- Generates a reset or an FIQ Interrupt whenever a time-out period is reached
- Software enable, lockout, and counter-reset mechanisms add security against inadvertent writes
- Protection mechanism guards against interrupt-service failure:
  - The first WDT time-out triggers FIQ and asserts nWDFIQ status flag
  - If FIQ service routine fails to clear nWDFIQ, then the next WDT time-out triggers a system reset.

## Timers

The LH79524 and LH79525 incorporate three 16-bit independently programmable Timer modules. The timers are clocked by the system clock, but have an internal scaled-down system clock that is used for the Pulse Width Modulator (PWM) and compare functions.

All counters are incremented by an internal prescaled counter clock or external clock and can generate an overflow interrupt. All three timers have separate internal prescaled counter clocks, with either a common external clock or a prescaled version of the system clock.

- Timer 0 has five Capture Registers and two Compare Registers.
- Timer 1 and Timer 2 have two Capture and two Compare Registers each.

The Capture Registers have edge-selectable inputs and can generate an interrupt. The Compare Registers can force the compare output pin either HIGH or LOW upon a match.

The timers support a PWM Mode that uses the two Timer Compare Registers associated with a timer to create a PWM. Each timer can generate a separate interrupt. The interrupt becomes active if any enabled compare, capture, or overflow interrupt condition occurs. The interrupt remains active until all compare, capture, and overflow interrupts are cleared.

## General Purpose Input/Output (GPIO)

The LH79524 provides up to 108 bits of programmable input/output, and the LH79525 provides 86 bits. Many of the GPIO pins are multiplexed with other signals. All GPIO feature:

- Individually programmable input/output pins
- All default to Input on power-up.
- LH79524
  - Ports A-I, K, L, and N: Bidirectional I/O (Port N is 4 bits wide)
  - Port J: Input only
  - Port M: Output only
- LH79525
  - Ports A-I: Bidirectional I/O
  - Port J: Input only
  - Port M: Output only (6 bits wide)

## Boot Controller

The boot controller allows selection of the hardware device to be used for booting.

- Supports booting from 8-, 16-, or 32-bit devices, selectable via external pins at power-on reset
- Configures the byte lane boot state for nCS1, selectable via external pins at power-on reset.
- Supports booting from alternate external devices (e.g., NAND flash) via external pins on power-on reset
- Glueless interface to external NAND flash.

## USB Device

The USB Device integrated into the LH79524/LH79525 is compliant with the USB 1.1 and 2.0 specification, and compatible with both the OpenHCI and Intel UHCI standards. The USB Device:

- Supports Full-Speed (12 Mbit/s) operation, and suspend and resume signaling
- Four Endpoints
- Bulk/Interrupt or Isochronous Transfers
- FIFO for each Endpoint direction (except EP0 which shares a FIFO between IN/OUT). FIFOs exist in  $2464 \times 8$  RAM
- Supports DMA accesses to FIFO.

## Ethernet MAC Controller

The on-board Ethernet MAC Controller (EMAC) is compatible with IEEE 802.3, and has passed the University of New Hampshire (UNH) testing. It supports both 10- and 100-Mbit/s, and full and half duplex operation. Other features include:

- Statistics counter registers for RMON/MIB
- MII interface to the physical layer
- Interrupt generation to signal receive and transmit completion
- Transmit and receive FIFOs
- Automatic pad and CRC generation on transmitted frames
- Automatic discard of frames received with errors
- Address checking logic supports up to four specific (hardware) 48-bit addresses
- Supports promiscuous mode where all valid received frames are copied to memory
- Hash matching of unicast and multicast destination addresses
- Supports physical layer management through MDIO interface
- Supports serial network interface operation
- Support for:
  - Half duplex flow control by forcing collisions on incoming frames
  - Full duplex flow control with recognition of incoming pause frames and hardware generation of transmitted pause frames
  - 802.Q VLAN tagging with recognition of incoming VLAN and priority tagged frames
- Multiple buffers per receive and transmit frame
- Software configures the MAC address
- Jumbo frames of up to 10,240 bytes supported.

## I<sup>2</sup>C Controller

The I<sup>2</sup>C Controller includes a two-wire I<sup>2</sup>C serial interface capable of operating in either Master or Slave mode. The block conforms to the I<sup>2</sup>C 2.1 Bus Specification for data rates up to 400 kbit/s. The two wires are SCL (serial clock) and SDA (serial data). The I<sup>2</sup>C module provides the following features:

- Two-wire synchronous serial interface
- Operates in both the standard mode, for data rates up to 100 kbit/s, and the fast mode, with data rates up to 400 kbit/s
- Communicates with devices in the fast mode as well as the standard mode if both are attached to the bus.

## SSP To I<sup>2</sup>S Converter

The SSP to I<sup>2</sup>S converter is an interface that converts a synchronous serial communication stream in TI DSP-compatible mode into an I<sup>2</sup>S compliant synchronous serial stream. The I<sup>2</sup>S converter operates on serial data in both master and slave mode.

The I<sup>2</sup>S converter provides:

- Programmable Word Select (WS) delay
- Left/right channel information:
  - Current WS value at the pin
  - WS value associated with next entry written to TX FIFO
  - WS value associated with next entry read from RX FIFO
- Ability to invert WS state
- Ability to invert the bit clock
- Supports frame size of 16 bits only. Any other frame size will result in a frame size error. Each frame transmits starting with the most-significant bit.
- Master and slave modes supported
- As with the SSP, a single combined interrupt is generated as an OR function of the individual interrupt requests. This interrupt replaces the SSP interrupt, which is used solely as an input to the I<sup>2</sup>S converter.
- Additional interrupts:
  - Transmit FIFO underrun
  - Transmit frame size error
  - Receive frame size error
- A set of Interrupt registers contain all the information in the SSPIMSC, SSPRIS, and SSPMIS registers, plus the transmit underrun error and frame size errors
- Additional status bits:
  - Transmit FIFO Full
  - Receive FIFO Empty
- Passes SSP data unaltered when module is not enabled
- Loopback Test Mode support.

## ADC and Brownout Detector

The ADC block consists of an 10-channel, 10-bit Analog-to-Digital Converter with integrated Touch Screen Controller (TSC). The complete touch screen interface is achieved by combining the front-end biasing, control circuitry with analog-to-digital conversion, reference generation, and digital control.

The ADC has a bias-and-control network that allows correct operation with both 4- and 5-wire touch panels. A 16-entry × 16-bit wide FIFO holds a 10-bit ADC output and a 4-bit tag number.

When the screen is touched, it pushes the conductive coating on the coversheet against the coating on the glass, making electrical contact. The voltages produced are the analog representation of the position touched. The voltage level of the coversheet is converted continuously by the ADC and monitored by the system.

Other features include:

- 10-bit fully differential Successive Approximation Register (SAR) with integrated sample/hold
- A 10-channel multiplexer that routes user-selected inputs to the ADC in single-ended and differential modes
- A 16-entry × 16-bit wide FIFO that holds the 10-bit ADC output
- Front bias-and-control network for touch screen interface and support functions, which are compatible with industry-standard 4- and 5-wire touch-sensitive panels
- Touch-pressure sensing circuits
- Pen-down sensing circuit and interrupt generator
- Independent voltage reference generator
- Conversion automation function to minimize interrupt overhead
- Brownout Detector
- Battery Control Signal.

## ELECTRICAL SPECIFICATIONS

### Absolute Maximum Ratings

| PARAMETER                        | SYMBOL | RATING      | UNIT |
|----------------------------------|--------|-------------|------|
| DC Core Supply Voltage           | VDDC   | -0.3 to 2.4 | V    |
| DC I/O Supply Voltage            | VDD    | -0.3 to 4.6 | V    |
| DC Analog Supply Voltage for ADC | VDDA0  | -0.3 to 4.6 | V    |
|                                  | VDDA1  | -0.3 to 2.4 | V    |
|                                  | VDDA2  | -0.3 to 2.4 | V    |
| Storage Temperature              | TSTG   | -55 to +125 | °C   |

**NOTE:** These stress ratings are only for transient conditions. Operation at or beyond absolute maximum rating conditions may affect reliability and cause permanent damage to the device.

## Recommended Operating Conditions

| PARAMETER                          | MINIMUM  | TYPICAL     | MAXIMUM    | NOTES |
|------------------------------------|----------|-------------|------------|-------|
| DC Core Supply Voltage (VDDC)      | 1.7 V    | 1.8 V       | 1.9 V      | 1, 4  |
| DC I/O Supply Voltage (VDD)        | 3.0 V    | 3.3 V       | 3.6 V      | 4     |
| DC Analog Supply Voltage (VDDA0)   | 3.0 V    | 3.3 V       | 3.6 V      |       |
| DC Analog Supply Voltage (VDDA1)   | 1.7 V    | 1.8 V       | 1.9 V      |       |
| DC Analog Supply Voltage (VDDA2)   | 1.7 V    | 1.8 V       | 1.9 V      |       |
| Clock Frequency                    | 3.27 MHz |             | 76.205 MHz | 2     |
| Crystal Frequency                  | 10.0 MHz | 11.2896 MHz | 20.0 MHz   | 3     |
| Operating Temperature (Industrial) | -40°C    | 25°C        | +85°C      |       |

### NOTES:

1. Linear Regulator disabled.
2. With PLL enabled. Without PLL, minimum frequency is 0 MHz. Some peripherals may not operate at minimum frequency.
3. Choose 11.2896 MHz to ensure proper operation of the I<sup>2</sup>S, USB, and UART peripherals.
4. Core Voltage should never exceed I/O Voltage after initial power up. See "Power Supply Sequencing" on page 28.

## Power Supply Sequencing

When the linear regulator is *not* enabled, NXP recommends that the 1.8 V power supply be energized before the 3.3 V supply. If this is not possible, the 1.8 V supply may not lag the 3.3 V supply by more than 100  $\mu$ s. If longer delay time is needed, it is recommended that the voltage difference between the two power supplies be within 1.5 V during power supply ramp up. To avoid a potential latchup condition, voltage should be applied to input pins only after the device is powered-on as described above.

## DC/AC Specifications

Unless noted, all data provided are based on:

- -40°C to +85°C (Industrial temperature range)
- VDDC = 1.7 V to 1.9 V
- VDD = 3.0 V to 3.6 V, VDDA = 1.7 V to 1.9 V.

## DC SPECIFICATIONS

| SYMBOL           | PARAMETER                                       | MIN. | TYP. | MAX. | UNIT       | CONDITIONS                                                        |
|------------------|-------------------------------------------------|------|------|------|------------|-------------------------------------------------------------------|
| VIH              | CMOS input HIGH voltage                         | 2.0  |      | 5.5  | V          | CEN = 1                                                           |
| VIL              | CMOS input LOW voltage                          |      |      | 0.8  | V          | CEN = 1                                                           |
| VIT+             | Positive Input threshold voltage (Schmitt pins) | 2.0  |      |      | V          | CSEN = 1                                                          |
| VIT-             | Negative Input threshold voltage (Schmitt pins) |      |      | 0.8  | V          | CSEN = 1                                                          |
| VHYST            | Schmitt trigger hysteresis                      |      | 0.35 |      | V          | CSEN = 1                                                          |
| VOH <sup>1</sup> | Output drive (2 mA type)                        | 2.6  |      |      | V          | IOH = -2 mA                                                       |
|                  | Output drive (4 mA type)                        | 2.6  |      |      | V          | IOH = -4 mA                                                       |
|                  | Output drive (8 mA type)                        | 2.6  |      |      | V          | IOH = -8 mA                                                       |
|                  | Output drive (12 mA type)                       | 2.6  |      |      | V          | IOH = -12 mA                                                      |
| VOL <sup>1</sup> | Output drive (2 mA type)                        |      |      | 0.4  | V          | IOL = 2 mA                                                        |
|                  | Output drive (4 mA type)                        |      |      | 0.4  | V          | IOL = 4 mA                                                        |
|                  | Output drive (8 mA type)                        |      |      | 0.4  | V          | IOL = 7 mA                                                        |
|                  | Output drive (12 mA type)                       | 2.6  |      |      | V          | IOH = 12 mA                                                       |
| RIN              | Input leakage pull-up/pull-down resistors       |      | 40   |      | k $\Omega$ | VIN = VDD or GND (Calculate input leakage current at desired VDD) |
| IACTIVE          | Active current                                  |      | 85   |      | mA         | Note 2                                                            |
| ISTANDBY         | Standby current                                 |      | 50   |      | mA         | Notes 2, 3                                                        |
| ISLEEP           | Sleep current                                   |      | 3.8  |      | mA         |                                                                   |
| ISTOP1           | Stop1 current                                   |      | 420  |      | $\mu$ A    |                                                                   |
| ISTOP2           | Stop2 current                                   |      | 115  |      | $\mu$ A    | RTC ON, Linear Regulator ON                                       |
| ISTOP2           | Stop2 current                                   |      | 95   |      | $\mu$ A    | RTC OFF, Linear Regulator ON                                      |
| ISTOP2           | Stop2 current                                   |      | 45   |      | $\mu$ A    | RTC ON, Linear Regulator OFF                                      |
| ISTOP2           | Stop2 current                                   |      | 25   |      | $\mu$ A    | RTC OFF, Linear Regulator OFF                                     |

### NOTES:

1. Table 2 details each pin's buffer type.
2. Running Typical Application over operating range.
3. Current measured with CPU stopped and all peripherals enabled

## Linear Regulator DC Characteristics.

| SYMBOL     | PARAMETER                              | MIN. | TYP. | MAX. | UNIT    |
|------------|----------------------------------------|------|------|------|---------|
| IQUIESCENT | Quiescent Current                      |      | 75   |      | $\mu$ A |
| ISLEEPLR   | Current with Linear Regulator disabled |      | 8    |      | $\mu$ A |
| IOLR       | Output Current Range                   | 0.0  |      | 200  | mA      |
| VOLR       | Output Voltage, Linear Regulator       |      | 1.84 |      | V       |

## AC Test Conditions

| PARAMETER                                | RATING     | UNIT |
|------------------------------------------|------------|------|
| Supply Voltage (VDD)                     | 3.0 to 3.6 | V    |
| Core Voltage (VDDC)                      | 1.7 to 1.9 | V    |
| Input Pulse Levels                       | VSS to VDD | V    |
| Input Rise and Fall Times                | 2          | ns   |
| Input and Output Timing Reference Levels | VDD/2      | V    |

## Power Consumption By Peripheral Device

Table 13 shows the typical power consumption by individual peripheral device.

**Table 13. Peripheral Current Consumption**

| PERIPHERAL          | TYPICAL    | UNITS |
|---------------------|------------|-------|
| ADC/TSC             | 590        | μA    |
| Counter/Timers      | 203        | μA    |
| DMA                 | 4.2        | mA    |
| Ethernet Controller | 670        | μA    |
| I <sup>2</sup> S    | 200        | μA    |
| LCD Controller      | 2.2        | mA    |
| RTC                 | 5.1        | μA    |
| SSP                 | 508        | μA    |
| UARTs               | 203        | μA    |
| USB Device (+PLL)   | 5.6 (+3.3) | mA    |

## AC Specifications

All signals described in Table 14 relate to transitions after a reference clock signal. The illustration in Figure 9 represents all cases of these sets of measurement parameters; except for the Asynchronous Memory Interface — which are referenced to Address Valid.

The reference clock signals in this design are:

- HCLK, the System Bus clock
- PCLK, the Peripheral Bus clock (locked to HCLK in the LH79524/LH79525)
- SSPCLK, the Synchronous Serial Interface clock
- UARTCLK, the UART Interface clock
- LCDDCLK, the LCD Data clock from the LCD Controller
- and SDCLK, the SDRAM clock.

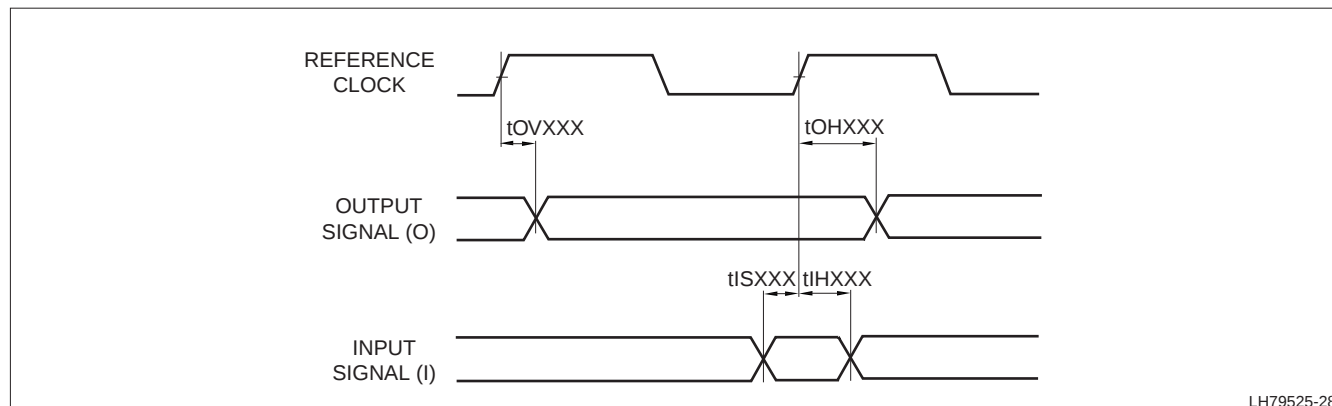
All signal transitions are measured from the 50% point of the clock to the 50% point of the signal. See Figure 9.

For outputs from the LH79524/LH79525, tOVXXX (e.g. tOVA) represents the amount of time for the output to become valid from the rising edge of the reference clock signal. Maximum requirements for tOVXXX are shown in Table 14.

The signal tOHXXX (e.g. tOHA) represents the amount of time the output will be held valid from the rising edge of the reference clock signal. Minimum requirements for tOHXXX are listed in Table 14.

For Inputs, tISXXX (e.g. tISD) represents the amount of time the input signal must be valid before the rising edge of the clock signal. Minimum requirements for tISXXX are shown in Table 14.

The signal tIHXXX (e.g. tIHD) represents the amount of time the output must be held valid from the rising edge of the reference clock signal. Minimum requirements are shown in Table 14.



