NetDCU9

Display

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1 Overview

1.1 Display Interface

The NetDCU9 has a very flexible and powerful interface for LCD and EL displays. Many different displays can be connected directly to the NetDCU9 without the need of any further hardware.

From the view of the software, the display driver is fully configurable by the user. Some display types are already predefined, so that a simple choice from a list is all that is required. If the display is not already predefined, the user has the possibility to adjust the driver to a new display by himself by setting a few parameters or download a new display-driver (xxx.txt). On WindowsCE this is done by setting some keys in the registry. On Embedded Linux, this is done by setting an environment variable in the boot monitor program. This is explained in separate chapters later in this document.

1.2 Display Adapters

F&S offers different display adapters to facilitate the connection of as many different displays as possible to the NetDCU9. For a lot of displays there are already tailor-made solutions available and the appropriate adapter is mentioned in the section for the specific display. For further information about the adapters themselves see the separate document “Display Adapters”.

2 Display Connections

This section describes the pin-by-pin connections to different known displays.

2.21 AUO Optronix

2.21.1 AUO G084SN03

TFT Display
Resolution: 800 x 600 pixels, 3,3V
Corresponding Adapter: NetDCU-ADP/LVDS1

AUO G084SN03		NetDCU9	
Pin	Meaning	Pin	Meaning
1	VDD	2	VLCD
2	VDD	4	VLCD
3	GND	6	GND
4	GND	8	GND
5	RxIN0	1	Tx0-
6	RxIN0+	3	Tx0+
7	GND	-	
8	RxIN1-	5	Tx1-
9	RxIN1+	7	Tx+
10	GND	-	
11	RxIN2-	9	Tx-
12	RxIN2+	11	Tx+
13	GND	-	
14	CKIN-	13	TxCLK-
15	CKIN+	15	TxCLK+
16	GND	16	GND
17	NC		
18	NC		
19	GND	-	
20	GND	-	

2.22 InnoLux
2.22.1 x
2.23 CHRYSTAL-CLEAR
2.23.1 x
2.24 PLANAR
2.24.1 x
2.25 DATA MODUL

3 Display Driver under Windows CE

3.1 Introduction

Please request the display driver configuration filematching with your display from F&S:

support@fs-net.de

Configuration must be done by hardware also:

NetDCU9

VCC 3.3V R18
VCC 5V R17

As already mentioned, the display driver is fully configurable via the Windows CE registry. The user has the possibility to adjust the driver to a new display by himself.

The display driver supports the following features:

- Interface for digital LCD TFT/CSTN/STN
- Output to digital LCD with 8/16/32 BPP
- Output to analog LCD with 8/16/32 BPP
- Hardware Zoom
- Overlays
- DirectDraw
- Direct 3D mobile
- MultiMonitor support (same/different resolutions)

The registry key for the driver is:

```
[HKLM\Drivers\Display\SMIVGX]
```

Use the following parameters to configure the driver or download a new display-driver-file:

Download of display-driver-file to NetDCU9:

Start DCUTermi.exe
File – Transmit Text File - …\xxx.txt
(display-driver-files available from F&S company)

Configure the registry:

Key	Value	Meaning
Mode	Dword:	Number of the predefined configuration or new user configuration.
EarlyLCDVoltage	Dword:	Set this parameter to 1 to power on the LCD voltage very early at the boot-process.
Verbose	Dword:	Enables additional output at serial debug port.
PLL2clock	Dword:	Output clock of PLL2. 336/288/240/192 MHz Default: 240MHz (-> Page 16, Chapter 3.1.1.1 LCD clock)
FB_BASE	Dword:	Do NOT change !
FG_BASE	Dword:	Do NOT change !
VideoInterpolation	Dword:	0=no interpolation 1=Horizontal 2=Vertical 3=Horizontal & Vertical Default: 3
CxZoom	Dword:	Zoom width

		Default: Disabled
CyZoom	Dword:	Zoom height Default: Disabled
CursorZoom	Dword:	Enable or Disable Cursor Zooming in Zoom-In/Zoom-Out mode. Default: Disabled

With parameter Mode you have the possibility to use one of the predefined configurations stored in the kernel or to define a new configuration in registry. Values between 0 and 99 are reserved for predefined configurations. For your own configuration you have to use a value between 100 and 199.

