VERSION 2.3

1 Overview T5UIC1 is based on Dwin Technology's T5 CPU and is aimed at no need for touch screen and UI functions A simplified serial port command screen designed for simple, cost-critical application requirements.
Its main features include:

(1) 65K color TFT display.
(2) Basic drawing commands, Chinese and ASCII text display, support JPEG icon, JPEG picture, bar code, two-dimensional code display.
(3) 384Kbytes font space. It stores 6*12-32*64 dot matrix ASCII and 12*12-64*64 dot matrix GB2312 Chinese character library (Chinese characters are scaled based on 16*16 dot matrix).
(4) 512Kbytes image and icon storage space is divided into 16 storage spaces according to 32KB. It can store up to 16 JPEG full-screen pictures. Or store 0-16 JPEG icon library files (a single icon library file can exceed 32KB and occupy multiple memory spaces).
(5) 32KBytes SRAM data memory that can be read and written by serial port, the data is lost after power-on, and all initialized to 0x00 after power-on. Mainly used in online pictures, icon library data update, or real-time JPEG icon, picture display.
(6) 16Kbytes Flash data memory that can be read and written by serial port, the data will not be lost when power off, and the write life is 100,000 times. Mainly used for data storage such as user configuration parameters.
(7) SD/SDHC interface configuration parameters and update fonts and pictures.
(8) An additional full-duplex serial port is extended.
(9) The CPU can be configured to run at 250MHz or 400MHz.

2 Serial port instruction set
2.1 Basic conventions

Color definition 16bit color, 5R6G5B mode

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

Red

D15	D14	D13	D12	D11
R4	R3	R2	R1	R0

Green

D10	D9	D8	D7	D6	D5
G5	G4	G3	G2	G1	G0

Blue

D4	D3	D2	D1	D0
B4	B3	B2	B1	B0

(2) Coordinate system

2.2 Serial data frame format The serial port is fixed in 8N1 mode, and the baud rate is configured by the SD card in the T5UIC1.CFG file. The serial port data frame consists of 4 parts: frame header, command, data, CRC check, and frame end character, which are described in the following table:

Frame Header	Instruction	Data	CRC Check (optional)	End of Frame
Fixed at 0xAA	1 byte See instruction set description.	The maximum length is 248 bytes	CRC check of instructions and data	Fixed to 0xCC 33 C3 3C

Frame header - fixed at 0xAA

Command - 1 bytes, see instruction set description.

Data - The maximum length is 248 bytes.

CRC check (optional) - CRC check of instructions and data

End of Frame - fixed to 0xCC 33 C3 3C

2.3 Instruction Set

(1) Configuration and interface instructions

Function	Instruction	Data	Description
Handshake	0x00	None (issued)/0x4F4B (screen response)	Example: Tx: AA 00 CC 33 C3 3C Rx: AA 00 4F 4B CC 33 C3 3C
CRC Report	0xFF	0x01	When the serial port CRC check is enabled, if the CRC check fails, it will automatically respond to this command.
Backlight Brightness Adjustment	0x30	DIM_Set	DIM_Set: backlight brightness value, 0x00-0xFF. 0x00 backlight is off, 0xFF backlight is the brightest, and 0x01-0x1F setting value backlight may flicker. The power-on default value is 0xFF. Example: AA 30 80 CC 33 C3 3C, the brightness is adjusted to 50%.
Write Data Memory	0x31	Issued: Type, Address, Data Write Flash response: 0xA5 0x4F 0x4B.	Processing time, SRAM is negligible; Flash take up to 1 second. Type: Write memory selection, 0x5A=32KB SRAM, 0xA5=16KB Flash. Address: write data memory address, 0x0000-0x7FFF or 0x3FFF. Data: The data string to be written. Example: AA 31 5A 00 00 31 32 33 34 CC 33 C3 3C Write to SRAM
Read Data Memory	0x32	Issued: Type, Address, Length Response: Type, Address, Length, Data	Processing time: SRAM is negligible, Flash delay is about 0.1mS. Type: Read memory selection, 0x5A=32KB SRAM, 0xA5=16KB Flash. Address: write data memory address, 0x0000-0x7FFF or 0x3FFF. Length: the number of data bytes read, 0x01-0xF0. Data: The read data string. Example: Tx: AA 32 5A 00 00 04 CC 33 C3 3C read SRAM Rx: AA 32 5A 00 00 04 31 32 33 34 CC 33 C3 3C data response