**Figure 9. LH79524/LH79525 Signal Timing**

Table 14. AC Signal Characteristics

| SIGNAL                                | TYPE           | LOAD  | SYMBOL             | MIN.               | MAX.               | DESCRIPTION                     |
|---------------------------------------|----------------|-------|--------------------|--------------------|--------------------|---------------------------------|
| ASYNCHRONOUS MEMORY INTERFACE SIGNALS |                |       |                    |                    |                    |                                 |
| A[27:0]                               | Output         | 50 pF | tWC                | 3 × tHCLK – 5.0 ns |                    | Write Cycle time                |
|                                       | Input          |       | tRC                | 2 × tHCLK – 5.0 ns |                    | Read Cycle time                 |
| D[31:0]                               | Output         | 50 pF | tDHWE              | tHCLK – 5.5 ns     |                    | Data out hold to nWE release    |
|                                       |                |       | tDWE               | tHCLK – 4.5 ns     |                    | Data out valid to nWE release   |
|                                       |                |       | tDSCS              | 14.0 ns            |                    | Data valid to nCSx release      |
|                                       |                |       | tDSOE              | 12.5 ns            |                    | Data valid to nOE release       |
|                                       |                |       | tDSB               | 12.0 ns            |                    | Data valid to nBLEx release     |
|                                       |                |       | tDHCS              | 0.0 ns             |                    | nCSx release to data invalid    |
|                                       |                |       | tDHOE              | 0.0 ns             |                    | nOE release to data invalid     |
| nCS[3:0]                              | Output         | 50 pF | tAV                |                    | 2.5 ns             | nCSx valid to Address valid     |
|                                       |                |       | tAHCS              | tHCLK – 3.0 ns     |                    | Address hold after nCSx release |
|                                       |                |       | tAHOE              | tHCLK - 1.0 ns     |                    | Address hold after nOE release  |
|                                       |                |       | tASCS              |                    | 2.5 ns             | Address valid to nCSx valid     |
|                                       |                |       | tCW                |                    | 2 × tHCLK + 3.0 ns | nCSx valid to nWE release       |
|                                       |                |       | tCB                |                    | 2 × tHCLK          | nCSx valid to nBLE release      |
|                                       |                |       | tCS                | tHCLK – 3.5 ns     |                    | nCSx width                      |
| nBLE                                  | Output         | 50 pF | tBV                |                    | 1.5 ns             | nCSx valid to nBLE valid        |
|                                       |                |       | tAHB               | tHCLK – 2.0 ns     |                    | Address hold after nBLE release |
|                                       |                |       | tDB                | tHCLK – 6.0 ns     |                    | Data out valid to nBLE release  |
|                                       |                |       | tDHBR              | 0.0 ns             |                    | Data in hold to nBLE release    |
|                                       |                |       | tDHBW              | tHCLK + 9 ns       |                    | Data out hold to nBLE release   |
|                                       |                |       | tBR                | –2.0 ns            |                    | Address hold to nBLE release    |
|                                       |                |       | tAB                |                    | 2 × tHCLK ns       | Address valid to nBLE release   |
|                                       |                |       | tASB               |                    | 1.0 ns             | Address valid to nBLE valid     |
|                                       |                |       | tBLE               | tHCLK – 4.5 ns     |                    | nBLE width (read)               |
| tBP                                   | tHCLK – 4.5 ns |       | nBLE width (write) |                    |                    |                                 |
| nWE                                   | Output         | 50 pF | tASWE              |                    | tHCLK + 1.5 ns     | Address valid to nWE valid      |
|                                       |                |       | tAW                |                    | 2 × tHCLK + 0.5 ns | Address valid to nWE release    |
|                                       |                |       | tWR                | tHCLK – 3.0 ns     |                    | Address Hold to nWE release     |
|                                       |                |       | tWP                | tHCLK – 1 ns       |                    | Write Enable width              |
| nOE                                   | Output         | 50 pF | tOE                | tHCLK – 1 ns       |                    | Ouput Enable width              |
|                                       |                |       | tOEV               |                    | – 0.5 ns           | nOE valid after nCSx valid      |
| SYNCHRONOUS MEMORY INTERFACE SIGNALS  |                |       |                    |                    |                    |                                 |
| A[23:0]                               | Ouput          | 50 pF | tOVA               |                    | tSDCLK/2 + 4.5 ns  | Address Valid                   |
| D[31:0]                               | Output         | 50 pF | tOVD               |                    | tSDCLK/2 + 7.0 ns  | Output Data Valid               |
|                                       |                |       | tOHD               | tSDCLK/2 – 4.0 ns  |                    | Output Data Hold                |
|                                       | Input          |       | tISD               | 5.0 ns             |                    | Input Data Setup                |
|                                       |                |       | tIHD               | 1.5 ns             |                    | Input Data Hold                 |
| nCAS                                  | Output         | 50 pF | tOVCA              |                    | tSDCLK/2 + 4.0 ns  | CAS Valid                       |
|                                       |                |       | tOHCA              | tSDCLK/2 – 4.0 ns  |                    | CAS Hold                        |
| nRAS                                  | Output         | 50 pF | tOVRA              |                    | tSDCLK/2 + 4.5 ns  | RAS Valid                       |
|                                       |                |       | tOHRA              | tSDCLK/2 – 4.0 ns  |                    | RAS Hold                        |

Table 14. AC Signal Characteristics (Cont'd)

| SIGNAL                               | TYPE   | LOAD  | SYMBOL    | MIN.                  | MAX.              | DESCRIPTION                                  |
|--------------------------------------|--------|-------|-----------|-----------------------|-------------------|----------------------------------------------|
| nWE                                  | Output | 30 pF | tOVSDW    |                       | tSDCLK/2 + 4.5 ns | SDWE Write Enable Valid                      |
|                                      |        |       | tOHSDW    | tSDCLK/2 – 4.0 ns     |                   | SDWE Write Enable Hold                       |
| SDCKE                                | Output | 30 pF | tOVCO     |                       | tSDCLK/2 + 4.5 ns | SDCKE Clock Enable Valid                     |
|                                      |        |       | tOHC0     | tSDCLK/2 – 4.0 ns     |                   | SDCKE Clock Enable Hold                      |
| DQM[3:0]                             | Output | 30 pF | tOVDQ     |                       | tSDCLK/2 + 5.0 ns | DQM Data Mask Valid                          |
|                                      |        |       | tOHDQ     | tSDCLK/2 – 4.0 ns     |                   | DQM Data Mask Hold                           |
| nSDCS[1:0]                           | Output | 30 pF | tOVSC     |                       | tSDCLK/2 + 4.5 ns | SDCS Data Mask Valid                         |
|                                      |        |       | tOHSC     | tSDCLK/2 – 4.0 ns     |                   | SDCS Data Mask Hold                          |
| SDCLK                                | Output | 30 pF | tSDCLK    | 19.37 ns              |                   | SDRAM Clock Period                           |
| <b>SYNCHRONOUS SERIAL PORT (SSP)</b> |        |       |           |                       |                   |                                              |
| SSPFRM                               | Output | 50 pF | tOVSSPFRM |                       | 14 ns             | tOVSSPFRM Output Valid, Referenced to SSPCLK |
| SSPTX                                | Output | 50 pF | tOVSSPTX  |                       | 14 ns             | SSP Transmit Valid                           |
| SSPRX                                | Input  |       | tISSPRX   | 20 ns                 |                   | SSP Receive Setup                            |
| <b>ETHERNET MAC CONTROLLER (EMC)</b> |        |       |           |                       |                   |                                              |
| ETHERTXER                            | Output | 50 pF | tOVTXER   |                       | 25 ns             | Transmit Data Valid after ETHERTXCLK         |
|                                      |        |       | tOHTXER   | ETHERTXCLK/2 + 2.0 ns |                   | Transmit Data Hold after ETHERTXCLK          |
| ETHERTX[3:0]                         | Output | 50 pF | tOVTXD    |                       | 25 ns             | Transmit Data Valid after ETHERTXCLK         |
|                                      |        |       | tOHTXD    | ETHERTXCLK/2 + 2.0 ns |                   | Transmit Data Hold after ETHERTXCLK          |
| ETHERTXEN                            | Output | 50 pF | tOVTXEN   |                       | 25 ns             | Transmit Data Valid after ETHERTXCLK         |
|                                      |        |       | tOHTXEN   | ETHERTXCLK/2 + 2.0 ns |                   | Transmit Data Hold after ETHERTXCLK          |
| ETHERRXDV                            | Input  |       | tISRXDV   | 10 ns                 |                   | Receive Data Setup prior to ETHERRXCLK       |
|                                      |        |       | tIHRXDV   | 10 ns                 |                   | Receive Data Hold prior to ETHERRXCLK        |
| ETHERRX[3:0]                         | Input  |       | tISRXD    | 10 ns                 |                   | Receive Data Setup prior to ETHERRXCLK       |
|                                      |        |       | tIHRXD    | 10 ns                 |                   | Receive Data Hold prior to ETHERRXCLK        |

## Analog-To-Digital Converter

### Electrical Characteristics

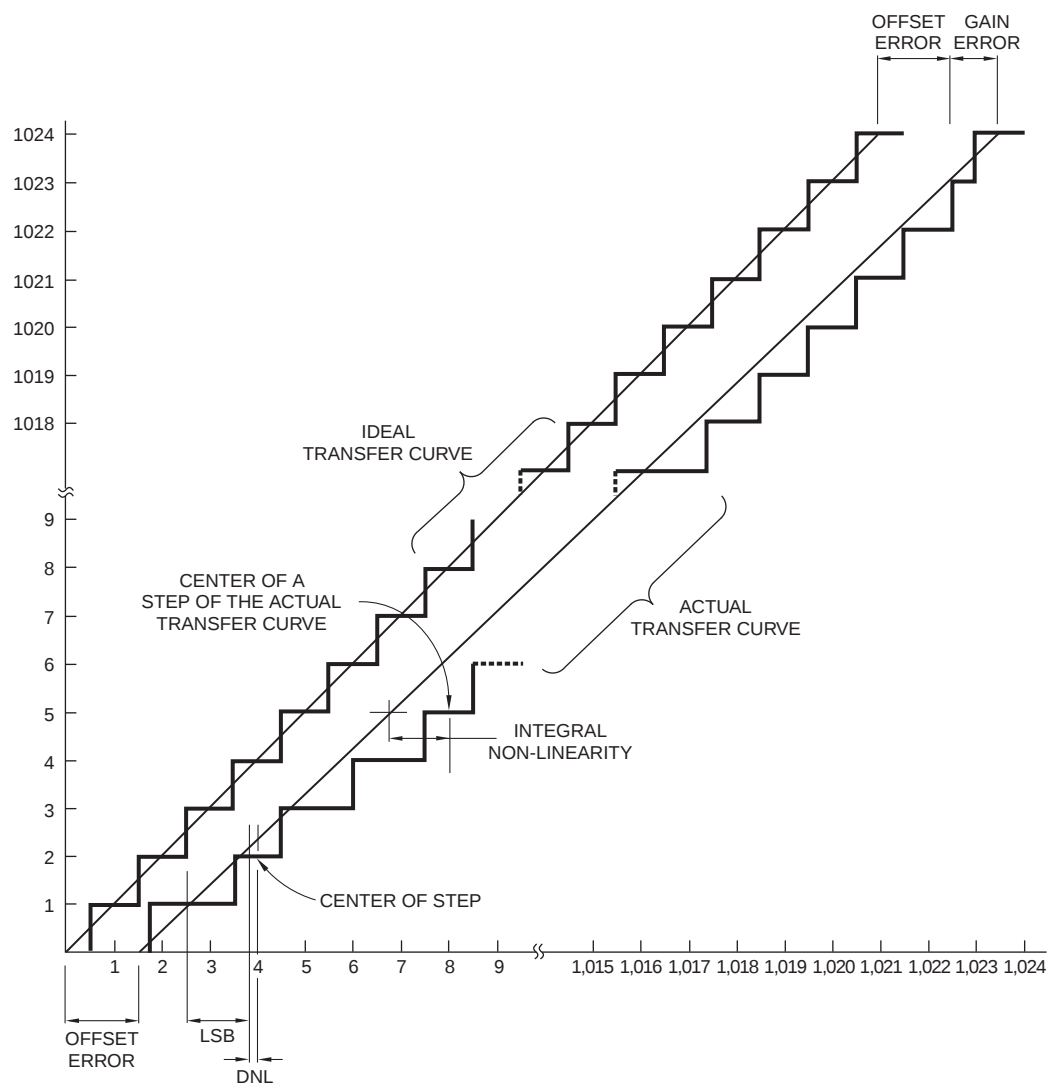
Table 15 shows the ADC electrical characteristics.  
See Figure 10 for the ADC transfer characteristics.

**Table 15. ADC Electrical Characteristics**

| PARAMETER                            | MIN.           | TYP.   | MAX.           | UNITS        | NOTES |
|--------------------------------------|----------------|--------|----------------|--------------|-------|
| A/D Resolution                       | 10             |        | 10             | Bits         |       |
| Throughput Conversion                | 17             |        |                | CLK Cycles   | 1     |
| Acquisition Time                     | 3              |        |                | CLK Cycles   |       |
| Data Format                          |                | binary |                |              |       |
| CLK Frequency                        | 500            |        | 5,000          | ns           |       |
| Differential Non-Linearity           | -0.99          |        | 3.0            | LSB          |       |
| Integral Non-Linearity               | -3.0           |        | +3.0           | LSB          |       |
| Offset Error                         | -10            |        | +10            | mV           |       |
| Gain Error                           | -2.0           |        | +2.0           | LSB          |       |
| Reference Voltage Output             | 1.85           | 2.0    | 2.15           | V            |       |
| VREF-                                | VSSA           | VSSA   | (VREF+) -1.0 V | V            | 2     |
| VREF+                                | (VREF-) +1.0 V | VREF   | VDDA           | V            | 2     |
| Crosstalk between channels           |                | -60    |                | dB           |       |
| Analog Input Voltage Range           | 0              |        | VDDA           | V            | 3     |
| Analog Input Current                 |                |        | 5              | $\mu$ A      |       |
| Reference Input Current              |                |        | 5              | $\mu$ A      |       |
| Analog input capacitance             |                |        | 15             | pF           |       |
| Operating Supply Voltage             | 3.0            |        | 3.6            | V            |       |
| Operating Current, VDDA0             |                | 590    | 1000           | $\mu$ A      |       |
| Powerdown Current, VDDA0             |                | 1      | 10             | $\mu$ A      |       |
| Standby Current                      |                | 180    | 300            | $\mu$ A      | 4     |
| Brown Out Trip Point (falling point) | 2.36           | 2.63   | 2.9            | V            |       |
| Brown Out Hysteresis                 |                | 120    |                | mV           |       |
| Operating Temperature                | -40            |        | 85             | $^{\circ}$ C |       |

#### NOTES:

1. The analog section of the ADC takes  $16 \times A2DCLK$  cycles per conversion plus  $1 \times A2DCLK$  cycles to be made available in the PCLK domain. An additional  $3 \times PCLK$  cycles are required before being available on the APB.
2. The internal voltage reference is driven to nominal value  $VREF = 2.0$  V. Using the Reference Multiplexer, alternative low impedance ( $R_S < 500$ ) voltages can be selected as reference voltages. The range of voltages allowed are specified above. However, the on-chip reference cannot drive the ADC unless the reference buffer is switched on.
3. The analog input pins can be driven anywhere between the power supply rails. If the voltage at the input to the ADC exceeds  $VREF+$  or is below  $VREF-$ , the A/D result will saturate appropriately at positive or negative full scale. Trying to pull the analog input pins above or below the power supply rails will cause protection diodes to be forward-biased, resulting in large current source/sink and possible damage to the ADC.
4. Bandgap and other low-bandwidth circuitry operating. All other ADC blocks shut down.



LH79525-2

**Figure 10. ADC Transfer Characteristics**

## External Memory Controller Waveforms

The External Memory Controller (EMC) handles transactions with both static and dynamic memory.

### STATIC MEMORY WAVEFORMS

This section illustrates static memory transaction waveforms. Each wait state is one HCLK period.

#### nWAIT Input

The EMC's Static Memory Controller supports an nWAIT input that can be used by an external device to extend the wait time during a memory access. The SMC samples nWAIT at the beginning of at the beginning of each system clock cycle. The system clock cycle in which the nCSx signal is asserted counts as the first wait state. See Figure 11 through Figure 20.

#### Read and Write Waveforms

Figure 17 shows the Read cycle with zero wait states. As shown in the figure, SWAITOENx and SWAITRDx are programmed to 0 for minimum Read cycle time.

The zero programmed into the SWAITRDx indicates that the read occurs with zero wait states, on the first rising edge following Address Valid. After a small propagation delay, nOE is deasserted (as is nCSx), latching the data into the SoC. The address line is held valid one more HCLK period ('C' in the figure). Thus, the minimum Read cycle is two HCLK periods.

Figure 18 shows the minimum write cycle time with both SWAITWRx and SWAITWENx programmed to zero. The write access time is determined by the number of wait states programmed in the SWAITWRx register.

In Figure 18, nCSx is asserted coincident (following a small propagation delay) with Valid Address. Data becomes valid another small propagation delay later. Unlike Read transactions, nWE (or nBLEx) assertion is always delayed one HCLK cycle. The nBLEx signal has the same timing as nWE for write to 8-bit devices that use the byte lane enables instead of the write enables.

The nWE (or nBLEx) signal remains asserted for one HCLK cycle when the nWE (or nBLEx) signal is deasserted and the data is latched into the external memory device. Valid address is held for one additional cycle before deassertion ('C' in the figure), as is the Chip Select. The minimum Write cycle is three HCLK periods.

Read wait state programming uses the SWAITRDx register. Figure 19 shows the results of programming SWAITRDx to 0x3, setting the EMC for three wait states. The deassertion of nOE is delayed from the first rising HCLK edge following Valid Address, as in Figure 17, to the fourth rising edge, a delay of 3 HCLK periods.

Figure 20 shows the results of programming the SWAITWRx and SWAITWENx registers for two Write wait states: register SWAITWENx = 0x0, and SWAITWRx = 0x2. Assertion of nCSx precedes nWE (nBLEx) by one HCLK period. Then, instead of the nWE (nBLEx) signal deasserting one HCLK period after assertion, it is delayed two wait states and the signal deasserts on the rising edge following two wait states.

Chapter 7 of the User's Guide has detailed register descriptions and additional programming examples.

