Application Guide of T5UIC1 Kernel

1 Introduction

T5UIC1 kernel runs on single T5 CPU LCMs series which is developed via lite instruction. It is designed for simple UI application: without touch panel, simple UI functions and low cost.

Features:
(1) 65K color TFT LCD display.
(2) 384Kbytes font memory provides storage of ASCII fonts (word size: 6*12 to 32*64 dot matrix) and GB2312 fonts (word size: 16*16 dot matrix).
(3) 512Kbytes picture memory provides storage of 16 JPEG full screen UI pictures.
(4) Use SD/SDHC interface to configure hardware parameters, and update fonts, pictures.
(5) Extend a full duplex serial interface.

2 Instruction Set

2.1 Basic Agreement

(1) Color Definitioin

16bit color, mode 5R6G5B.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0

(2) Coordinate System

2.2 Data Frame

The serial interface is fixed in the 8N1 mode, the baud rate is configured by the T5UIC1.CFG file via SD card. The data frame consists of header, instruction, data, and end mark. It is described in the following table.

Frame Header	Instruction	Data	End Mark
Fixed: 0xAA	1 byte, refer to instruction set	Up to 248 bytes	Fixed：0xCC 33 C3 3C

2.3 Instruction Set

(1) Configuration and Interface

Function	Instruction	Data	Description
Handshake	0x00	None(sent) / 0x4F4B(answer)	Example: Tx: AA 00 CC 33 C3 3C Rx: AA 00 4F 4B CC 33 C3 3C
Adjust backlight brightness	0x30	DIM_Set	DIM_Set: Backlight brightness value, 0x00-0xFF. 0x00: Turn off backlight, 0xFF: Maximum brightness. Set brightness 0x01-0x1F may cause screen flicker. Default value: 0xFF. Example: AA 30 80 CC 33 C3 3C Adjust brightness to 50%.
Configure extended serial interface	0x38	Bode_Set	Bode_Set: Set baud rate of the extended serial interface, 0x0001-0x03FF. Bode_Set=15667200/baud rate, minimum baud rate:15300. Default value: 0x0088 (baud rate 115200bps) Example: AA 38 03 30 CC 33 C3 3C Set baud rate to 19200bps.
TXD of extended serial interface	0x39	Datas	Send data packages through extended serial interface. Example: AA 39 31 32 33 34 35 36 37 38 39 CC 33 C3 3C Send “123456789” through the extended serial interface.
RXD of extended serial interface	0x3A	Len_Data，Datas	LCM upload the data sent to extended serial interface. Len_Data: data length. Datas: data. Example: Assume data 0x55 (a byte) is sent to extended serial interface, then LCM uploads AA 3A 01 55 CC 33 C3 3C.

(2) Drawing

Instruction	Data	Description
0x01	Color	Clear screen. Color: The color of clearing screen. Example: AA 01 00 1F CC 33 C3 3C
0x02	Color, Nx, Ny, (X0,Y0)……(Xn,Yn)	Point. Color: The color of point Nx: Actual pixel size in X direction, 0x01-0x0F. Ny: Actual pixel size in Y direction, 0x01-0x0F. (Xn, Yn): Coordinates of point Example: AA 02 F8 00 04 04 00 08 00 08 01 00 01 00 CC 33 C3 3C
0x03	Color, (X0,Y0), …… (Xn,Yn)	Line. Color: The color of line, 2Bytes. (Xn,Yn): The endpoint coordinate of line. Example: AA 03 FF FF 00 40 00 40 01 00 01 00 CC 33 C3 3C
0x05	Mode, Color, (Xs,Ys), (Xe,Ye)	Rectangular. Mode: 0x00=Color The color of rectangle frame. 0x01=Color The color fills the rectangular. 0x02=Color XOR display of data within rectangular area. Color: Color. (Xs,Ys),(Xe,Ye): Coordinates of rectangle at the upper left corner and lower right corner. Example: AA 05 02 07 E0 00 40 00 40 01 00 01 00 CC 33 C3 3C
0x09	Mode, DIS, Color, (Xs,Ys), (Xe,Ye)	Movement of the screen area. Mode: movement mode .7: Movement mode, 0=Cycle movement. 1=Move horizontally, empty area is filled with color .6-.4: Write 0 .3-.0: Direction of movement, 0x00=left. 0x01=right. 0x02=up. 0x03=down. DIS: Moving distance, number of pixels, 0x0000-horizontal resolution/2, 2Bytes. Color： Filling color, valid only when DIR.7=1. (Xs,Ys): The upper left corner coordinates of the area. (Xe,Ye): The lower right corner coordinates of the area. Example： AA 09 00 00 08 FF FF 00 40 00 40 01 00 01 00 CC 33 C3 3C