Function	Instruction	Data	Description
Write Picture Memory	0x33	Issued: 0x5A, 0xA5, PIC_ID Response: 0xA5 0x4F 0x4B.	The processing time can take up to 2 seconds. Write the contents of the 32KB SRAM data memory into the designated image memory space. PIC_ID: Picture memory space location, 0x00-0x0F, each space is 32Kbytes. Example: Tx: AA 33 5A A5 00 CC 33 C3 3C Rx: AA 33 4F 4B CC 33 C3 3C
Display orientation adjustment	0x34	Issued: 0x5A, 0xA5, Dis_CFG Response: 0xA5 0x4F 0x4B	Dis_CFG is defined as follows: 0x00=0 degrees, no rotation. 0x01=90 degree rotation. 0x02=180 degrees, the viewing angle is flipped. 0x03=270 degree rotation. Example: Tx: AA 34 5A A5 02 CC 33 C3 3C Rx: AA 34 4F 4B CC 33 C3 3C
Expansion serial port configuration	0x38	Baud_Set	Baud_Set: Set the baud rate of the extended serial port, 0x0001-0x03FF. Baud_Set=15667200/baud rate, the lowest baud rate is 15300. The power-on default value is 0x0088, which corresponds to a baud rate of 115200bps. Example: AA 38 03 30 CC 33 C3 3C Set the baud rate of the extended serial port to 19200bps.
Expansion serial port data transmission	0x39	Data	Send the Data packet from the extended serial port. Example: AA 39 31 32 33 34 35 36 37 38 39 CC 33 C3 3C Send the character string "123456789" from the extended serial port.
Expansion serial port data receiving	0x3A	Len_Data, Data	The screen actively uploads the data received by the extended serial port. Len_Data: The length of the data uploaded this time. Data: The data uploaded this time. Example: Assuming that the extended serial port receives a byte of data 0x55, the screen will automatically upload AA 3A 01 55 CC 33 C3 3C.

(2) Drawing related instructions

Instruction	Data	Description
0x01	Color	Clear screen; processing time 1.5mS (corresponding to 400MHz main frequency, the same below). Color: Clear screen color. Example: AA 01 00 1F CC 33 C3 3C
0x02	Color, Nx, Ny, （X0, Y0） ..... （Xn， Yn）	Set points; processing time=0.4*Nx*Ny*number of set points uS. Color: Set point color. Nx: Actual pixel size in X direction, 0x01-0x0F. Ny: Actual pixel size in Y direction, 0x01-0x0F. (Xn, Yn): Set point coordinate sequence. 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)	End point connection; processing time=0.5*Max (length of line segment in X direction, length of line segment in Y direction) uS. Color: Connection color, 2Bytes. (Xn, Yn): End point coordinates of the line segment. 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 area display; processing time=0.14*number of pixels uS. Mode: 0x00=Color color display rectangular frame. 0x01=Color fills the rectangular area with color. 0x02=Color XOR rectangle area data, mostly used for menu selection/unselection coloring. Color: color. (Xs,Ys), (Xe,Ye): The coordinates of the upper left and lower right corners of the rectangle. Example: AA 05 02 07 E0 00 40 00 40 01 00 01 00 CC 33 C3 3C