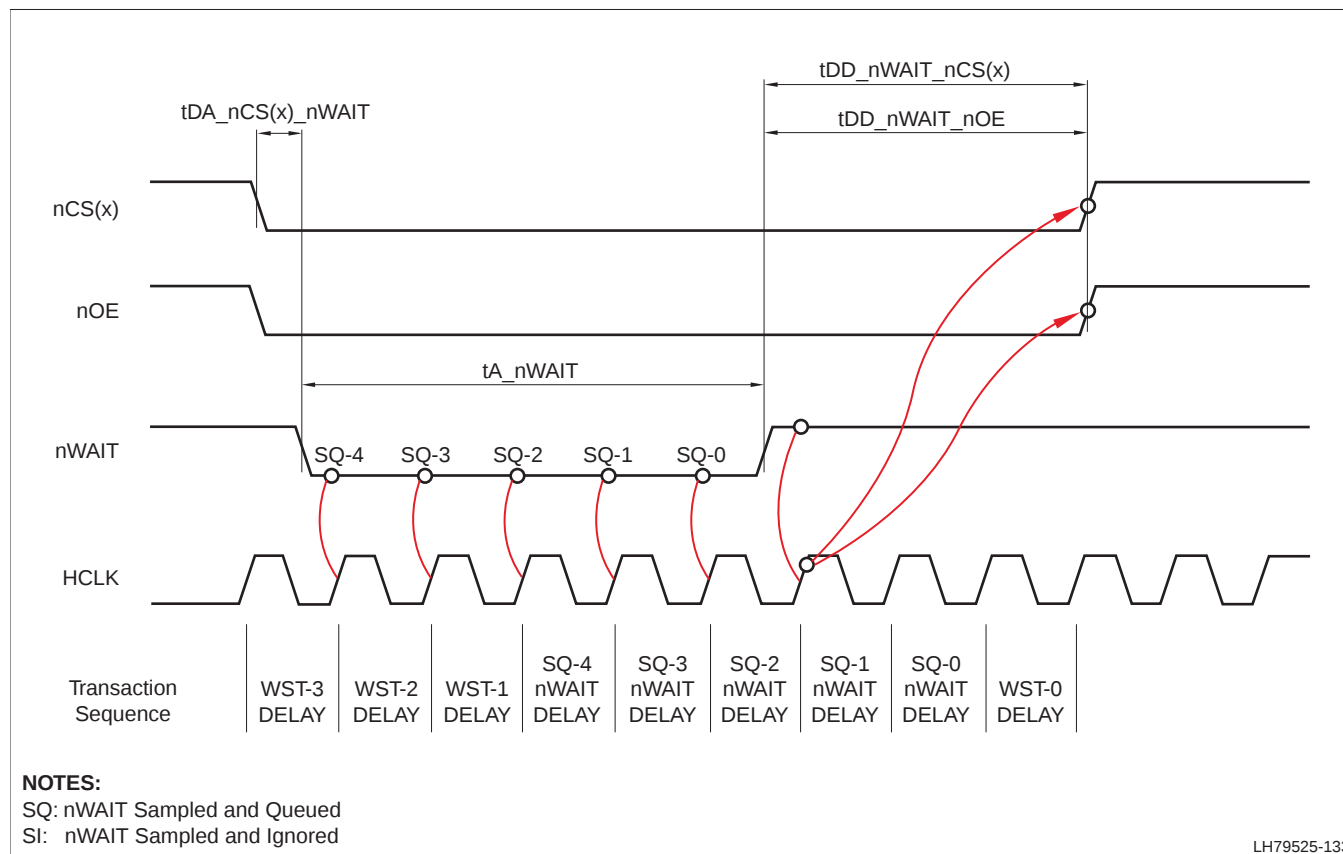


Figure 11. nWAIT Read Sequence (SWAITRDx = 3)

Table 16. nWAIT Read Sequence Parameter Definitions

| PARAMETER        | DESCRIPTION                                        | MIN. | MAX.   | UNIT <sup>1</sup> |
|------------------|----------------------------------------------------|------|--------|-------------------|
| tDA_nCS(x)_nWAIT | Delay from nCS(x) assertion to nWAIT assertion     | 0    | 16,365 | HCLK periods      |
| tDD_nWAIT_nCS(x) | Delay from nWAIT deassertion to nCS(x) deassertion |      | 4      | HCLK periods      |
| tDD_nWAIT_nOE    | Delay from nWAIT deassertion to nOE deassertion    |      | 4      | HCLK periods      |
| tA_nWAIT         | Assertion time of nWAIT                            | 2    |        | HCLK periods      |

**NOTES:**

- The timing relationship is specified as a cycle-based timing. Variations caused by clock jitter, power rail noise, and I/O conditioning will cause these timings to vary nominally. It is recommended that designers add a small margin to avoid possible corner-case conditions.
- The Read Wait States register (SWAITRDx) must be set to a minimum value of 3.
- For each rising clock edge (HCLK) that the assertion of nWAIT lags the assertion of nCSx, another read wait state (SWAITRDx) must be added to the minimum requirement.
- nWAIT delay cycles are *not* added for all nWAIT assertions sampled prior to WST-3. These nWAIT assertions are ignored.
- nWAIT delay cycles are added for all nWAIT assertions sampled from WST-3 until the de-assertion of nWAIT. nWAIT delay cycles are added once the wait state countdown has reached WST-1.
- Once nWAIT is sampled high, the current memory transaction is queued to complete.
- Since static and dynamic memory cannot be accessed at the same time, any prolonged access (either due to nWAIT or the Extended Wait Register) that causes an SDRAM refresh failure may cause SDRAM data to be lost.
- Timing assumes Output Enable Delay register (SWAITOENx) is programmed to 0.

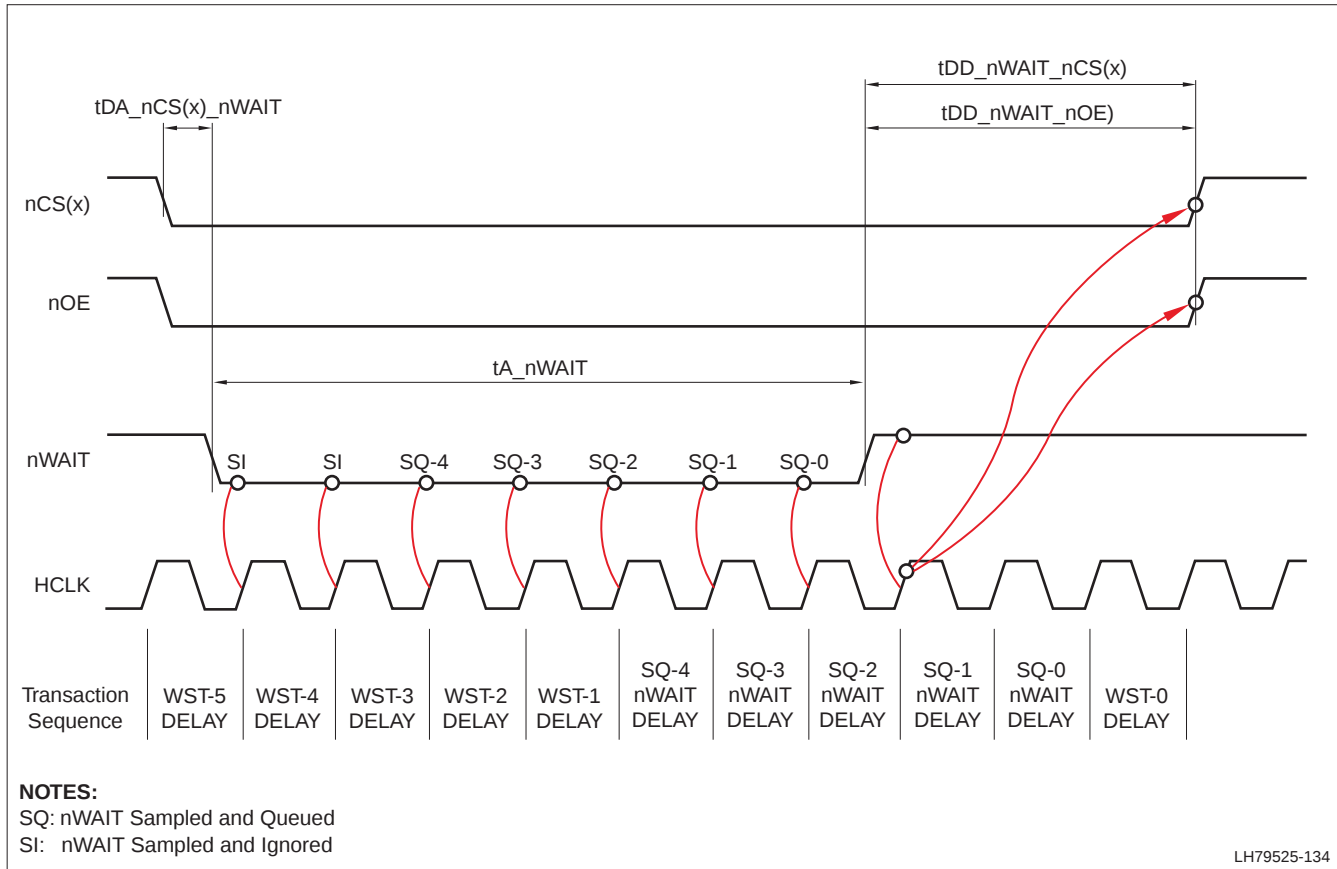


Figure 12. nWAIT Read Sequence (SWAITRDx = 5)

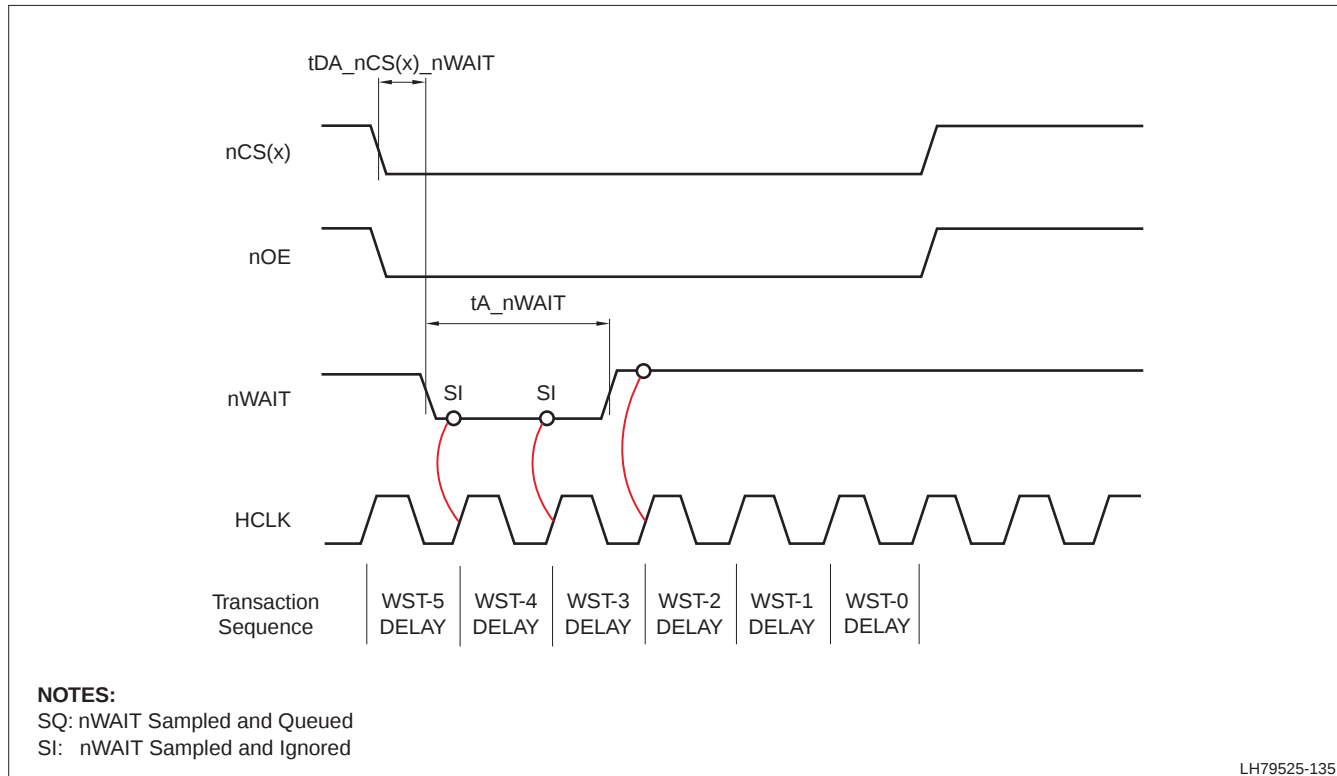


Figure 13. nWAIT Read Sequence (SWAITRDx = 5): nWAIT has no effect on the current transaction

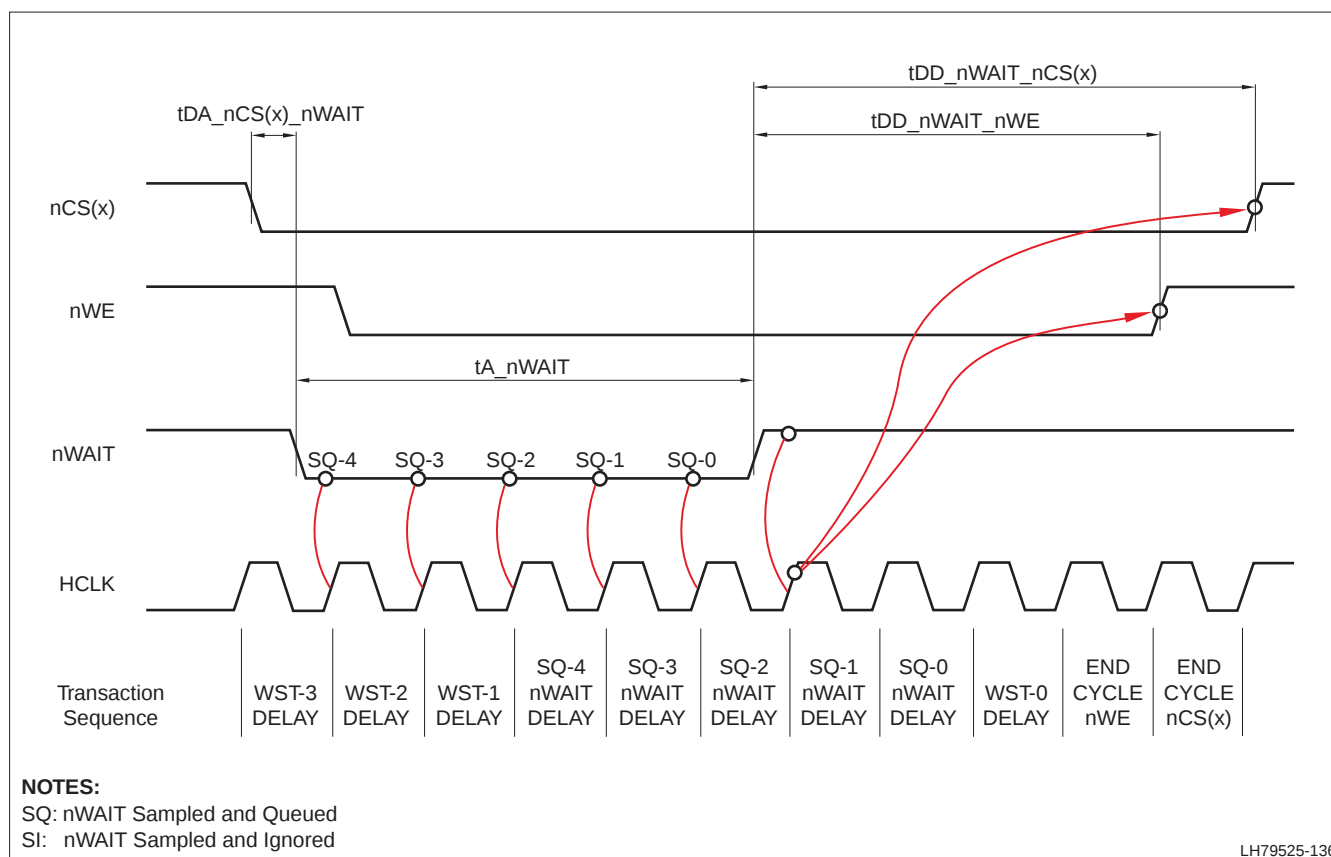


Figure 14. nWAIT Write Sequence (SWAITWRx = 3)

Table 17. nWAIT Write Sequence Parameter Definitions

| PARAMETER         | DESCRIPTION                                        | MIN. | MAX.   | UNIT <sup>1</sup> |
|-------------------|----------------------------------------------------|------|--------|-------------------|
| tIDA_nCS(x)_nWAIT | Delay from nCS(x) assertion to nWAIT assertion     | 0    | 16,365 | HCLK periods      |
| tDD_nWAIT_nCS(x)  | Delay from nWAIT deassertion to nCS(x) deassertion |      | 6      | HCLK periods      |
| tDD_nWAIT_nWE     | Delay from nWAIT deassertion to nWE deassertion    |      | 5      | HCLK periods      |
| tA_nWAIT          | Assertion time of nWAIT                            | 2    |        | HCLK periods      |

**NOTES:**

1. The timing relationship is specified as a cycle-based timing. Variations caused by clock jitter, power rail noise, and I/O conditioning will cause these timings to vary nominally. It is recommended that designers add a small margin to avoid possible corner-case conditions.
2. The Write Wait States register (SWAITWRx) must be set to a minimum value of 3.
3. For each rising clock edge (HCLK) that the assertion of nWAIT lags the assertion of nCSx, another write wait state (SWAITRDx) must be added to the minimum requirement.
4. nWAIT delay cycles are *not* added for all nWAIT assertions sampled prior to WST-3. These nWAIT assertions are ignored.
5. nWAIT delay cycles are added for all nWAIT assertions sampled from WST-3 until the de-assertion of nWAIT. nWAIT delay cycles are added once the wait state countdown has reached WST-1.
6. Once nWAIT is sampled high, the current memory transaction is queued to complete.
7. Since static and dynamic memory cannot be accessed at the same time, any prolonged access (either due to nWAIT or the Extended Wait Register) that causes an SDRAM refresh failure may cause SDRAM data to be lost.
8. Timing assumes Write Enable Delay register (SWAITWENx) is programmed to 0.

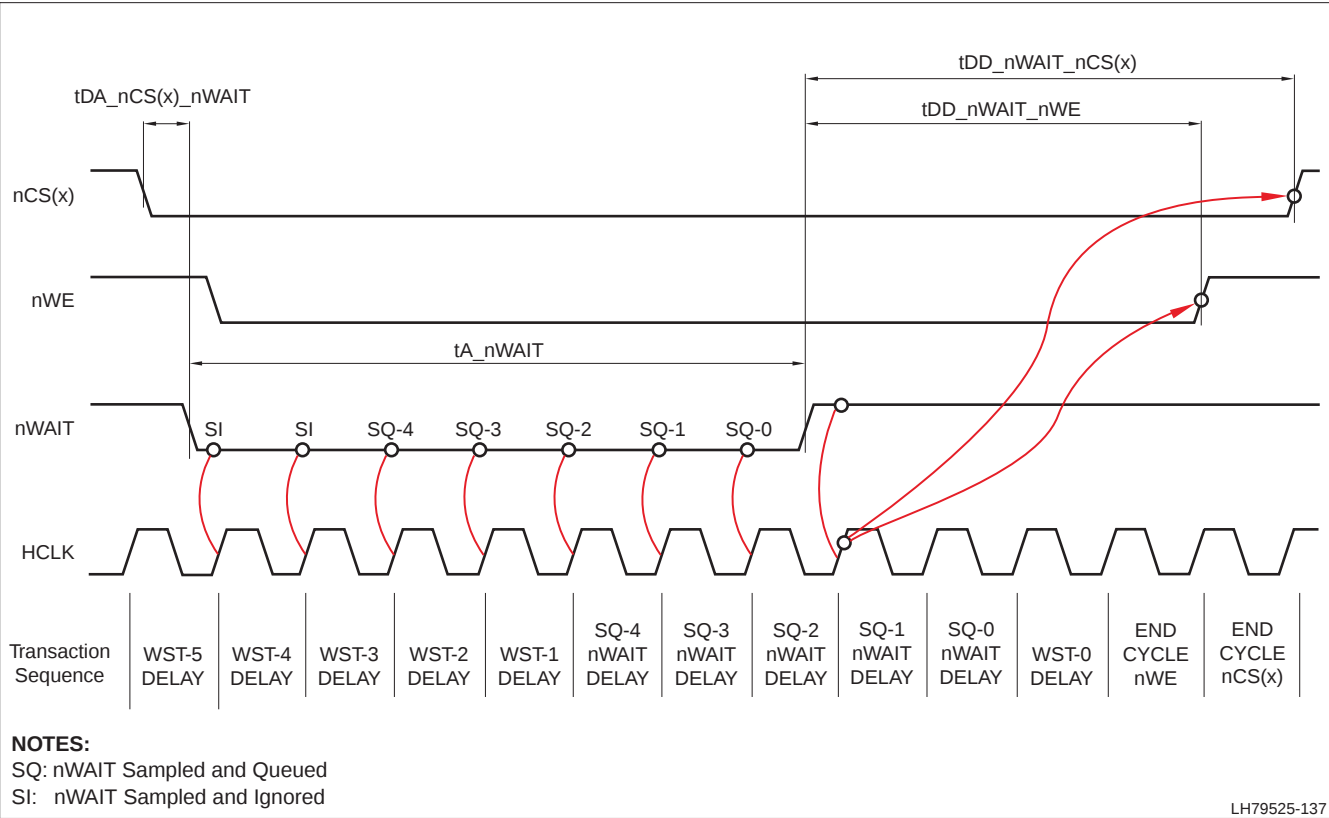


Figure 15. nWAIT Write Sequence (SWAITWRx = 5)