(3) Text

Instruction	Data	Description
0x11	Mode, Color, Bcolor, (x,y), Strings	The display of character string. Mode: Display mode. .7 Adjust character width 1=Adjust 0=Do not adjust. .6 Background color 1=Display 0=Do not display. .5-.4 Write 0. .3-.0: Font size, 0x00-0x09: 0x00=6*12 0x01=8*16 0x02=10*20 0x03=12*24 0x04=14*28 0x05=16*32 0x06=20*40 0x07=24*48 0x08=28*56 0x09=32*64 Color: Character color. Bcolor: Character background color. (x,y): The upper left corner of starting character. Strings: Characters to display. Example: AA 11 41 FF FF 00 00 00 20 00 80 44 57 49 4E 20 B5 CF CE C4 CC 33 C3 3C
0x14	Color, Nx, Ny, (X0,Y0)……(Xn,Yn)	Data variables. Mode: Display mode. .7 Background color 1=Display 0=Do not display. .6 1=Signed number 0=Unsigned number. .5 1=Display invalid 0 0=Do not display invalid 0. .4 1=Display invalid 0 as 0 0= Display invalid 0 as a space. .3-.0: Font size, 0x00-0x09, same as 0x11 instruction. Color: Character color. Bcolor: Background color. Num_I: Number of integers, 0x01-0x14. Num_F: Number of decimals, 0x00-0x14. Num_I+Num_F < 20. (x,y): Coordinates at the upper-left corner which the variable displays. Datas: Data variables which is up to 8 bytes. Example: AA 14 85 FF FF 00 00 0A 02 00 00 00 00 49 96 02 D2 CC 33 C3 3C

(4) Pictures and Icons

Instruction	Data	Description
0x21	(X,Y), QR_Pixel, DATA	Display the QR code. (x,y): The upper left corner coordinate QR code. QR_Pixel: Pixel number occupied by each point of QR code, 0x01-0x0F. DATA: Data, up to 154 bytes. QR code size: dot matrix, (46*QR_Pixel)*(46*QR_Pixle) Example: AA 21 00 08 00 08 04 68 74 74 70 3A 2F 2F 77 77 77 2E 64 77 69 6E 2E 63 6F 6D 2E 63 6E CC 33 C3 3C
0x22	0x00, JPEG_ID	Display JPEG picture Display JPEG pictures which are stored in 256Kbytes picture memory. JPEG_ID: 0x00-0x0F, picture ID. Always show the 0th picture when the power is on. Example: AA 22 00 00 CC 33 C3 3C
0x25	0x01, JPEG_ID	Decompress a JPEG picture and save it to virtual display area. Decompress a JPEG picture stored in 256Kbytes picture memory to the virtual display area, ready for the operation of copy and paste. JPEG_ID: 0x00-0x0F. Example: AA 25 01 01 CC 33 C3 3C
0x26	(Xs,Ys), (Xe,Ye), (x,y)	Copy an area of picture from virtual display area, and paste it on current displayed picture. (Xs, Ys): Upper left corner coordinates of the selected area in the virtual display area. (Xe, Ye): Bottom right corner coordinates of the selected area in the virtual display area. (x,y): Upper left corner coordinate of pasted position. For example: AA 26 00 40 00 40 01 00 01 00 00 20 00 20 CC 33 C3 3C

3 SD/SDHC interface

All of files (font, kernel, pictures) must be put in the DWIN_SET folder, then files can be downloaded into LCM via SD/SDHC interface. The SD card format must be 4K/FAT32. The file descripted as follow:

Type of files	Naming Format	Description
Kernel upgrade	T5UIC1_*.BIN	
Hardware Configuration	T5UIC1.CFG	
Font	0T5UIC1.HZK	Built by special font extraction software for T5UIC1.
JPEG pictures	Image ID + JPG file name (optional).JPG (For example, 0 boot interface.JPG)	Image ID from 0 to 15, 32Kbytes for each picture. Resolution of JPEG picture must be the same as screen physical resolution. Baseline mode, 4:4:4 or 4:1:1 format. A single JPEG image file must not exceed 32Kbytes.

4 Hardware Configuration

The hardware configuration file T5UIC1.CFG is in binary format and can be edited by software like UltraEdit. Edit T5UIC1.CFG according to followed table.

Type	Address	Length	Definition	Description
Identification Code	0x00	4	0x54 0x35 0x43 0x31	Fixed content
System Configuration	0x04	1	Display direction	0X00=0°no rotation. 0X01=90°rotation. 0X02=180°, the viewing angle is rotated. 0X03=270°rotation.
LCD Selection	0x05	1	LCD Display selection	0x00=480*272 DMT48270C043_04WN 0x01=240*320 DMT32240C028_04WN (Old product) 0x02=320*240 DMT32240C035_04WN 0x03=240*320 DMT32240C028_04WN 0x04=320*480 DMT48320C035_04WN 0x05=240*320 DMT32240C024_04WN
System Clock Calibration	0x06	2	System clock calibration	Write 0x5AA5 to start system clock calibration. While calibration is started, UART2 will send data packages every 30mS at 115200 bps and 8N1 mode. Each package contains more than 30 0x55. Clock is calibrated before shipment, user do not have to calibrate it.
Baud Rate Setting	0x08	2	Serial baud rate setting	Setting value = 7833600 / actual baud rate. The range of setting value= 1~1023, the lowest baud rate is 7657bps. 0x0044=115200bps.

During the file downloading, the LCD displays full-screen blue. And LCD resets or displays full-screen red when finishing download.

Appendix 1 Revision History

Date	Contents	Version
2017.04.17	First edition.	V1.0
2017.09.25	Unified into the T5UIC1 platform.	V1.0
2018.02.23	(1)The flash is expanded to 512Kbytes, 16*16 dot matrix GB2312 font display is supported, picture memory is added to 16. (2)Add QR code display function (0x21 instruction)	V1.1
2018.03.14	Support LCD with resolution 480*320.	V1.2

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Thank you for your continued support of DWIN.