Instruction	Data	Description
0x08	(x,y), Wide, Color1, Color0, data	Two-color bitmap filling; processing time=0.22*number of filled pixels uS. (X, y): the starting point coordinates of the upper left corner of the bitmap filled area; Wide: the width of the filled area in the X direction, 0x0001-0x01E0; Color1: the fill color corresponding to bit1; Color0: the fill color corresponding to bit0; data: fill data, Note that the data needs to be left-aligned to 1Byte in the width direction. For example, to fill the width of 6 pixels, 1Byte space is also needed, and the higher 6bit is effective. Example: AA 08 0004 0004 00 08 0000 FFFF 7C C6 C6 C6 7C C6 C6 C6 C6 7C CC 33 C3 3C
0x09	Mode, DIS, Color, （Xs,Ys）, (Xe, Ye)	The screen area moves; processing time=0.20*the number of pixels in the moving area uS. Mode: Move mode. 7: Move mode, 0=circular move. 1=Translation, the vacant area is filled with color. .6-.4: Write 0. . 3-.0: moving direction, 0x00=left. 0x01=To the right. 0x02=Up. 0x03=Down. DIS: moving distance, number of pixel dots, 0x0000-horizontal resolution/2, 2Bytes. Color: Fill color, only valid when DIR.7=1. (Xs, Ys): The coordinates of the upper left corner of the selected area. (Xe, Ye): The coordinates of the lower right corner of the selected area. Example: AA 09 00 00 08 FF FF 00 40 00 40 01 00 01 00 CC 33 C3

(3) Text related instructions

Instruction	Data	Description
0x11	Mode, Color, Bcolor, (x, y), Strings	Character string display; the processing time of a 16*16 dot matrix Chinese character is 76uS, and the rest are converted according to the ratio of the dot matrix. Mode: Display mode. .7 Character width adjustment setting 1=adjust 0=no adjustment. .6 Background color display setting 1=display 0=not display. .5-.4 Write 0. .3-.0: Font size, 0x00-0x09, the corresponding font size is as follows: 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 display color. Bcolor: the color of the character background (X, y): The coordinates of the upper left corner of the string display. Strings: Strings to be displayed, non-ASCII characters are displayed in GB2312 encoding format Chinese characters. 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

Instruction	Data	Description
0x14	Mode, Color, Bcolor，Num_I, Num_F, （x，y），Data	Data variable display; processing time is calculated with 0x11 instruction. Mode: Display mode. .7 Background color display setting 1=display 0=not display. . 6 1=signed number 0=unsigned number. .5 1=invalid 0 display 0=invalid 0 not display. .4 1=Invalid 0 is displayed as 0 0=Invalid 0 is displayed as a space. .3-.0: Font size, 0x00-0x09, same as 0x11 command; 0x0A-0x0F Use font 0x02:7400-0x02: BBFF special dot matrix size character of 18KB font space, according to 0-9, ., -, + , SP (space) in order. 0x0A=64*120 dot matrix; 0x0B=44*80 dot matrix. Color: Character display color. Bcolor: the color of the character background Num_I: The number of integer digits displayed, 0x01-0x14. Num_F: The number of decimal places displayed, 0x00-0x14, the sum of Num_I+Num_F cannot exceed 20. (X, y): The coordinates of the upper left corner of the variable display. Datas: Data variables, 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) Instructions related to pictures and icons

Instruction	Data	Description
0x21	（X,Y），QR_Pixel，DATA	QR code display; QR_Pixel=4 QR code processing time is 7.5mS. (X, y): the coordinate position of the two-dimensional code display; QR_Pixel: the size of the pixel occupied by each point of the two-dimensional code, 0x01-0x0F; DATA: display data, up to 154 bytes. The size of the QR code is (46*QR_Pixel)*(46*QR_Pixel) dot matrix. 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	JPEG picture display; 480*272 resolution 4:1:1 format compression processing time is 250mS. Display JPEG pictures saved in 512Kbytes picture memory. The picture is also cached in the 0# virtual display area (can be operated with 0x27 command). JPEG_ID: 0x00-0x0F, corresponding to the starting ID of the picture stored in JPEG. Example: AA 22 00 00 CC 33 C3 3C