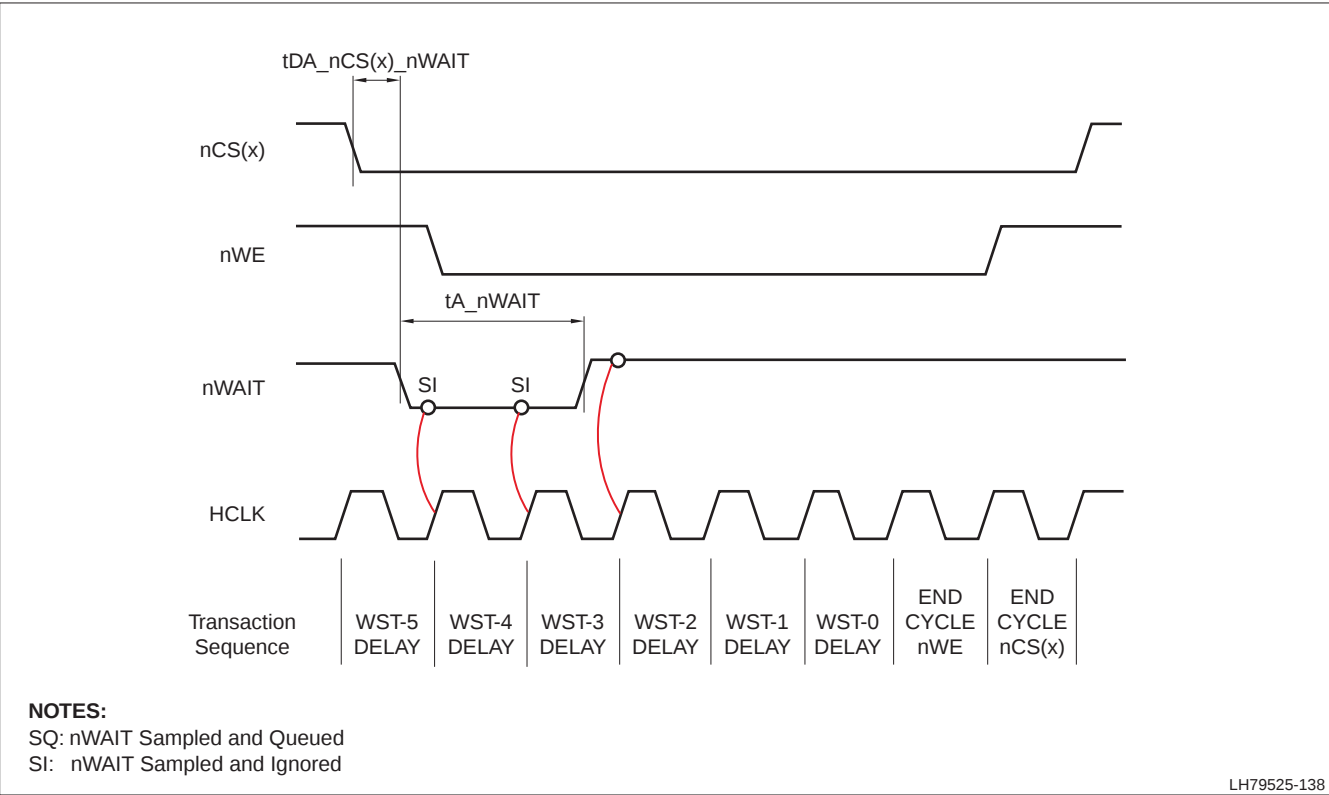
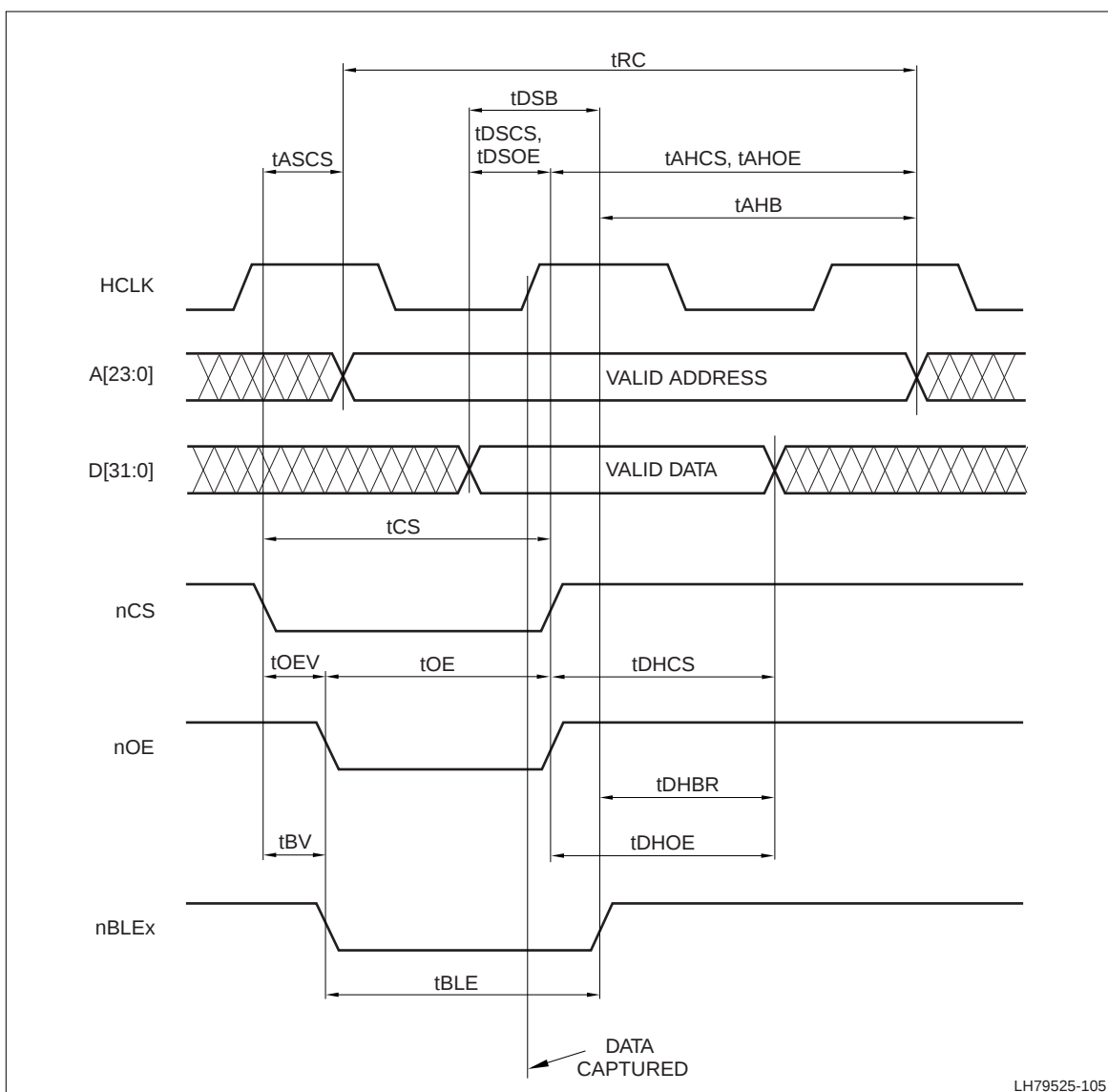


Figure 16. nWAIT Write Sequence (SWAITWRx = 5): nWAIT has no effect on the current transaction



LH79525-105

Figure 17. External Static Memory Read, Zero Wait States

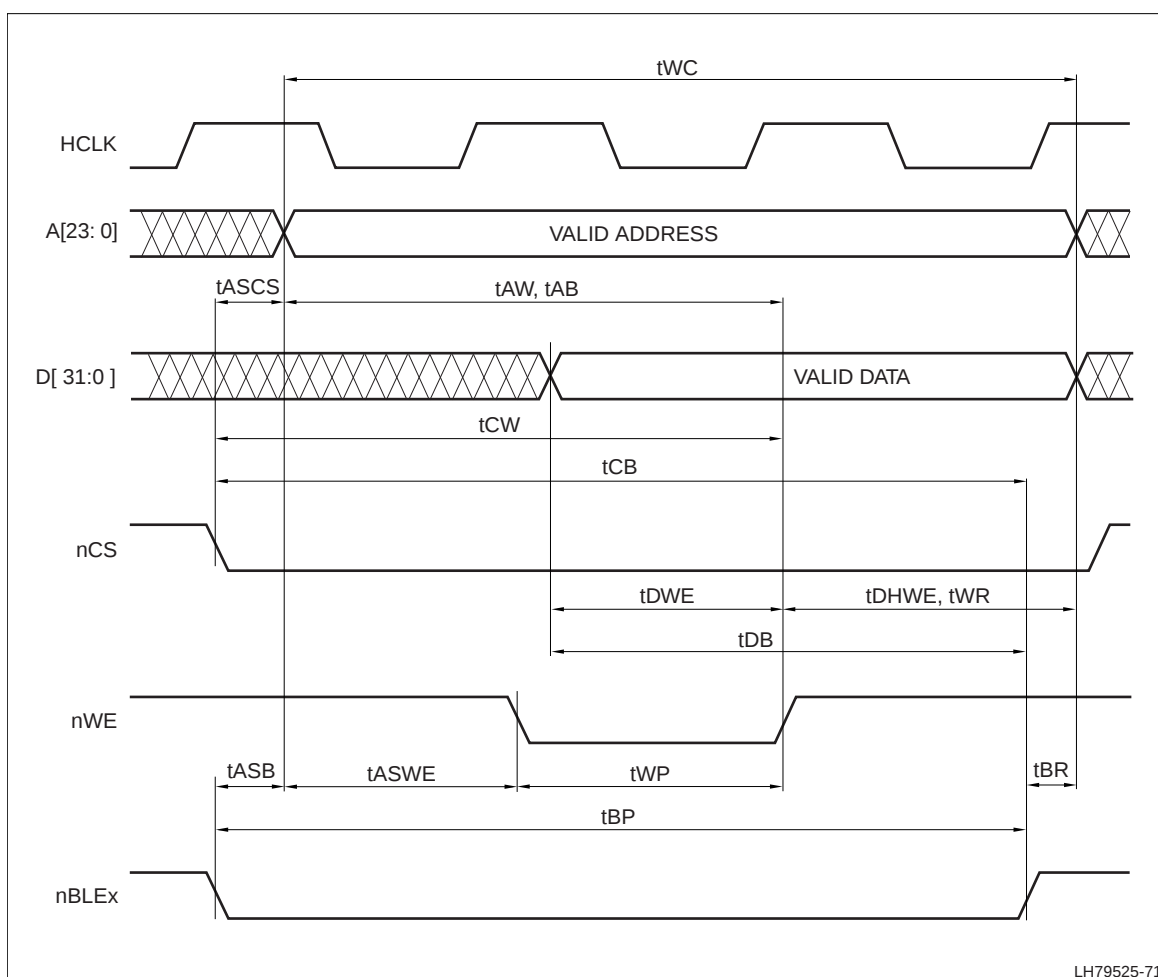


Figure 18. External Static Memory Write, Zero Wait States

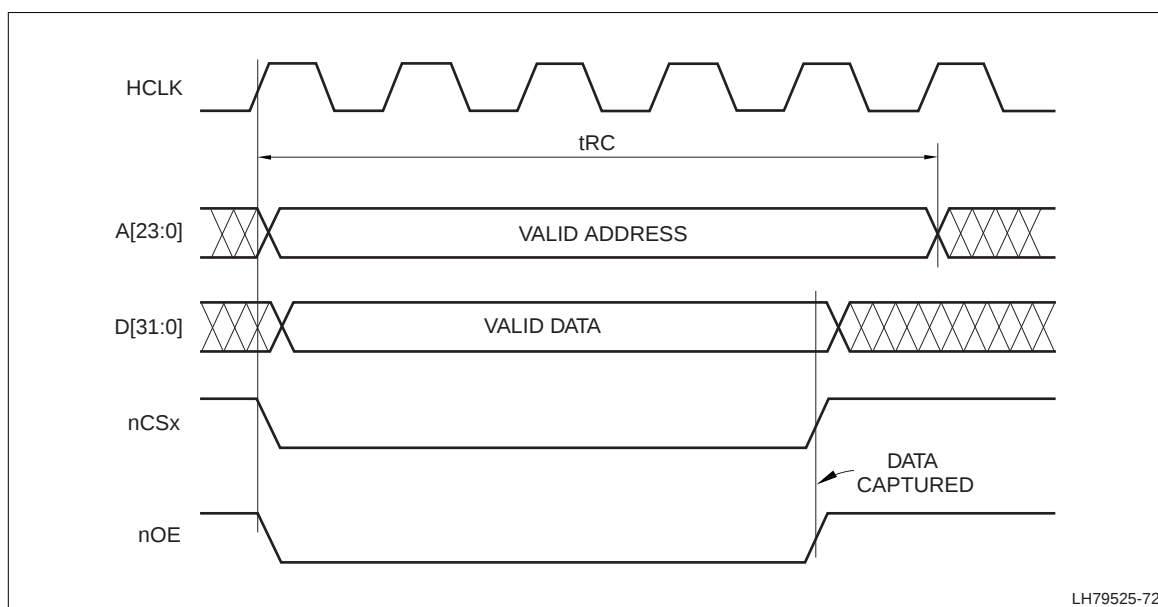


Figure 19. External Static Memory Read with Three Wait States

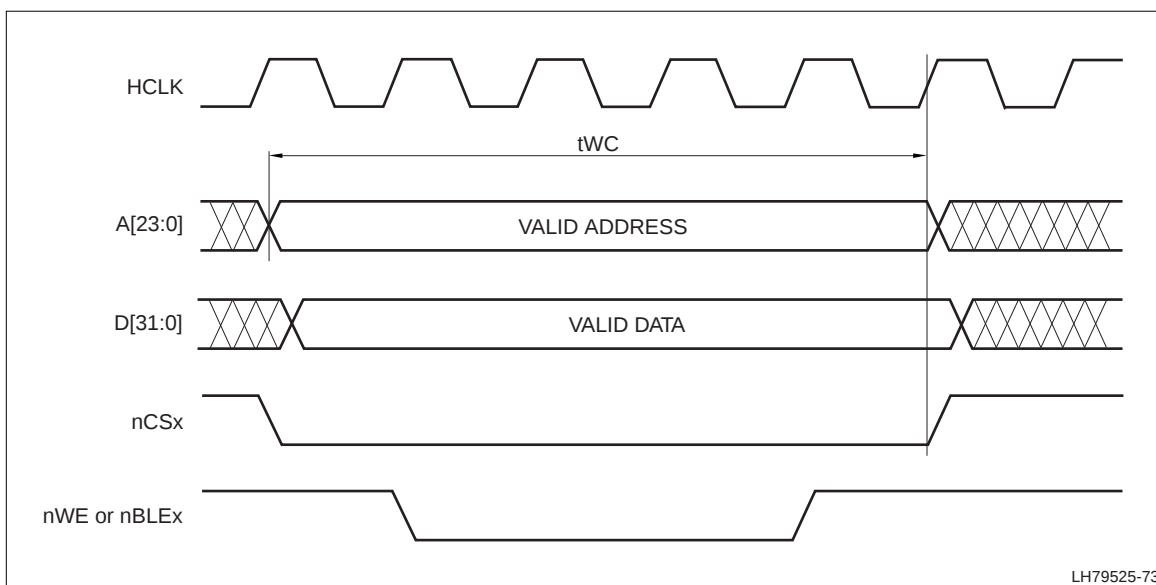
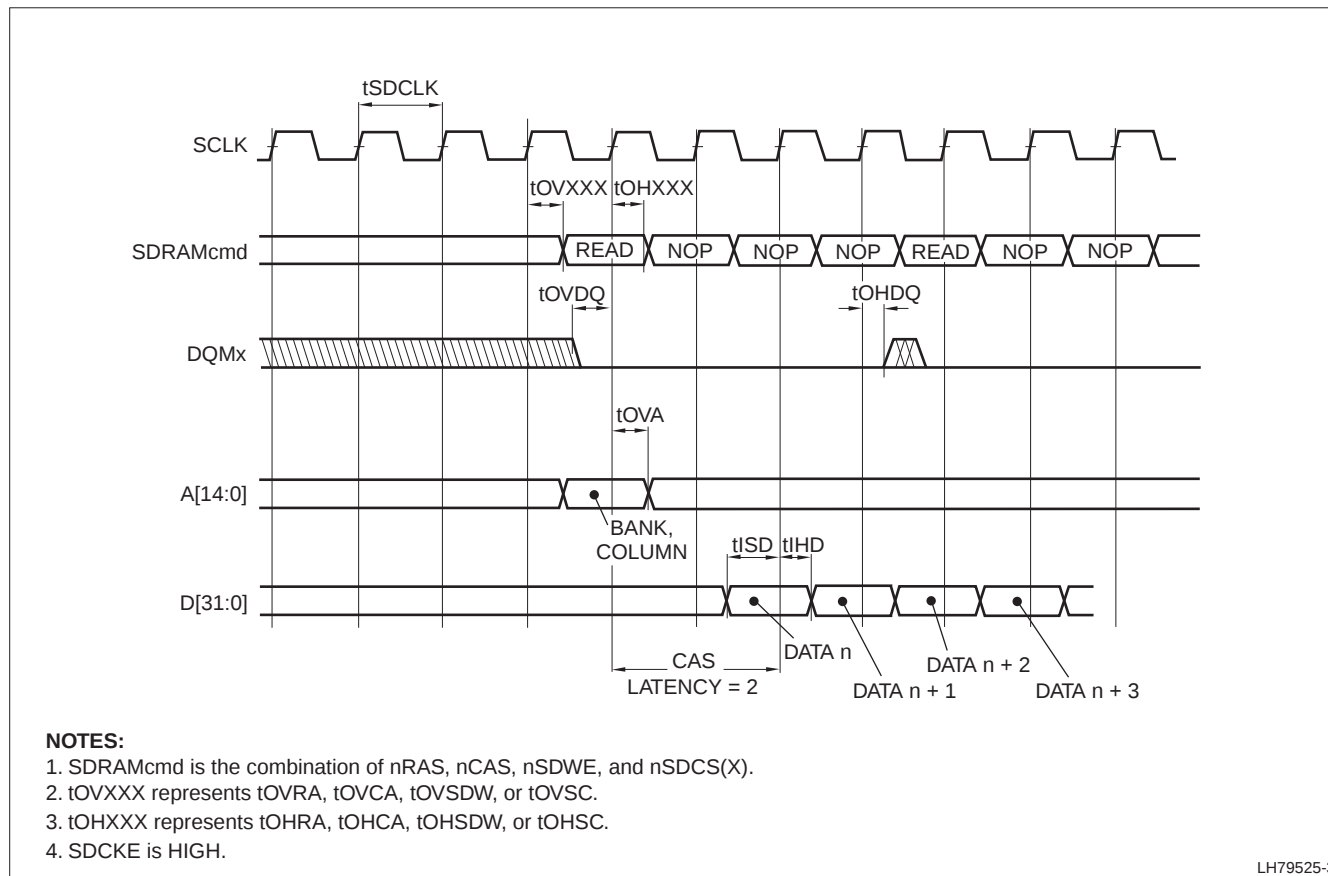