The following configurations are predefined in the kernel:

Mode	Name	XxY	Type
0	TFT, 60 Hz, 16Bpp	640x480	Active
1	TFT, 16Bpp	800x600	Active
2	TFT 16Bpp	1024x768	Active
3 *	TFT, 16Bpp	1280x1024	Active
4	TFT, 16Bpp	320x240	Active

* This mode can be used with VGA-monitor only
If you select one of the above configurations, automatically a sub-key with name Mode0 or Mode1 or ModeX is created. It is possible to adjust the predefined configuration by writing special values to this sub-key.

For configurations with Mode higher than 99 you have to create a new sub-key with the Name ModeXXX. Under this sub-key you can use the following parameters to adjust the driver.

3.1.1 Display Mode Registry settings

The following settings can be made to define a display mode. Settings are placed in the registry under key

```
[HKLM\Drivers\Display\SMIVGX\ModeX]

[HKLM\Drivers\Display\SMIVGX\Monitor0\ModeX]

[HKLM\Drivers\Display\SMIVGX\Monitor1\ModeX]
```

Key	Type	Meaning
"name"	sz:	Name of the driver as a text string. Only for information purposes.
Type	Dword:	See Table 1 Value **Type**
Config	Dword:	See Table 2 Value **Config**
Columns	Dword:	Amount of visible pixels in X-direction.
PPL	Dword:	Amount of clocks in X-direction before the HSYNC signal. This value is optional and normally the same as Columns.

Key	Type	Meaning
BLW	Dword:	Beginning-of-line-wait: **TFT:** Value (0-63) specifies the number of VCLK periods between the falling edge of HSYNC and the start of active data. **STN:** Determine the delay between VLINE and VCLK by counting the number of the HCLK. BLW[7:2] are reserved. 00 = 16 HCLK, 01 = 32 HCLK, 10 = 48 HCLK, 11 = 64 HCLK.
HSW	Dword:	Horiz-sync-pulse-width: Value (0-255) specifies the number of pixel clock periods to pulse the line clock at the end of each line.
ELW:	Dword:	End-of-line-wait: **TFT:** Value (0-255) specifies the number of of VCLK periods between the end of active data and the rising edge of HSYNC. **STN:** Bits indicate the blank time in one horizontal line duration time. These bits adjust the rate of the VLINE finely. The unit of ELW is HCLK x 8. Ex) If the value of ELW is 10, the blank time is inserted to VCLK during 80 HCLK.

Key	Type	Meaning
Rows	Dword:	Amount of visible pixels in Y-direction.
LPP	Dword:	Line per panel: This is an optional parameter and in most cases it is the same as Rows.
BFW	Dword:	Beginning-of-frame wait: **TFT:** Value (0–127) specifies the number of inactive lines at the start of a frame, after vertical synchronization period. **STN:** BFW must be cleared to zero (disabled).
VSW	Dword:	Vertical sync pulse width: **TFT:** Value (0–63) specifies the number of line clock periods to pulse the FRP pin at the end of each frame after the end-of-frame wait (EFW) period elapses. Frame clock used as VSYNC signal in active mode. **STN:** VSW must be cleared to zero (disabled).
EFW	Dword:	End-of-frame line clock wait count: **TFT:** Value (0–63) specifies the number of inactive lines at the end of a frame, before vertical synchronization period. **STN:** EFW must be cleared to zero (disabled).