Instruction	Data	Description
0x23	（x,y），Mode，Icon_IDs	Icon library icon display; 1 28*45 icon, background display mode, processing time 3.2mS. (X, y): The starting position of the first icon, corresponding to the upper left corner of the icon. Mode: Icon display mode. .7 Icon background display settings: 0=Background filtering is not displayed, 1=Background display. When setting the background filter to not display, the background must be pure black. .6 Background picture restoration settings (only valid when .7=0): 0=Background pictures are not restored, 1=Automatically use 0# pictures in the virtual display area for background restoration. .5 Background filter intensity selection (only valid when .7=0) 0=normal, 1=enhanced .4 undefined, write 0. .3-.0 Icon library storage location, 0x00-0x0F. Icon_IDs: Icon IDs that need to be displayed, each ID is represented by 1 Byte, 0x00-0xFF. Example: AA 23 00 10 00 10 08 00 01 02 03 CC 33 C3 3C

Instruction	Data	Description
0x24	（x,y），Mode，Address	SRAM memory icon display; 1 28*45 icon, background display mode, processing time 3.1mS. (X, y): The display position of the icon, corresponding to the upper left corner of the icon. Mode: Icon display mode. .7 Icon background display settings: 0=Background filtering is not displayed, 1=Background display. When setting the background filter to not display, the background must be pure black. .6 Undefined, write 0. .5 Background filtering intensity selection (only valid when .7=0) 0=normal, 1=enhanced .4-.0 undefined, write 0. Address: The starting address of SRAM memory to store JPEG icon data, 0x0000-0x7FFF. Example: AA 24 00 10 00 10 00 00 00 CC 33 C3 3C
0x25	0x01，JPEG_ID	The JPEG picture is decompressed to 1# virtual display area. 480*272 resolution 4:1:1 format compression processing time is 240mS. Decompress the JPEG pictures saved in the 512Kbytes picture memory to the 1# virtual display area, which is convenient for operations such as copying and pasting of icons. JPEG_ID: 0x00-0x0F, corresponding to the starting ID of the picture stored in JPEG. Example: AA 25 01 01 CC 33 C3 3C

Instruction	Data	Description
0x26	(Xs,Ys), (Xe，Ye)，(x,y)	1# Copy and paste the designated area of the virtual display area to the current display interface. 256*256 pixel area processing time is 12.5mS (0.2uS per pixel). (Xs, Ys): 1# The coordinates of the upper left corner of the selected area of the virtual display area icon. (Xe, Ye): 1# The coordinates of the lower right corner of the area specified by the icon in the virtual display area. (X, y): When pasting to the current display area, the coordinate position of the upper left corner. Example: AA 26 00 40 00 40 01 00 01 00 00 20 00 20 CC 33 C3 3C

Instruction	Data	Description
0x27	Mode, (Xs,Ys), (Xe, Ye), (x,y)	Copy and paste from the designated area of the virtual display area to the current display interface. 256*256 pixel area processing time is 12.5mS (0.2uS per pixel). Mode: Display mode. .7 Background display setting 0=Background filter is not displayed, 1=Background display. When setting the background filter to not display, the background must be pure black. .6 Background picture restoration settings (only valid when .7=0, .1=1): 0=Background pictures are not restored, 1=Automatically use 0# pictures in the virtual display area for background restoration. .5 Background filtering intensity selection (only valid when .7=0) 0=normal, 1=enhanced .4-.1 reserved, write 0. .0 Virtual display area selection 0=0#virtual display area, 1=1#virtual display area. (Xs, Ys): The coordinates of the upper left corner of the selected area of the icon in the virtual display area. (Xe, Ye): The coordinates of the lower right corner of the area designated by the icon in the virtual display area. (X, y): When pasting to the current display area, the coordinate position of the upper left corner. Example: AA 27 01 00 40 00 40 01 00 01 00 00 40 00 40 CC 33 C3 3C