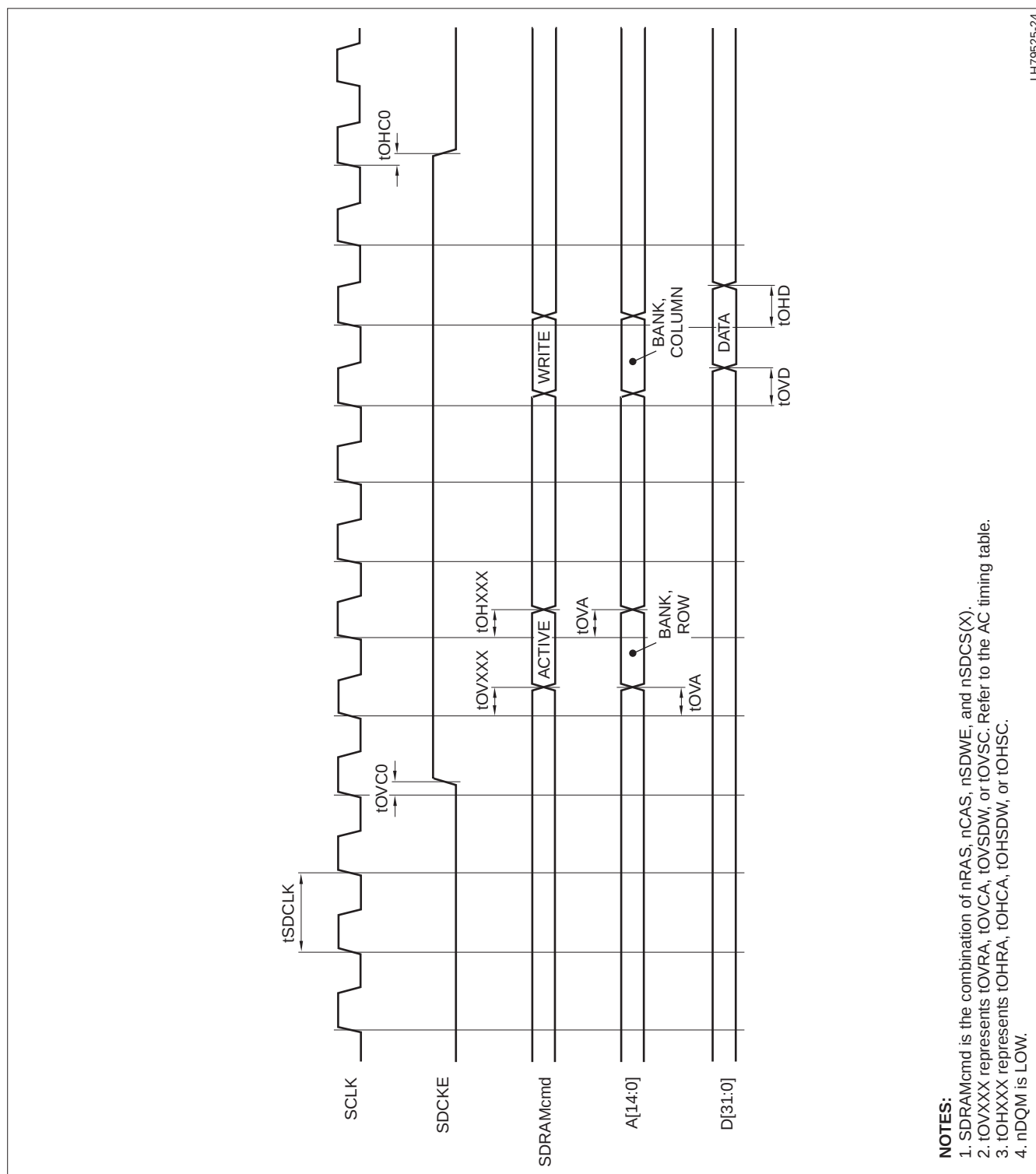
Figure 20. External Static Memory Write with Two Wait States

## SDRAM MEMORY CONTROLLER WAVEFORMS

Figure 21 shows the waveform and timing for an SDRAM Burst Read (page already open). Figure 22 shows the waveform and timing for SDRAM to Activate a Bank and Write.



**Figure 21. SDRAM Burst Read**



### Figure 22. SDRAM Bank Activate and Write

## External DMA Handshake Signal Timing

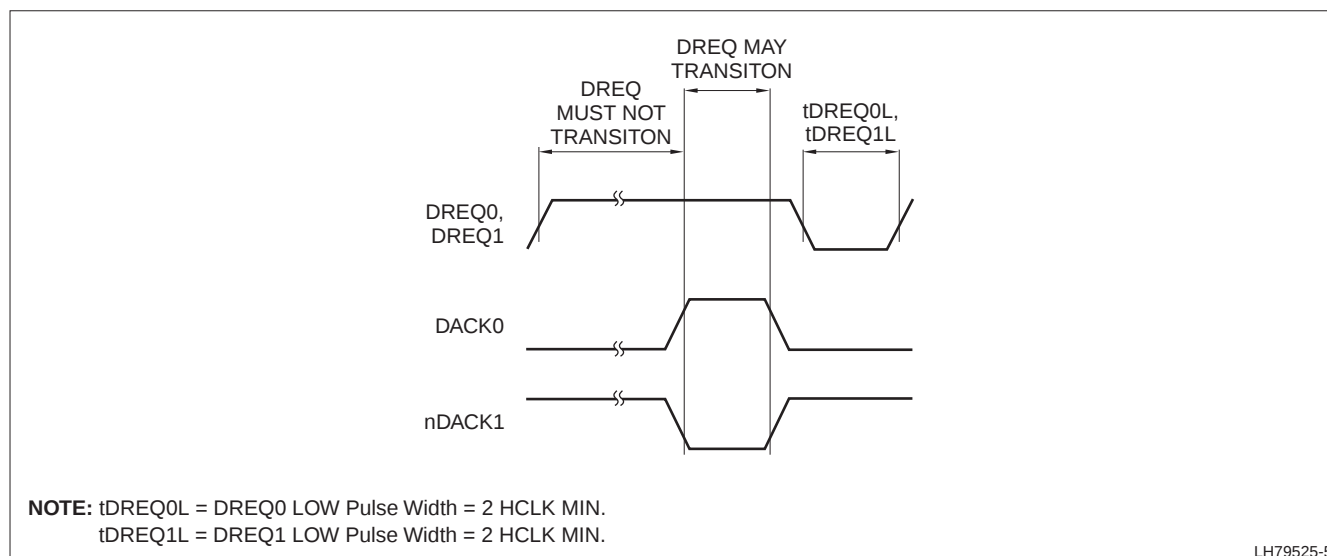
### DREQ TIMING

Once asserted, DREQ must not transition from LOW to HIGH again until after nDACK has been asserted.

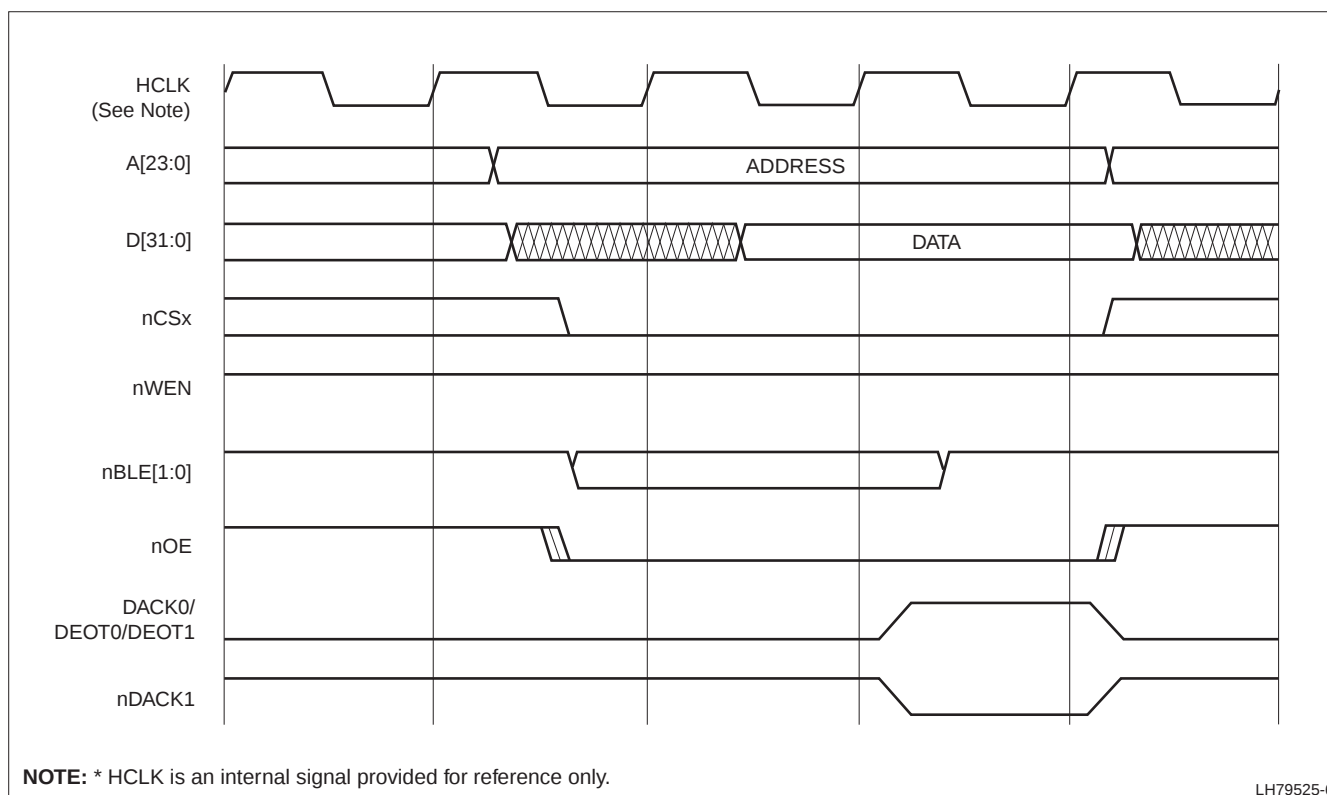
### DACK/DEOT TIMING

These timing diagrams indicate when nDACK and DEOT occur in relation to an external bus access to/from the external peripheral that requested the DMA transfer.

The first diagram shows the timing with relation to a single read or the last word of a burst read from the requesting peripheral. The remaining diagrams show timing for data transfers.



**Figure 23. DREQ Timing Restrictions**



**Figure 24. Read, from Peripheral to Memory, Burst Size = 1**

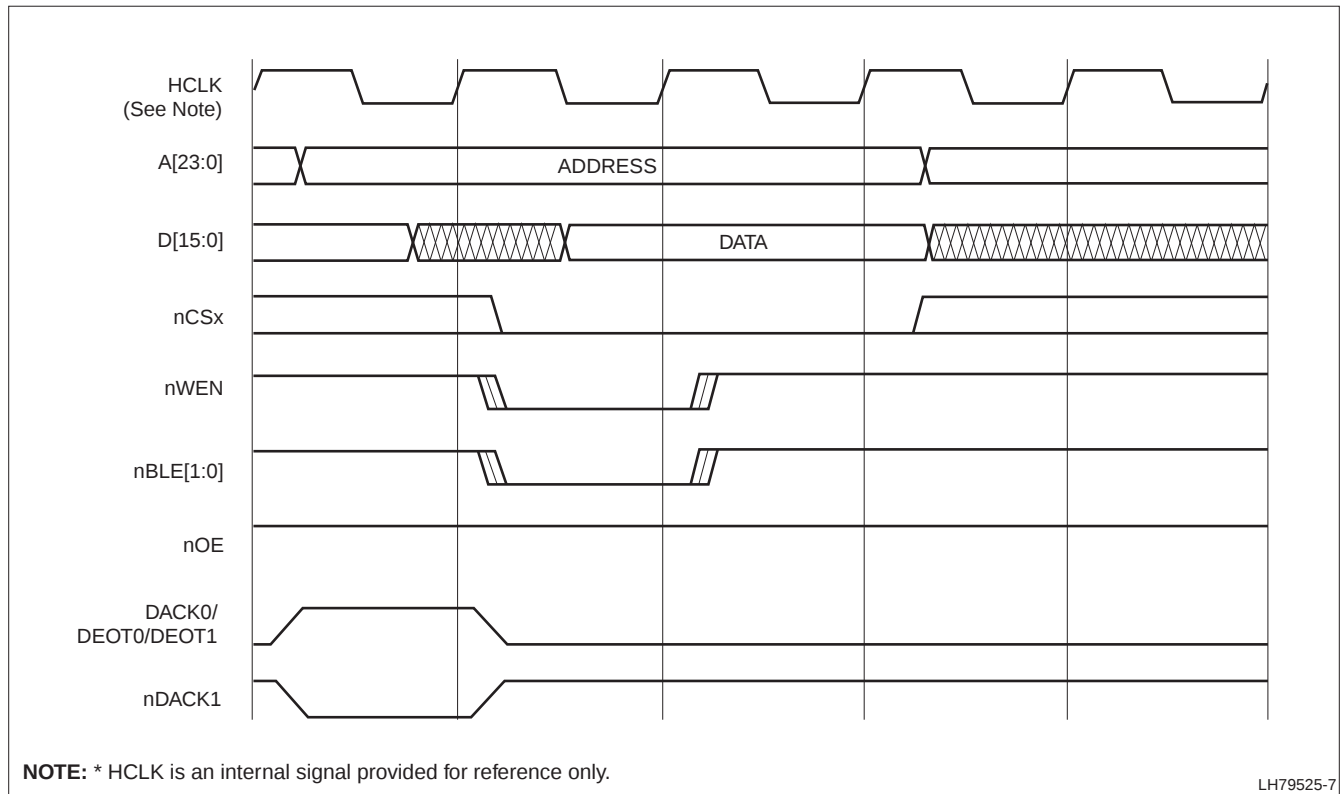


Figure 25. Write, from Memory to Peripheral, Burst Size = 1

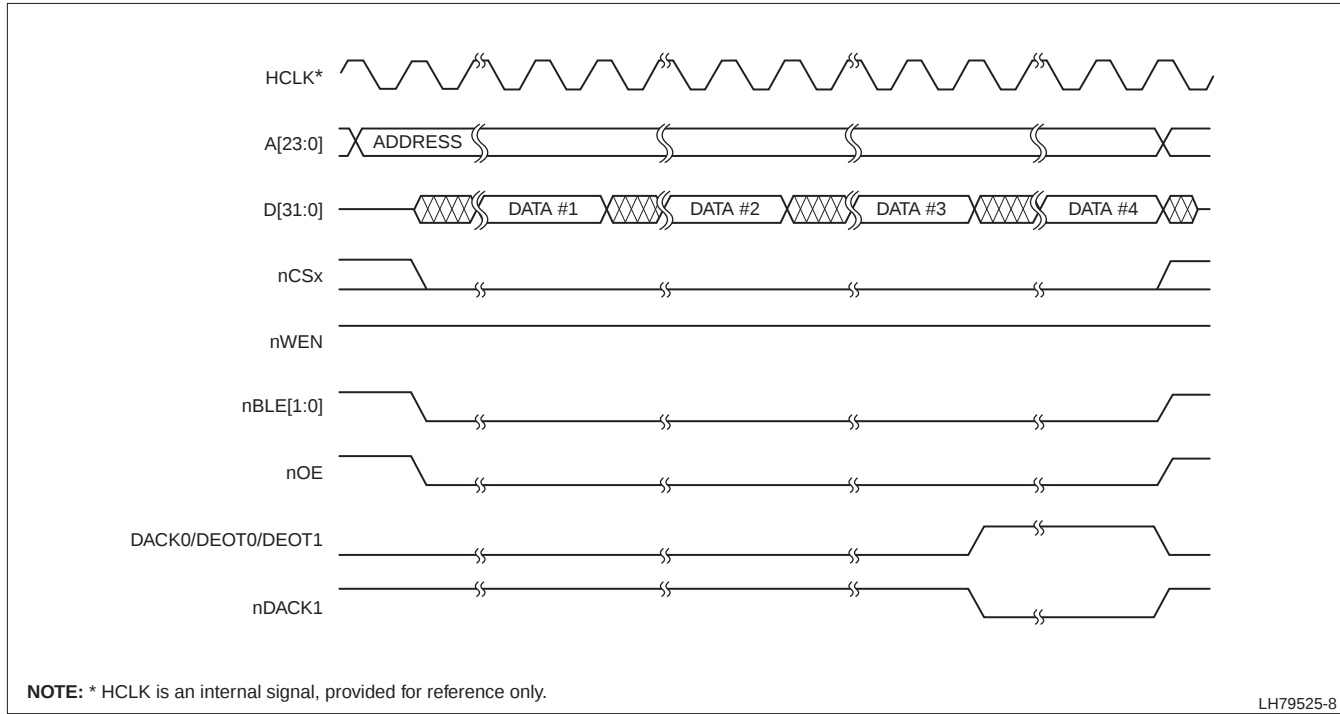
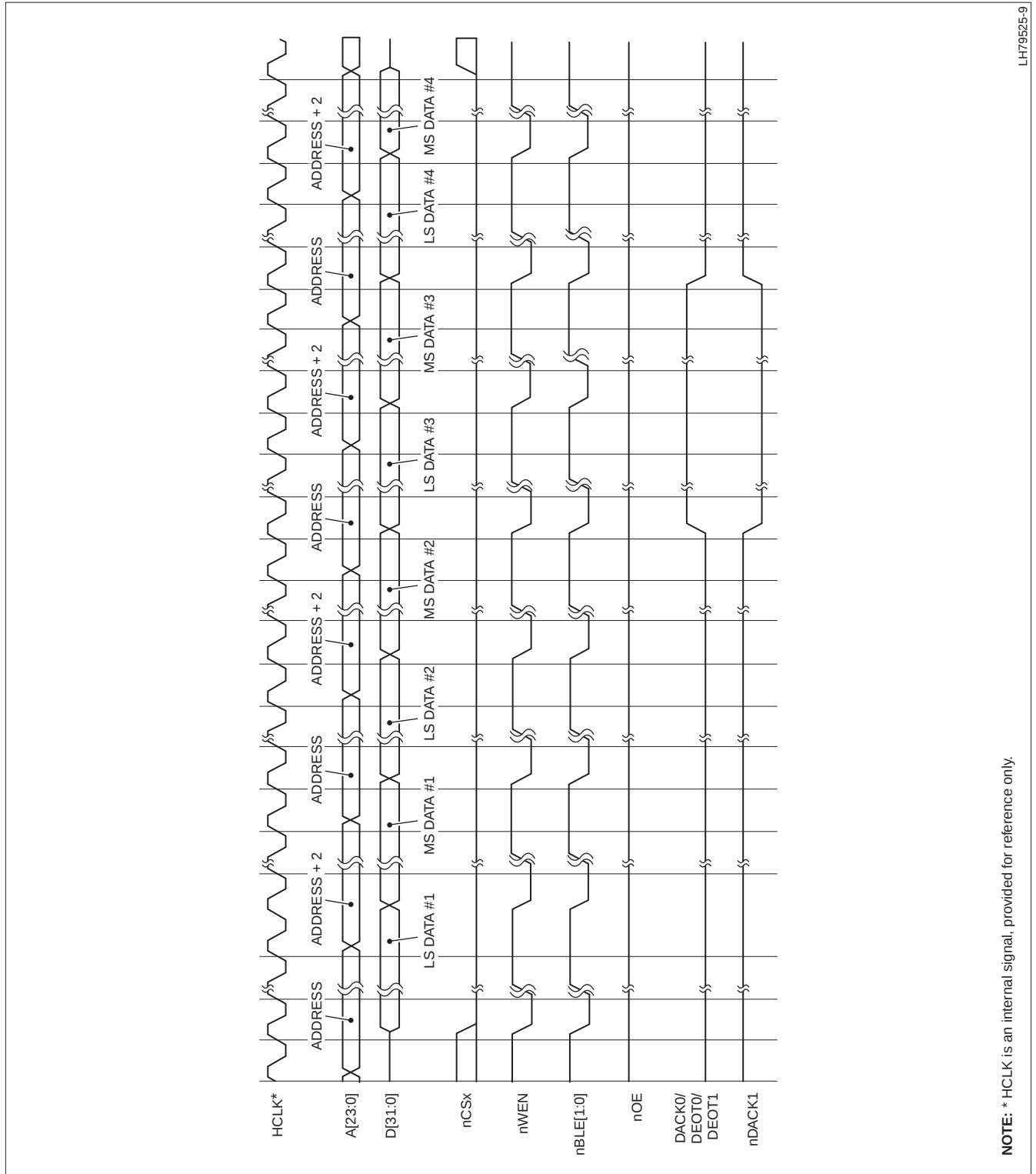