Key	Type	Meaning
Width	Dword:	Physical width of the display
Height	Dword:	Physical height of the display
Bpp	Dword:	Bits per Pixel. The number of bits that represents one pixel in display memory. See Table 3 Value **BPP**
ContrastEnable	Dword:	Switch on/off contrast voltage generation.
ContrastValue	Dword:	Initial value for contrast voltage.
LCDClk	Dword:	LCD pixel clock in MHz
EnableCursor	Dword:	1: show cursor on screen.
Voltage	Dword:	50 = 5 Volt, 33 = 3.3 Volt Parameter is not used at NetDCU9, configuration must be done by hardware. **NetDCU9** Display supply 3.3V R18 Display supply 5V R17
Rotate	Dword:	0, 90, 180, 270

Table 1 Value **Type**

Value	Meaning
0x0000	Default
0x0001	Dual Scan Display
0x0002	TFT-Display
0x0004	Colour-Display
0x0008	Monochrome 8Bit Display
0x1000	Enable output to PANEL (digital RGB)
0x2000	Enable output to CRT (analog)

Table 2 Value **Config**

Symb. Name	Value	Meaning
LCD_VSP	0x00100000	Vertical sync polarity: active low
LCD_HSP	0x00200000	Horizontal sync polarity: active low
LCD_OEP	0x00800000	Output enable polarity: active low
LCD_CLKP	0x00400000	Clock polarity: active low

Table 3 Value **BPP**

BPP	STN	CSTN	TFT
1*	ü		
2*	ü		
4	ü		
8			
16		ü	ü
24			ü

*Cursor and Rotate are not supported for this pixel depth.

3.1.1.1 Pixel clock generation

The value LCDCLK is only the requested pixel clock. The real pixel clock could be different.
NetDCU9 has internally two PLL's for generating pixel clock. One is fixed to 288MHz (PLL1) and the other one could be programmed to 336, 288, 240 or 192 MHz (PLL2). The resulting clock is the input for the frequency divider.

Because the frequency Divider works different for Panel output and Video output there are two table:

Table 4 Frequency divider for Panel output

Div by 1	Div by 3	Div by 5
/1	/3	/5
/2	/6	/10
/4	/12	/20
/8	/24	/40
/16	/48	/80
/32	/96	/160
/64	/192	/320
/128	/384	/640

Table 5 Frequency divider for Video output

Div by 1	Div by 3
/1	/3
/2	/6
/4	/12
/8	/24
/16	/48
/32	/96
/64	/192
/128	/384

3.1.2 Multiple Monitor Feature

This feature allows connection of one digital RGB display (PANEL) and one analog RGB display (CRT) to NetDCU9. You can use these multiple screens as one large combined screen to create more screen space for applications. That menas you can show different content on the two screens. This extra space is useful whenever you need to maximize your on-screen workspace.

The support for multiple screens does not affect the performance of applications when those applications run in a single screen environment. In other words, when an application runs on a system with a single screen, no additional overhead is present in the high-performance graphics operations code. On a multiple screen system, however, performance is slightly affected if an application runs only on one of the graphics devices. Also, performance can be greatly affected if an application spans multiple screens, especially for graphics-intensive operations.

Attention:
Enabling Multiple Monitor Feature disables DirectDraw support and display rotation.

Attention:
This feature is different from settings registry value Type to 0x3000. If you enable PANEL and CRT using reg value Type than the same content is shown on both outputs. In this case DirectDraw and display rotation is still supported.

3.1.2.1 Registry Settings

To specify the number of screens present in a multiple screen system, set the `HKLM\SYSTEM\GDI\MONITORS\TOTAL MONITORS` registry entry equal to the number of screens. You

should only set this registry entry to a value between one and four because Windows Embedded CE supports a maximum of four screens. The default value is one. The following code example shows how to specify that the system has two screens.

```
[HKLM\SYSTEM\GDI\MONITORS]
```

Required Settings:

Key	Type	Meaning
Total Monitors	Dword:1	Amount of monitors connected to NetDCU9. Possible values 1 or 2. Default: 1

Specify settings for digital panel under the following key:

```
[HKLM\Drivers\Display\SMIVGX\MONITOR0]
```

If you don't create the key values from the default key

```
[HKLM\Drivers\Display\SMIVGX]
```

are taken.

Specify settings for analog CRT under the following key:

```
[HKLM\Drivers\Display\SMIVGX\MONITOR1]
```

If you don't create the key and don't create vaue MODE under this key, same values as for digital panel are used.