Instruction	Data	Description
0x28	（x,y），Mode，Icon_Lib，Icon_IDs，Icon_IDe，Delay_Time	The icon animation automatically displays the command settings. (X, y): The starting position of the animation icon, corresponding to the upper left corner of the icon. Mode: Animation icon display mode. .7 Switch control 1=This group of animation is turned on 0=This group of animation is turned off; it can be controlled by the 0x29 command. .6 Start mode 1=Start from the start icon 0=Start from the last stop position. .5-.4 Undefined, write 0. .3-.0 The command position of this group of animation icons, 0x00-0x0F, there are a total of 16 groups of animation commands. Icon_lib: icon library storage location, 0x00-0x0F. Icon_IDs: the starting icon position of the animation, 0x00-0xFF. Icon_IDe: the position of the animation termination icon, 0x00-0xFF. Delay_time: The display time interval of the animation icon, 0x00-0xFF, the unit is 10mS. Example: AA 28 00 10 00 10 80 09 00 09 0A CC 33 C3 3C Set the 0th group of animation
0x29	Cartoon_Set	Icon animation automatically displays command control. Cartoon_Set: ICON animation command switch control; each bit corresponds to a group of commands, 1=on, 0=off; .15 corresponds to the 15th group of animation commands, and .0 corresponds to the 0th group of animation commands. Example: AA 29 00 05 CC 33 C3 3C Turn on group 0 and group 2 animation commands.

Instruction	Data	Description
0x2A	(X,Y) , DATA	EAN-13 bar code display, the processing time is about 0.5mS. (X, y): The coordinate position displayed by the barcode must be an even number. DATA: 12Bytes barcode data, the data is HEX encoding mode (0x00-0x09). The width of the bar code bit module is fixed at 2 pixels, and the size of the entire bar code area is 222*94 dot matrix. Example: AA 2A 00 08 00 08 09 07 08 07 05 03 09 09 08 03 02 04 CC 33 C3 3C

3 SD/SDHC interface

The downloaded file must be placed in the DWIN_SET folder in the root directory of the SD card, and must be a 4KB sector, FAT32 format SD or SDHC card. The file naming instructions are as follows:

File Type	Naming rules	Description
Program upgrade file	T5UIC1_*.BIN	
Hardware Profile	T5UIC1.CFG	
Font File	0T5UIC1.HZK	T5UIC1 font library special extraction software generation.
JPEG File	Picture storage ID+(optional) file name.JPG (for example, 0 boot interface.JPG)	The image or icon library stores ID 0-15. The JPEG file must have the same physical resolution as the screen, Baseline mode, 4:4:4 or 4:1:1 format. The file size of a single JPEG image cannot exceed 32Kbytes.
JPEG ICON File	ICON storage ID + (optional) file name.ICO (for example, 8 icon library.ICO)	The image or icon library stores ID 0-15. The JPEG file must have the same physical resolution as the screen, Baseline mode, 4:4:4 or 4:1:1 format. The file size of a single JPEG image cannot exceed 32Kbytes.

The T5UIC1.CFG hardware configuration file adopts binary data format. The unused data is written as 0x00, which can be edited with software such as UltraEdit. The description is as follows:

Category	Address	Length	Definition	Description
Configuration Identification	0x00	4	0x54 0x35 0x43 0x31	Fixed content