Figure 26. Read, Peripheral to Memory: Peripheral Burst Size = 4



Color LCD Controller Timing Diagrams

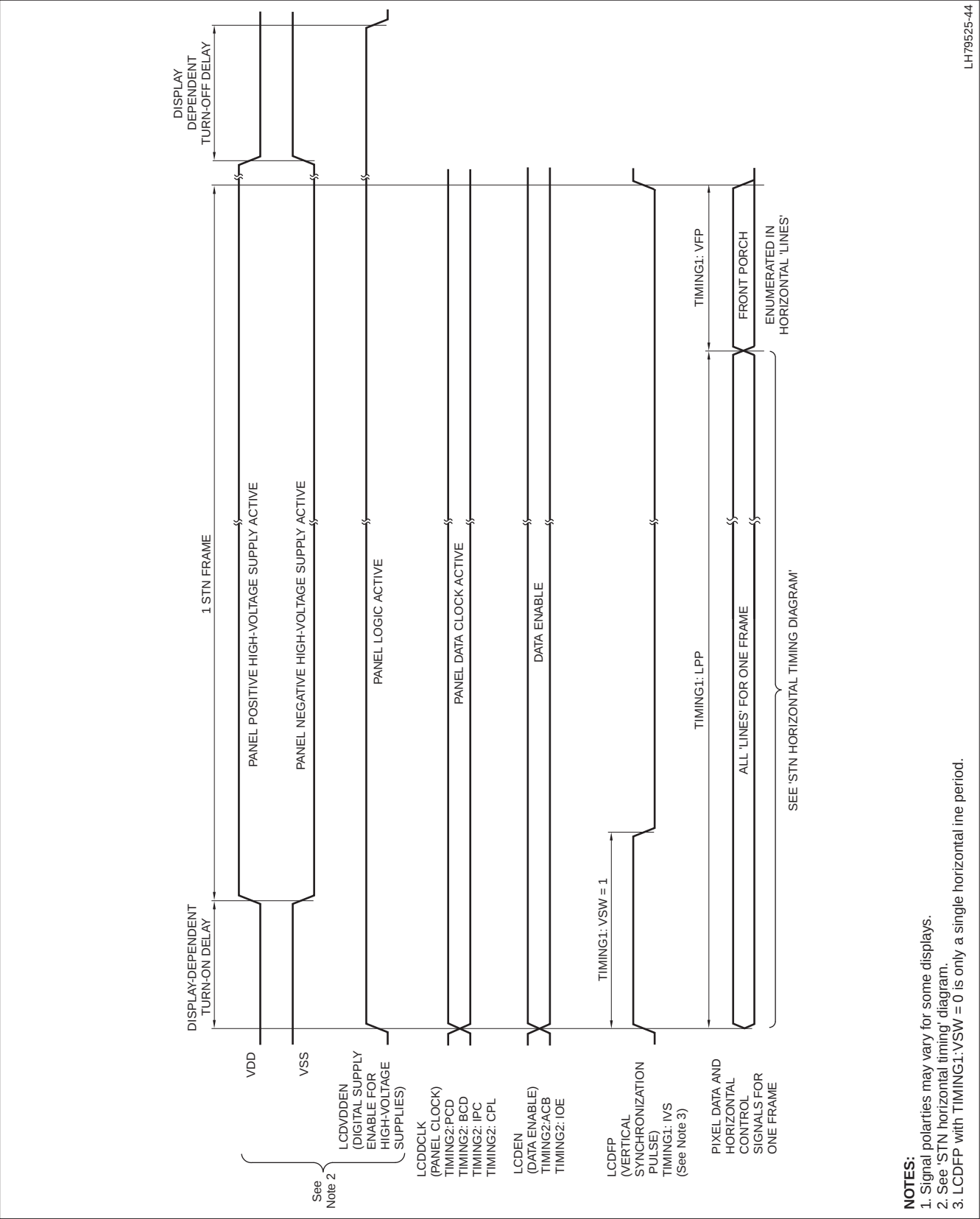


Figure 28. STN Horizontal Timing

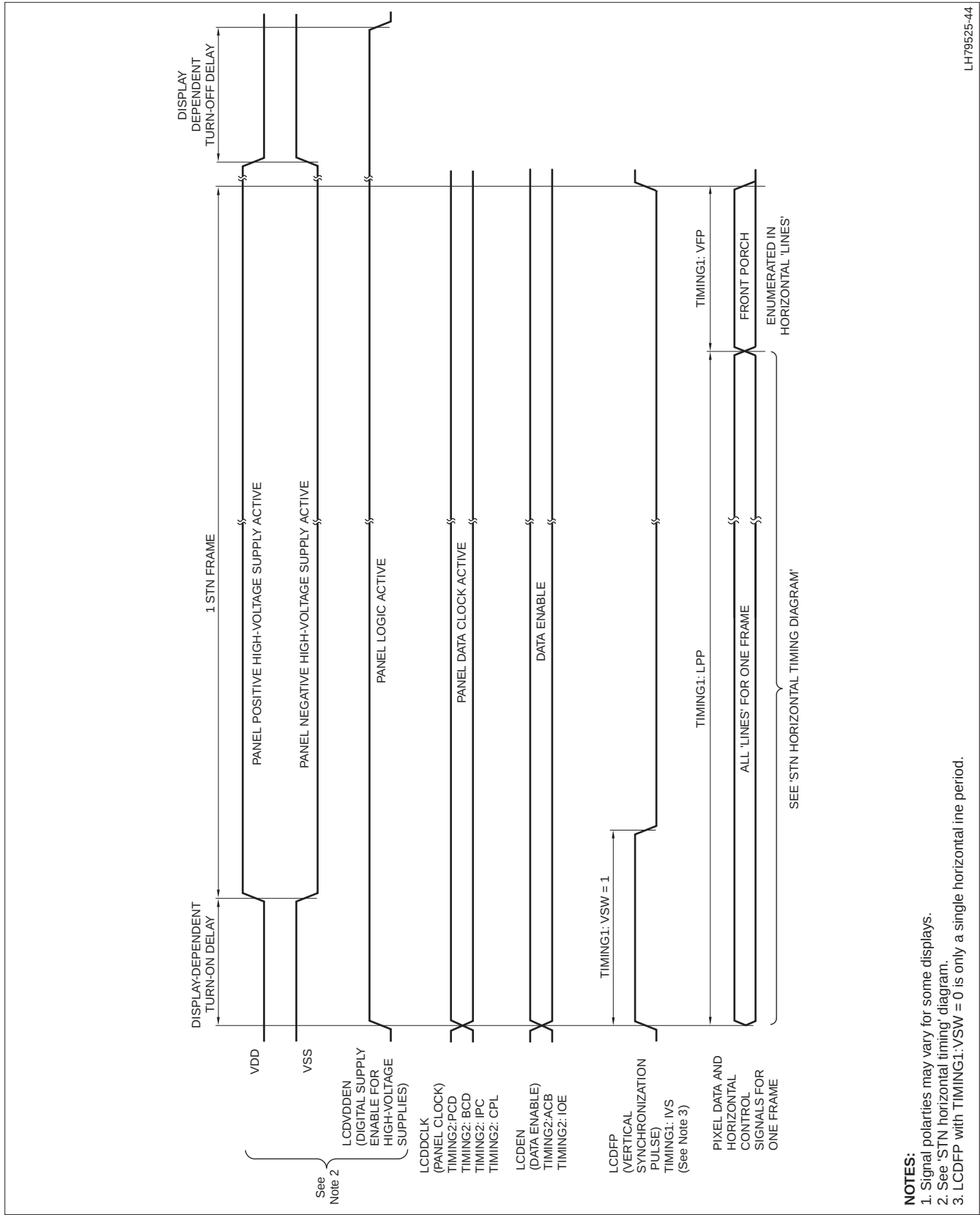


Figure 29. STN Vertical Timing

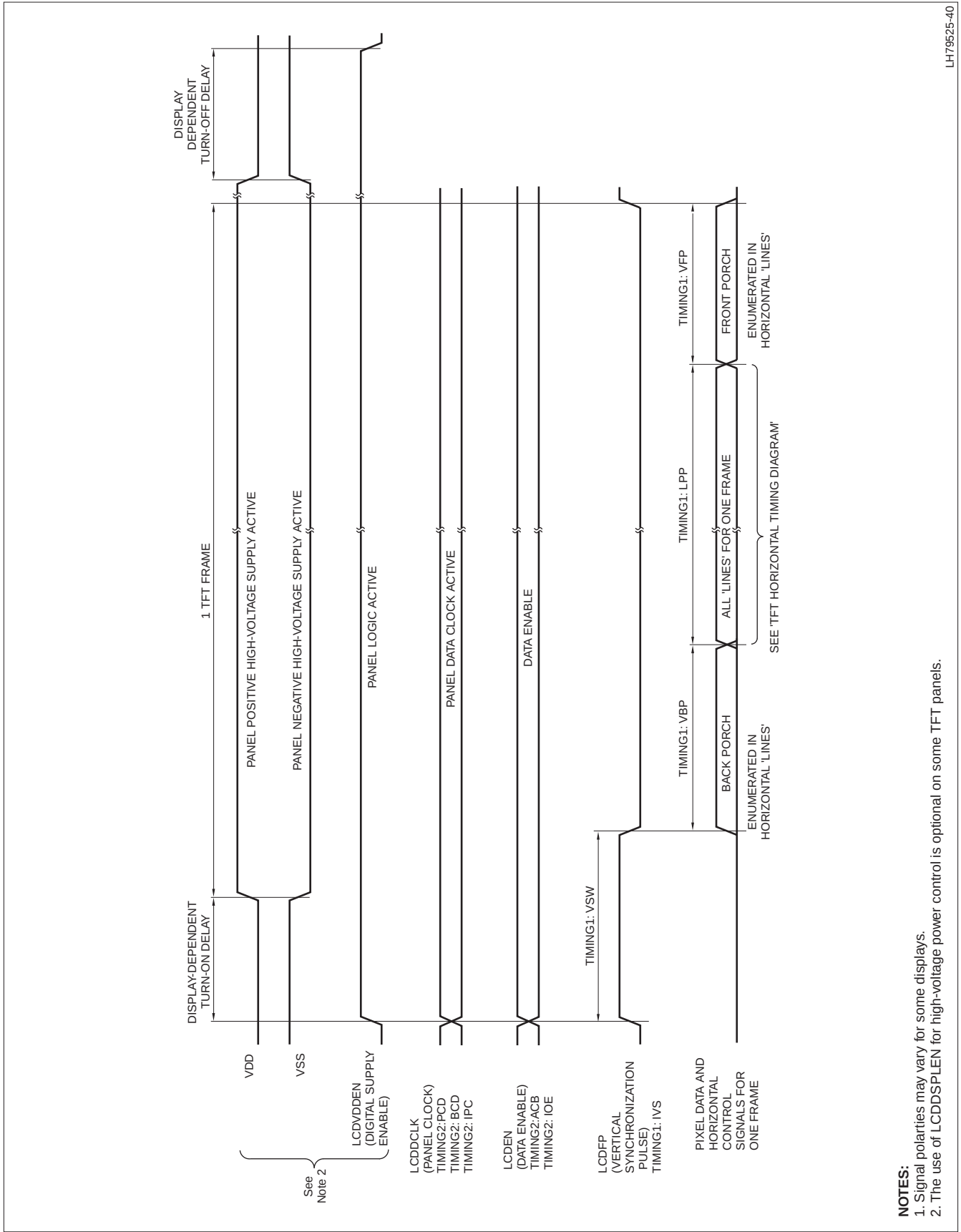


Figure 30. TFT Horizontal Timing

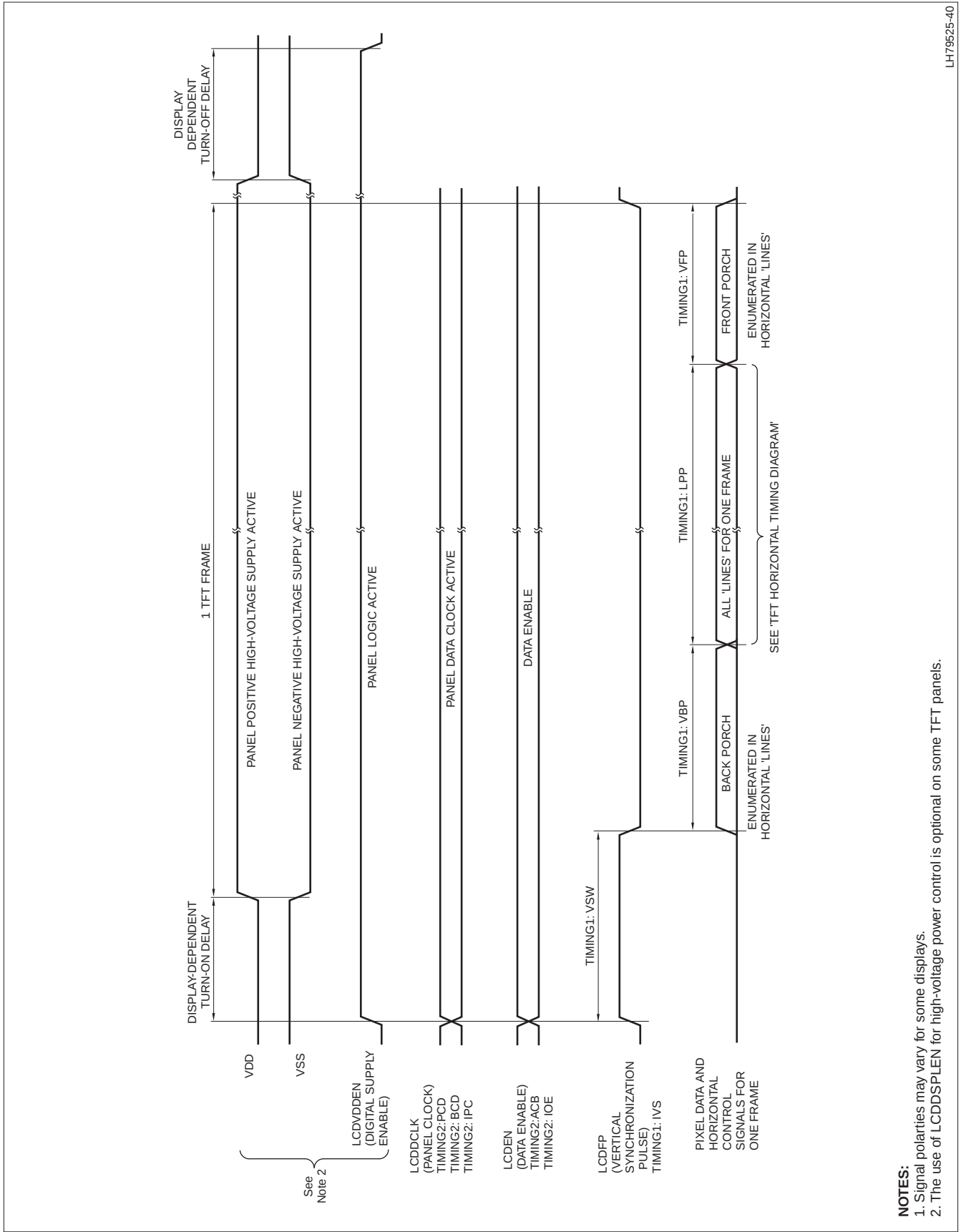


Figure 31. TFT Vertical Timing

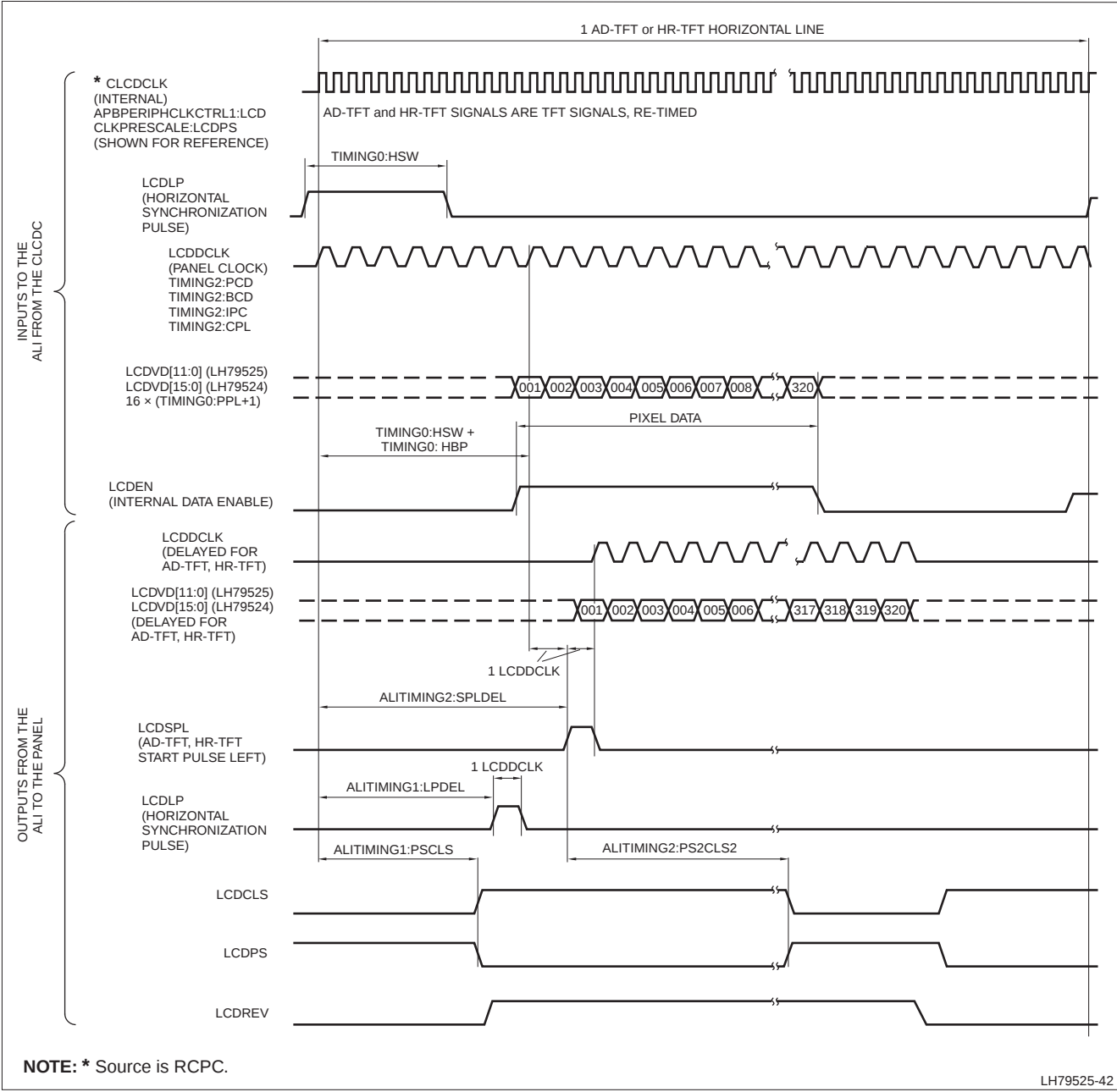


Figure 32. AD-TFT, HR-TFT Horizontal Timing

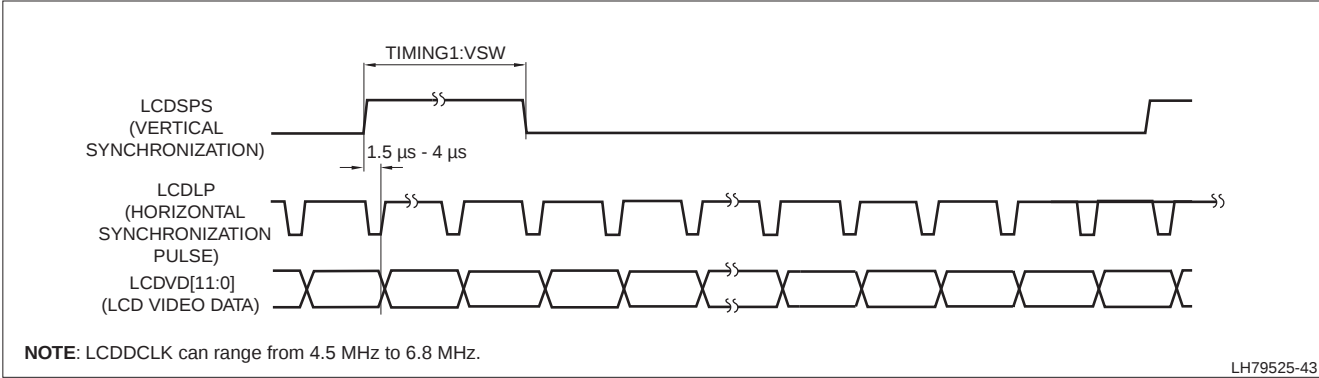


Figure 33. AD-TFT, HR-TFT Vertical Timing

## Synchronous Serial Port

The SSP timing is illustrated in Figure 34.