Example:

Following registry values for digital panel with QVGA resolution and analog CRT with SVGA resolution.

```
reg open \SYSTEM\GDI\MONITORS
reg set value “Total Monitors” dword 2
reg open \Drivers\Display\SMIVGX
reg set val Mode dword 4
reg create key MONITOR1
reg set value Mode dword 1
reg save
```

3.1.2.2 Application development

The following table shows the functions that Windows Embedded CE provides for working with multiple screens.

Function	Description
EnumDisplayMonitors	Enumerates screens that intersect a region formed by the intersection of a specified clipping rectangle and the visible region of a specified device context.
GetMonitorInfo	Retrieves information about a screen.
MonitorEnumProc	An application-defined callback function that is called by the EnumDisplayMonitors function.
MonitorFromPoint	Retrieves a handle to the screen that contains a specified point.
MonitorFromRect	Retrieves a handle to the screen that has the largest area of intersection with a specified rectangle.
MonitorFromWindow	Retrieves a handle to the screen that has the largest area of intersection with the bounding rectangle of a specified window.

3.2 Settings Of The Predefined Display Modes

3.2.1 Kyocera

3.2.2 Sharp LM8V31

(not tested)

Key	Data-Type	Value
"name"	sz:	Sharp LM8V31
Type	Dword:	5
Config	Dword:	0x00400000
Columns	Dword:	640
BLW	Dword	4
HSW	Dword	3
ELW	Dword	4
Rows	Dword:	480
BFW	Dword:	0
VSW	Dword:	2
EFW	Dword:	0
Width	Dword:	151
Height	Dword:	114
Bpp	Dword:	16
ContrastEnable	Dword:	1
ContrastValue	Dword:	0xE5
LCDClk	Dword:	8
Msignal	Dword	0
EnableCursor	Dword:	0
PhysFrameBuffDraw	Dword:	0

3.2.3 Sharp LQ10V1DG11

(not tested)

Key	Data-Type	Value
"name"	Sz:	SHARP LQ10V1DG11
Type	Dword:	6
Config	Dword:	0x00700000
Columns	Dword:	640
BLW	Dword	60
HSW	Dword	64
ELW	Dword	36
Rows	Dword:	480
BFW	Dword:	32
VSW	Dword:	2
EFW	Dword:	11
Width	Dword:	211
Height	Dword:	158
Bpp	Dword:	16
ContrastEnable	Dword:	0
ContrastValue	Dword:	0
LCDClk	Dword:	25
Msignal	Dword	2
EnableCursor	Dword:	1
PhysFrameBuffDraw	Dword:	0

3.2.4 Sharp LQ057

Key	Data-Type	Value
"name"	sz:	SHARP LQ057
Type	Dword:	6
Config	Dword:	0x00700000
Columns	Dword:	320
PPL	Dword:	320
BLW	Dword:	52
HSW	Dword:	2
ELW	Dword:	4
Rows	Dword:	240
LPP	Dword:	240
BFW	Dword:	5
VSW	Dword:	3
EFW	Dword:	5
Width	Dword:	115
Height	Dword:	86
Bpp	Dword:	16
ContrastEnable	Dword:	0
ContrastValue	Dword:	0
LCDClk	Dword:	6300000
MSignal	Dword:	0
EnableCursor	Dword:	1

3.2.5 Kyocera TCG057

Key	Data-Type	Value
"name"	sz:	Kyocera TCG057
Type	Dword:	6
Config	Dword:	0x00400000
Columns	Dword:	320
PPL	Dword:	320
BLW	Dword	30
HSW	Dword	32
ELW	Dword	16
Rows	Dword:	240
LPP	Dword:	240
BFW	Dword:	4
VSW	Dword:	2
EFW	Dword:	8
Width	Dword:	115
Height	Dword:	86
Bpp	Dword:	16
ContrastEnable	Dword:	0
ContrastValue	Dword:	0
LCDClk	Dword:	12000000
MSignal	Dword	0
EnableCursor	Dword:	1

4 Display Driver under NetDCU9/Linux

Please check the documentation attached to the NetDCU9-SKIT (prepared from emlix-company)

5 Important Notice

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