Category	Address	Length	Definition	Description
System Configuration	0x04	1	System Configuration	.7 CPU main frequency selection 0=250MHz 1=400MHz .6 Power-on display setting 0=display the 0th# picture 1=black clear screen, back light off.5 serial port CRC check switch 0=off 1=on. 4-. 2 Undefined, write 0 .1-. 0 display direction setting 0x00 (00) = 0 degrees, no rotation. 0x01(01)=90 degree rotation. 0x02(10)=180 degrees, the viewing angle is reversed. 0x03(11)=270 degree rotation.
Screen Selection	0x05	1	Display Selection	0x00=480*272 DMT48270C043_04WN 0x01=240*320 DMT32240C028_04WN（Old LCD Screen） 0x02=320*240 DMT32240C035_04WN 0x03=240*320 DMT32240C028_04WN 0x04=320*480 DMT48320C035_04WN 0x05=240*320 DMT32240C024_04WN(EWTN Screen) 0x06=320*480 DMT48320C035_04WN*(IPS Screen) 0x07=240*320 DMT32240C024_04WN*(IPS Screen) 0x08=240*320 DMT32240C020_04WN*(IPS Screen)
System Clock Calibration	0x06	2	System Clock Calibration	Write 0x5AA5 to start the system clock calibration. During the calibration process, the UART2 serial port sends more than 30 data packets of 0x55 data per packet at 115200bps, 8N1 mode, and 30mS intervals. It has been calibrated before leaving the factory, so no additional calibration is required during use.
Baud Rate Setting	0x08	2	Serial port baud rate setting	Setting value=7833600/target baud rate. Setting value range = 1-1023, the lowest baud rate is 7657bps. 0x0044=115200bps.
Screen Selection Enable	0x0A	1	Screen Selection Enable	0x5A=0x05 The screen selection configuration of the address is valid. Other=The configuration is invalid.

During the download process, the screen displays blue, and the screen resets or displays red after the download is complete.

Appendix 1 Revision History

Date	Revisions	Release Version
2017.04.17	Initial Release.	V1.0
2017.09.25	Unified into the T5UIC1 platform.	V1.0
2018.02.23	Flash expands 512Kbytes, adds 16*16 dot matrix GB2312 Chinese character library, expands the number of pictures to 16; adds 0x21 two-dimensional code display instructions.	V1.1
2018.03.14	Added support for 480*320 display screen.	V1.2
2018.04.13	Use 16*16 dot matrix Chinese characters as the benchmark to zoom to expand the display range of Chinese characters to 12*12-64*64.	V1.3
2018.11.21	Added 250MHz/400MHz main frequency selection; Added the option to display 0# picture or black screen at boot; Added 400MHz main frequency, instruction processing time reference, 250MHz time*1.6 times calculation; Added 0x23 icon library ICON display command; Added Added 0x24 SRAM memory ICON display command for real-time JPEG image display; Added 0x27 0# virtual display area copy and paste commands; Added 0x28, 0x29 animation icon commands; Added 0x31, 0x32 read and write data memory (16KB Flash Or 32KB SRAM) instruction; 0x33 is added to write the contents of 32KB SRAM data memory into picture memory instruction for online picture update; 0x34 display direction adjustment instruction is added.	V2.0
2019.12.02	The CRC check option is added to the serial port.	V2.1

Date	Revisions	Release Version
2020.04.07	Added 0x08 two-color bitmap filling instruction. Added 0x2A EAN-13 bar code display.	V2.2
2021.03.03	The 0x0A address of FG file adds the screen selection enable setting.	V2.3

If you have any questions during the use of this document or Diwen products, or if you want to know more about the latest information about Diwen products, please contact us in time: 400 Toll free: 400 018 9008 Enterprise QQ and WeChat: 400 018 9008 Enterprise mail: dwinhmi @dwin.com.cn Thank you for your continued support to Diwen, your support is the driving force for our progress! thank you all!

T5UIC1 Application Guide

Ver2.3

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1 Overview

T5UIC1 is a simplified version based on Diwen Technology's T5 CPU, designed for applications that do not require a touch screen, simple UI functions, and demanding cost requirements.

Serial command screen.

Its main features include:

(1) 65K color TFT display.

(2) Basic drawing commands, Chinese and ASCII text display, support JPEG icon, JPEG picture, barcode, two-dimensional code display.

(3) 384Kbytes font space.

Stored 6*12-32*64 dot matrix ASCII and 12*12-64*64 dot matrix GB2312 Chinese character library (Chinese characters are scaled based on 16*16 dot matrix).