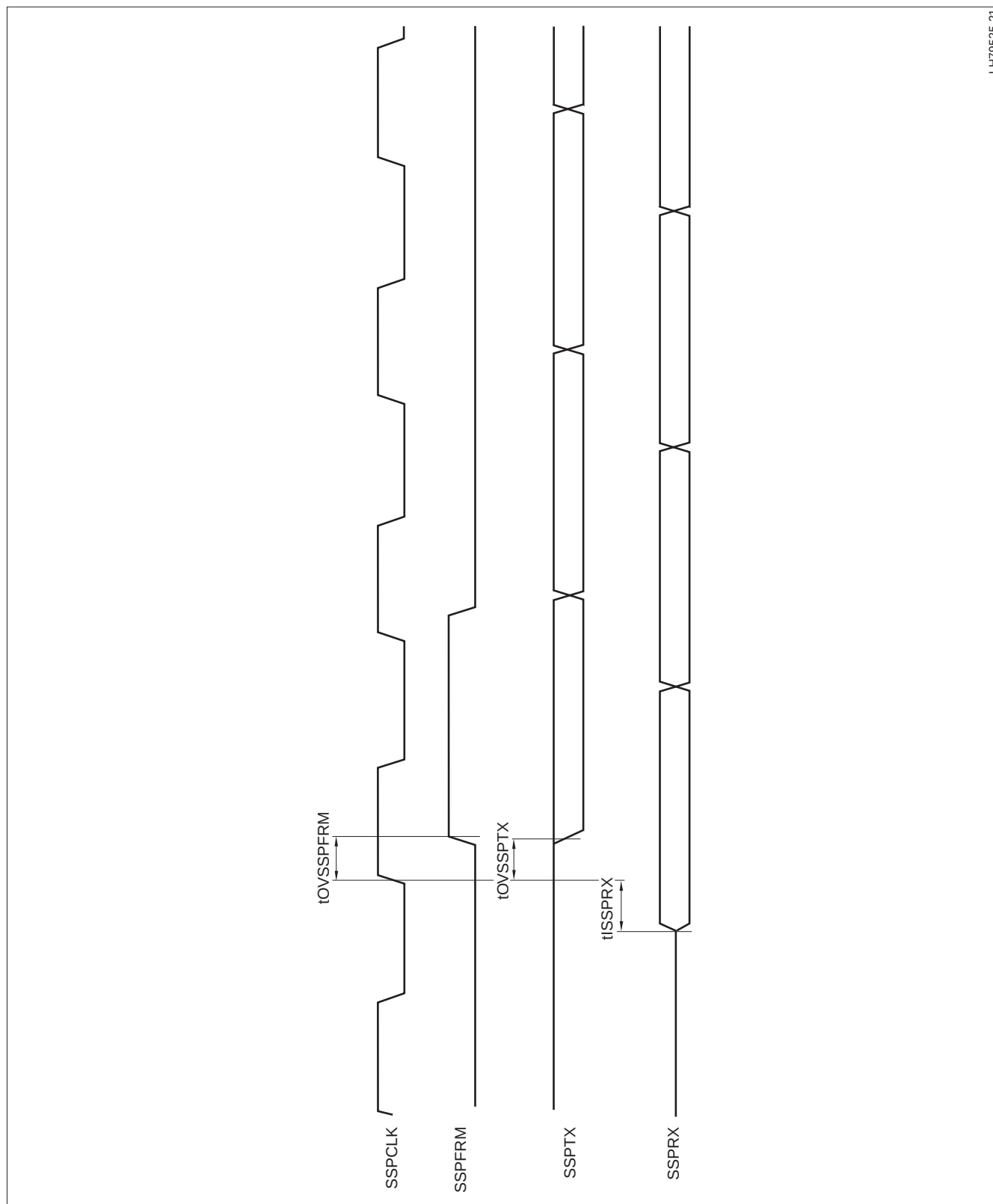


Figure 34. Synchronous Serial Port Waveform

Ethernet MAC Controller Waveforms

The timing for the EMC is presented in the following two illustrations. Figure 35 shows an Ethernet transmit and Figure 36 shows an Ethernet receive.

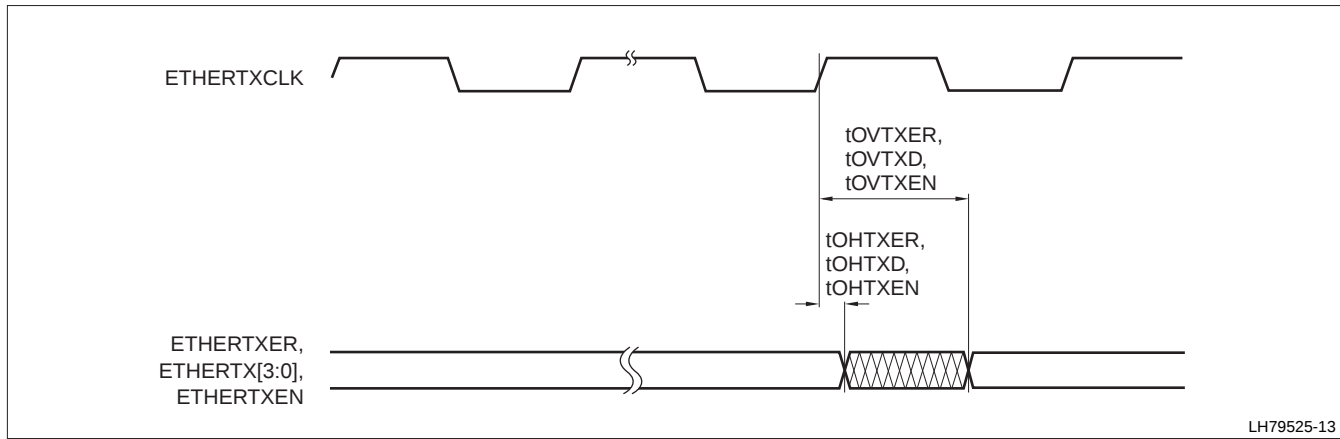


Figure 35. Ethernet Transmit Timing

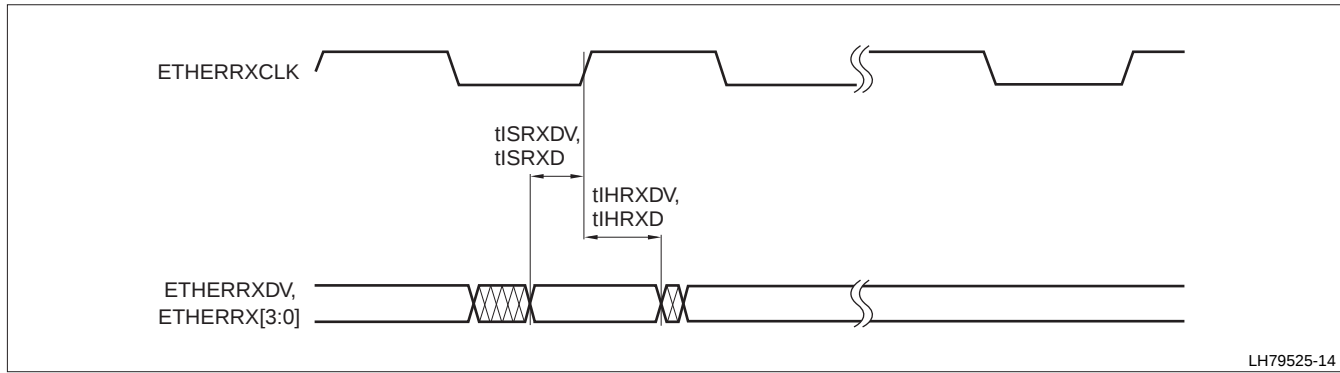


Figure 36. Ethernet Receive Timing

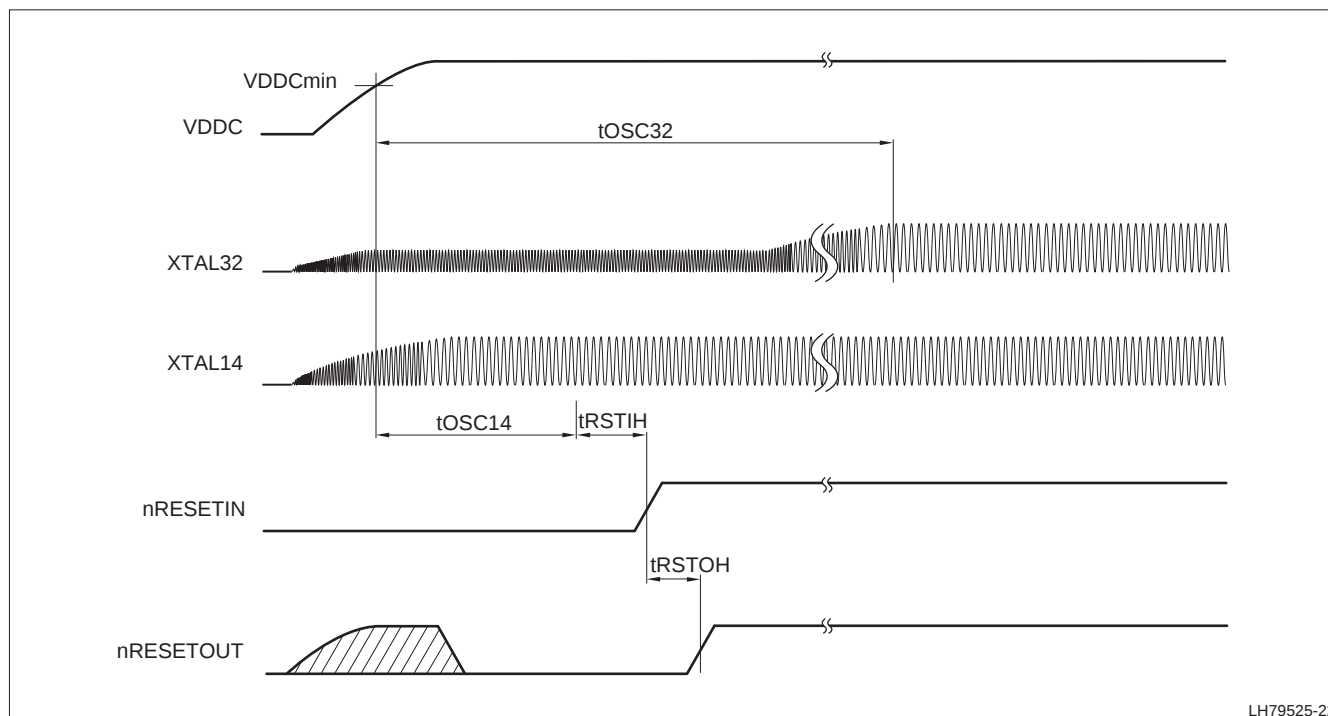
## Reset, Clock, and Power Controller (RCPC) Waveforms

Figure 37 shows the method the LH79524/LH79525 uses when coming out of Reset or Power On.

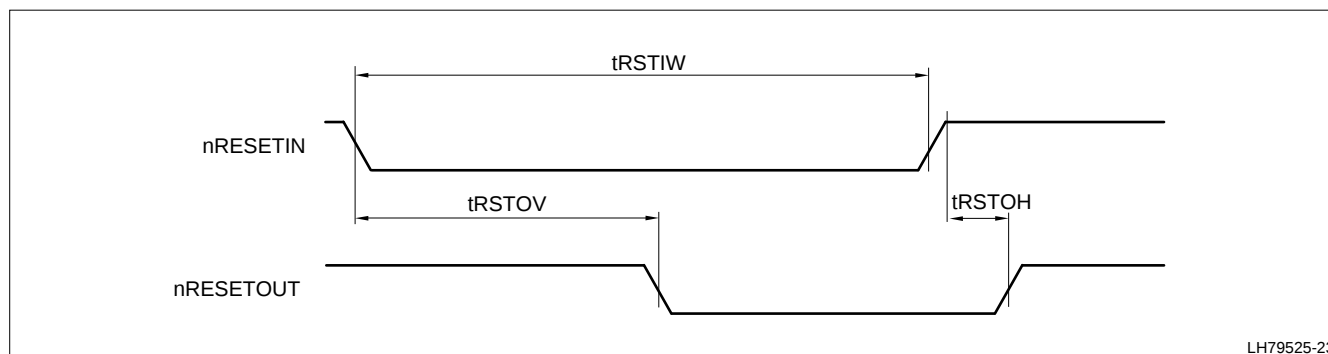
Figure 38 shows external reset timing, and Table 18 gives the timing parameters.

**Table 18. Reset AC Timing**

| PARAMETER | DESCRIPTION                                                                    | MIN. | TYP. | MAX. | UNIT    |
|-----------|--------------------------------------------------------------------------------|------|------|------|---------|
| tOSC32    | Oscillator stabilization time after Power Up (VDDC = VDDCMIN)                  |      |      | 550  | ms      |
| tOSC14    | Oscillator stabilization time after Power Up (VDDC = VDDCMIN) or exiting STOP2 |      |      | 2.5  | ms      |
| tRSTIH    | nRESETIN hold time after crystal stabilization                                 | 200  |      |      | $\mu$ S |
| tRSTIW    | nRESETIN Pulse Width (once sampled LOW)                                        | 2    |      |      | HCLK    |
| tRSTOV    | nRESETIN LOW to nRESETOUT valid (once nRESETIN sampled LOW)                    |      | 3.5  |      | HCLK    |
| tRSTOH    | nRESETOUT hold relative to nRESETIN HIGH                                       |      | 1    |      | HCLK    |



**Figure 37. PLL Start-up**



**Figure 38. External Reset**

## UNUSED INPUT SIGNAL CONDITIONING

Floating input signals can cause excessive power consumption. Unused inputs which do not include internal pull-up or pull-down resistors should be pulled up or down externally, to tie the signal to its inactive state.

Some GPIO signals may default to inputs. If the pins which carry these signals are unused, software can program these signals as outputs, to eliminate the need for pull-ups or pull-downs. Power consumption may be higher than expected until such software executes.

Some LH79524/LH79525 inputs have internal pull-ups or pull-downs. If unused, these inputs do not require external conditioning.

## OTHER CIRCUIT BOARD LAYOUT PRACTICES

All output pins on the LH79524/LH79525 have fast rise and fall times. Printed circuit trace interconnection length must therefore be reduced to minimize overshoot, undershoot and reflections caused by transmission line effects of these fast output switching times. This recommendation particularly applies to the address and data buses.

When considering capacitance, calculations must consider all device loads and capacitances due to the circuit board traces. Capacitance due to the traces will

depend upon a number of factors, including the trace width, dielectric material the circuit board is made from and proximity to ground and power planes.

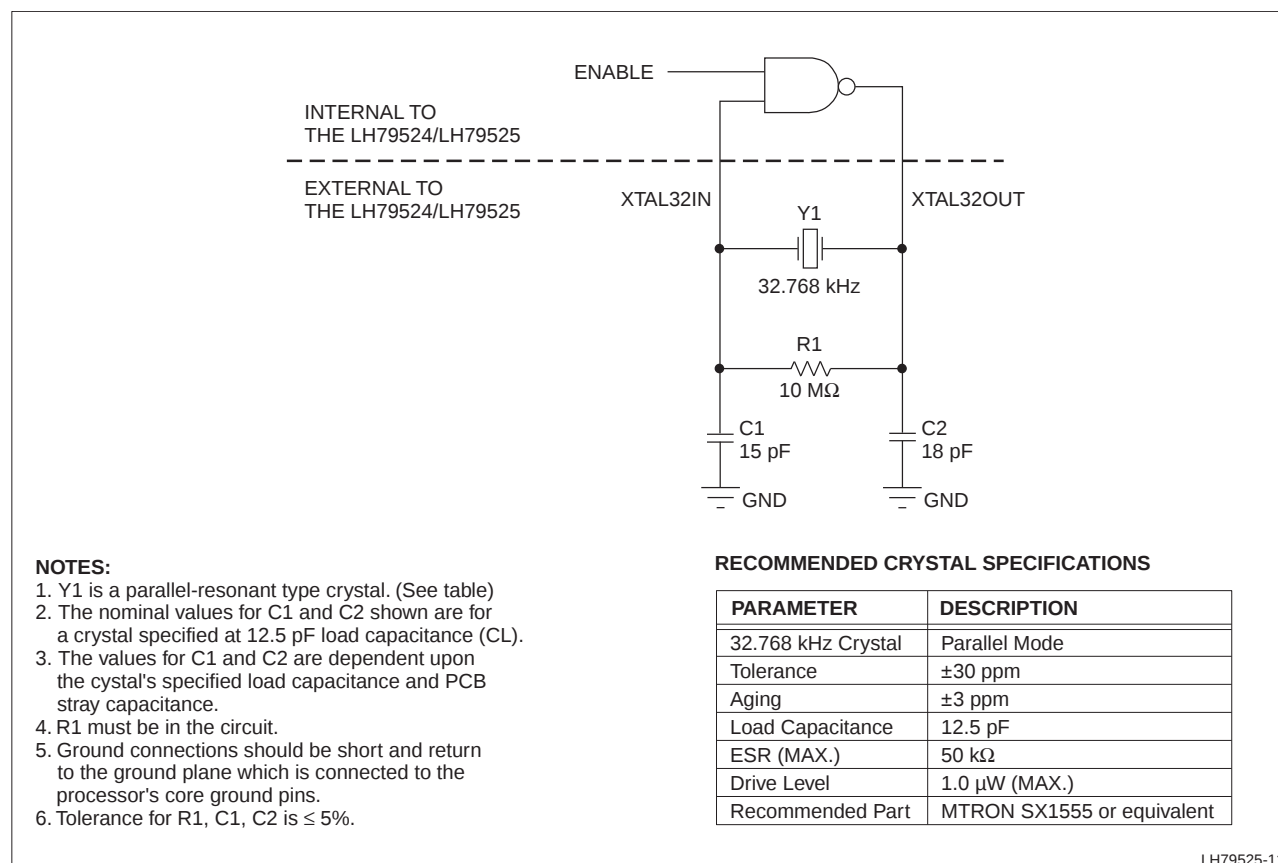
Attention to power supply decoupling and printed circuit board layout becomes more critical in systems with higher capacitive loads. As these capacitive loads increase, transient currents in the power supply and ground return paths also increase.

Add pull-ups to all unused inputs unless an internal pull-down resistor has been specified; see Table 3. Consider all signals that are Inputs at Reset.

## SUGGESTED EXTERNAL COMPONENTS

Figure 39 shows the suggested external components for the 32.768 kHz crystal circuit to be used with the NXP LH79524/LH79525. The NAND gate represents the logic inside the SoC. See the table in Figure 39 for crystal specifics.

Figure 40 shows the suggested external components for the 10 - 20 MHz crystal circuit to be used with the NXP LH79524/LH79525. The NAND gate represents the logic inside the SoC. See the chart for crystal specifics.



**Figure 39. Suggested External Components, 32.768 kHz Oscillator (XTAL32IN and XTAL32OUT)**

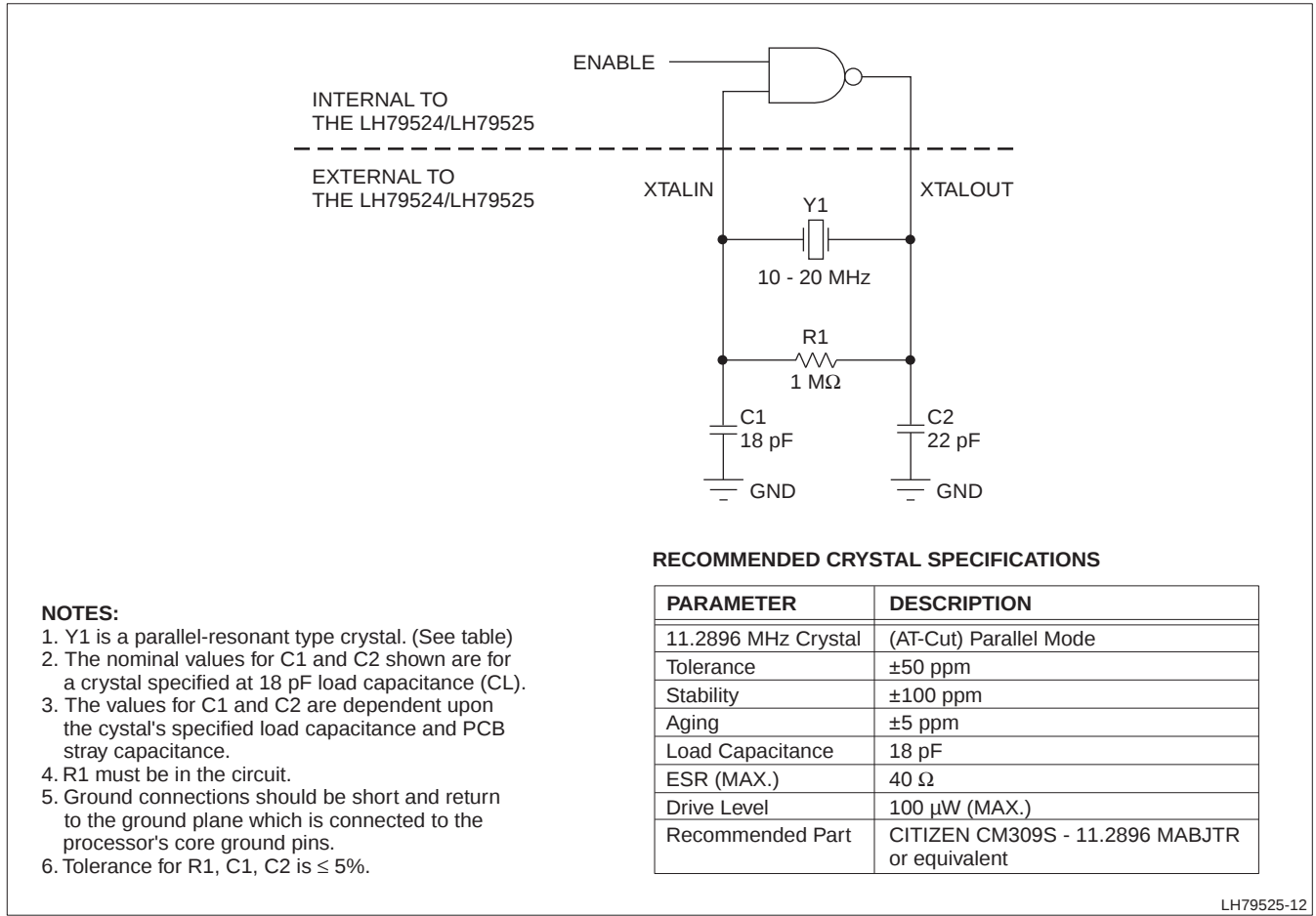


Figure 40. Suggested External Components, 10 MHz to 20 MHz Oscillator

PACKAGE SPECIFICATIONS

LQFP176: plastic low profile quad flat package; 176 leads; body 20 x 20 x 1.4 mm

SOT1017-1

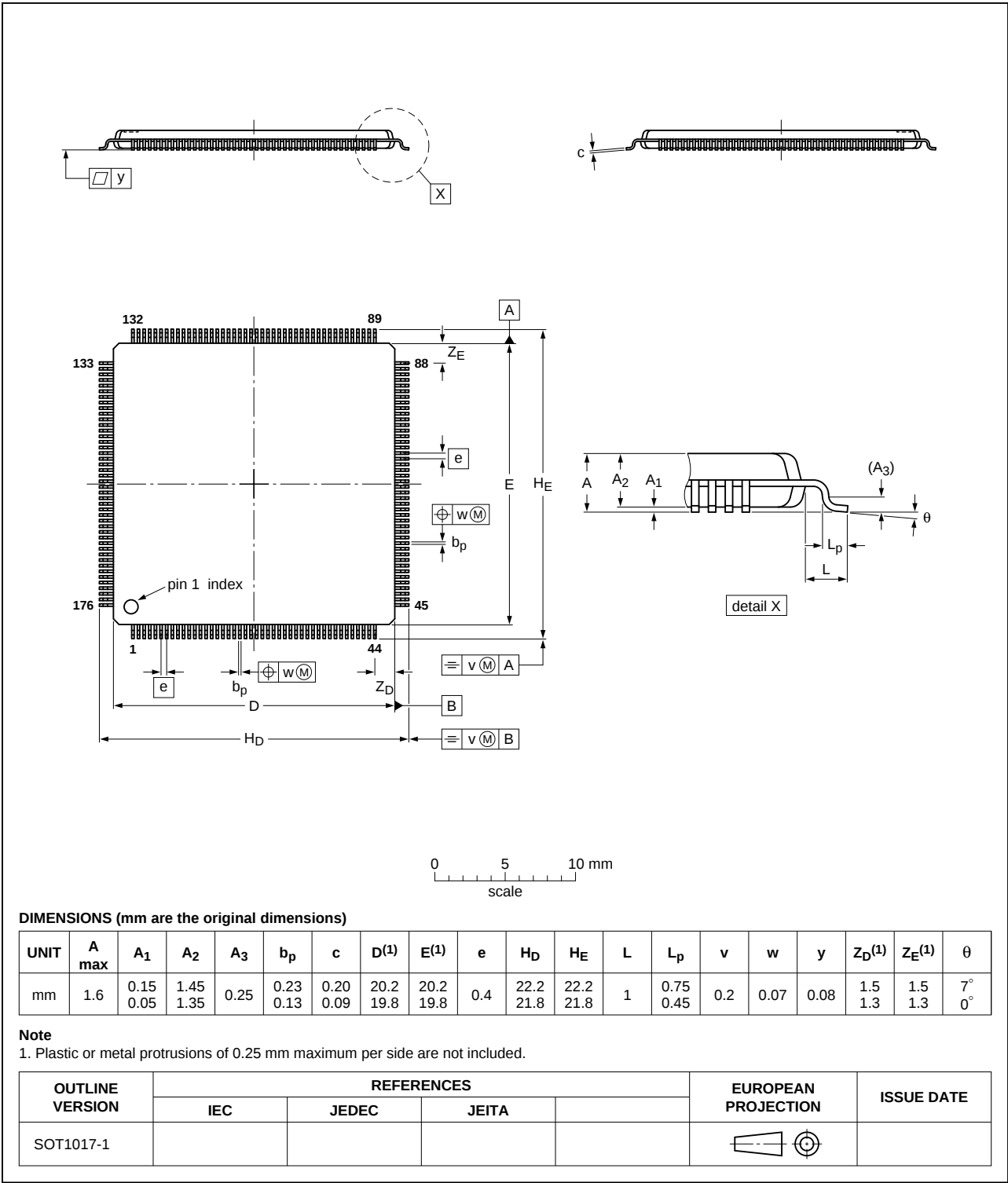


Figure 41. Package outline SOT1017-1 (LQFP176)

LFBGA208: plastic low profile fine-pitch ball grid array package; 208 balls

SOT1019-1

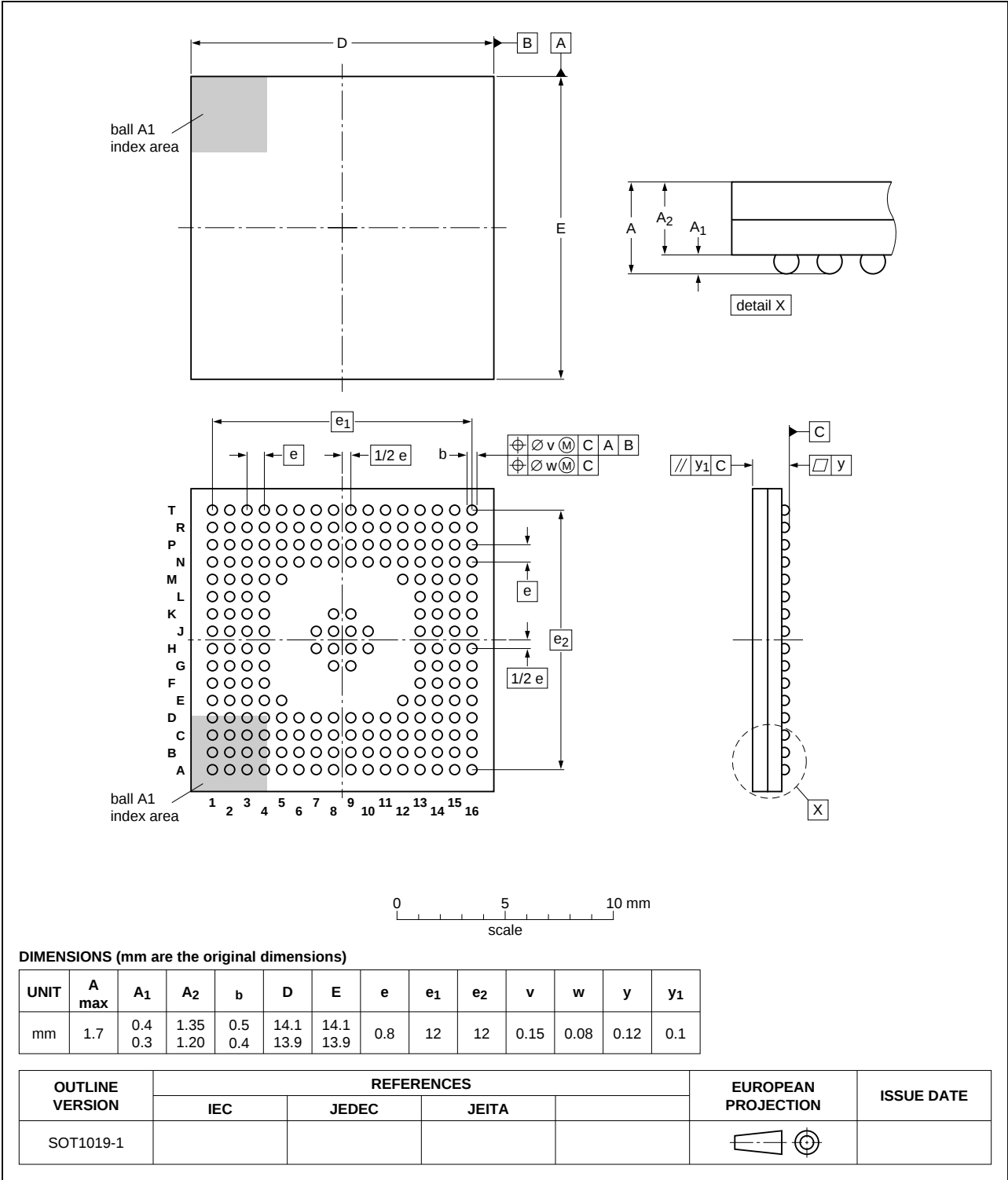


Figure 42. Package outline SOT1019-1 (LFBGA208)

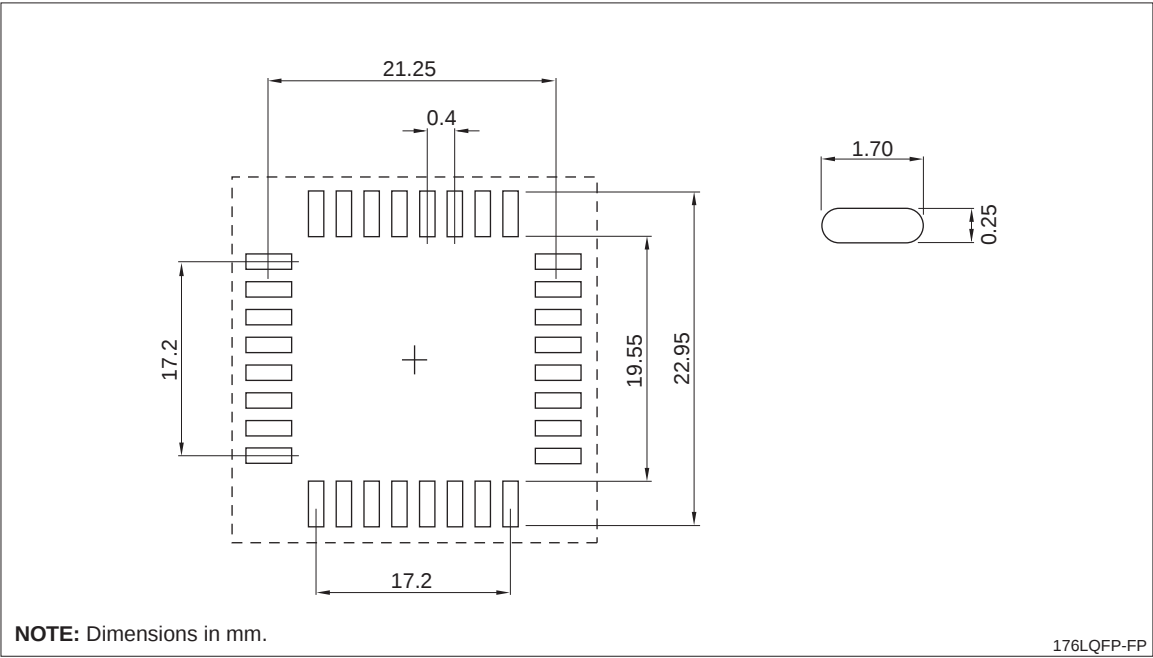


Figure 43. LH79525: LQFP176 PCB Footprint

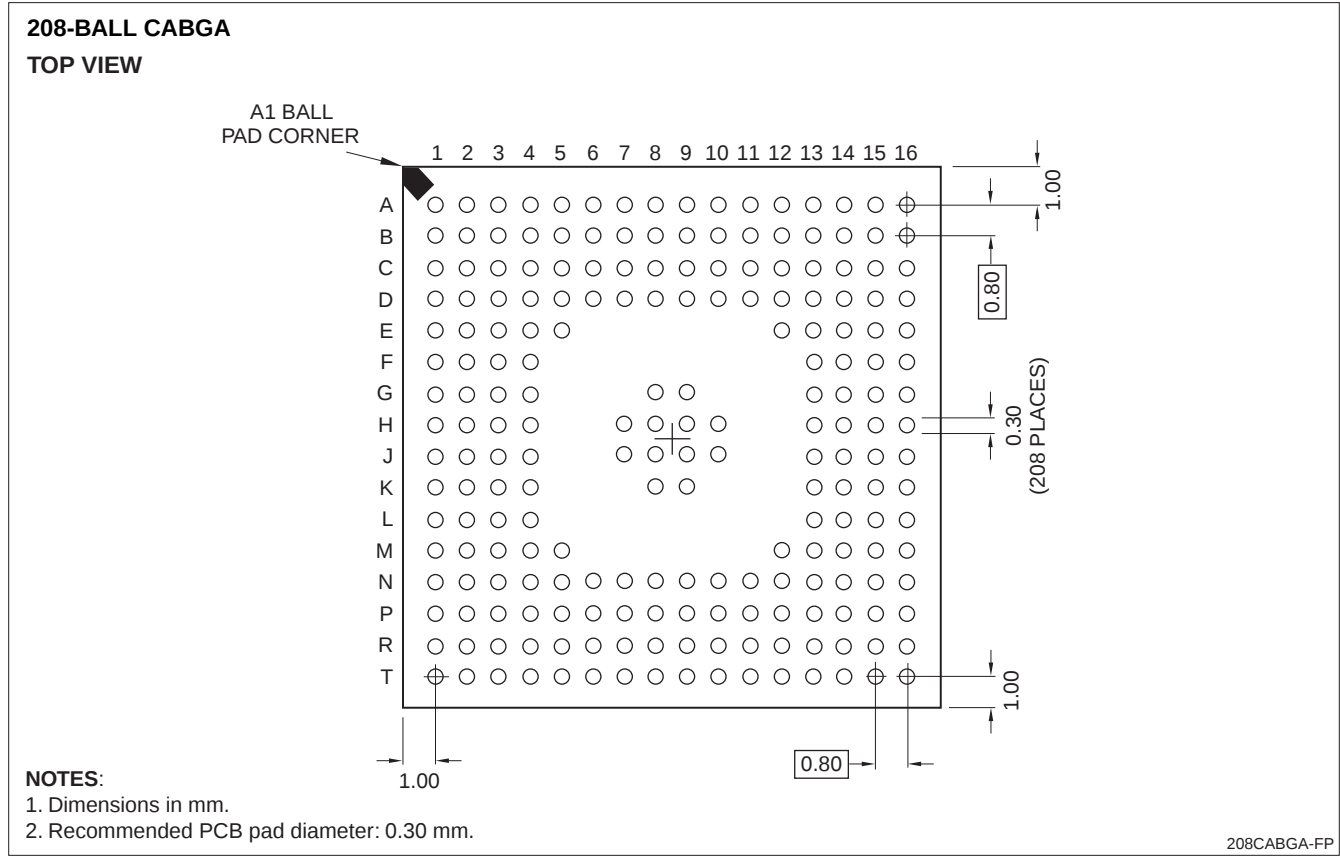


Figure 44. LH79524: LFBGA208 PCB Footprint

## REVISION HISTORY

**Table 19. Revision history**

| Document ID                                                                                                       | Release date | Data sheet status      | Change notice | Supersedes                            |
|-------------------------------------------------------------------------------------------------------------------|--------------|------------------------|---------------|---------------------------------------|
| LH79524_525_N_2                                                                                                   | 20090317     | Product data sheet     | -             | LH79524_525_N_1                       |
| Modifications: <ul style="list-style-type: none"><li>• Changed document status to "Product data sheet".</li></ul> |              |                        |               |                                       |
| LH79524_525_N_1                                                                                                   | 20070716     | Preliminary data sheet | -             | 9-29-06 LH79524-525 Data Sheet REV A1 |

## 9. Annex A - Legal information

### 9.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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