(4) 512Kbytes image and icon storage space is divided into 16 storage spaces according to 32KB.

It can store up to 16 JPEG full-screen pictures.

Or store 0-16 JPEG icon library files (a single icon library file can exceed 32KB and occupy multiple memory spaces).

(5) 32KBytes SRAM data memory that can be read and written by serial port, the data is lost when power is off, and all are initialized to 0x00 when power on.

Mainly used in online pictures, icon library data update, or real-time JPEG icon, picture display.

(6) 16Kbytes Flash data memory that can be read and written by serial port, the data will not be lost when power off, and the write life is 100,000 times.

Mainly used for data storage such as user configuration parameters.

(7) SD/SDHC interface configuration parameters and update fonts and pictures.

(8) An additional full-duplex serial port is extended.

(9) The CPU can be configured to run at 250MHz or 400MHz.

T5UIC1 Application Guide

2 Serial port instruction set

2.1 Basic conventions

(1) Color definition

16bit color, 5R6G5B mode

D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5

R4 R3 R2 R1 R0 G5 G4 G3 G2 G1 G0

(2) Coordinate system

2.2 Serial data frame format

The serial port is fixed in 8N1 mode, and the baud rate is configured with SD card by T5UIC1.CFG file.

The serial port data frame is composed of 4 parts: frame header, command, data, CRC check, and frame end character, which are described in the following table:

Frame header

instruction

data

CRC check (optional)

End of frame

It is fixed to 0xAA 1 byte, see instruction set description. The maximum length is 248 bytes. CRC check of instructions and data

Fixed as 0xCC 33 C3 3C

Ver2.3
Beijing Diwen Technology Co., Ltd.

2.3 Instruction set

(1) Configuration and interface commands

Features

instruction

data

Description
shake hands
0x00 None (issued)/0x4F4B (screen response)
For example:
Tx: AA 00 CC 33 C3 3C
Rx: AA 00 4F 4B CC 33 C3 3C
CRC report
0xFF 0x01
When the serial port CRC check is enabled, if the CRC check fails, it will automatically respond to this command.
Backlight brightness adjustment 0x30 DIM_Set
DIM_Set: backlight brightness value, 0x00-0xFF.
0x00 backlight is off, 0xFF backlight is the brightest, among which 0x01-0x1F setting value backlight It may flicker.
The power-on default value is 0xFF.
Example: AA 30 80 CC 33 C3 3C adjust the brightness to 50%.
Write data memory 0x31
Issued: Type, Address, Datas
Write Flash response: 0xA5 0x4F 0x4B.
Processing time, SRAM can be ignored; Flash takes 1 second at most.
Type: Write memory selection, 0x5A=32KB SRAM, 0xA5=16KB Flash.
Address: write data memory address, 0x0000-0x7FFF or 0x3FFF.
Datas: The data string to be written.
Example: AA 31 5A 00 00 31 32 33 34 CC 33 C3 3C write SRAM
Read data memory 0x32
Issued: Type, Address, Length
Response: Type, Address, Length, Datas
Processing time, SRAM can be ignored, and Flash delay is about 0.1mS.
Type: Read memory selection, 0x5A=32KB SRAM, 0xA5=16KB Flash.
Address: write data memory address, 0x0000-0x7FFF or 0x3FFF.
Length: The length of the read data byte, 0x01-0xF0.
Datas: The read data string.
For example:
Tx: AA 32 5A 00 00 04 CC 33 C3 3C read SRAM
Rx: AA 32 5A 00 00 04 31 32 33 34 CC 33 C3 3C data response
Write picture memory 0x33
Issued: 0x5A, 0xA5, PIC_ID
Response: 0xA5 0x4F 0x4B.
The processing time can take up to 2 seconds.
Write the contents of the 32KB SRAM data memory into the designated image memory space.
PIC_ID: Picture memory space location, 0x00-0x0F, each space is 32Kbytes.
For example:
Tx: AA 33 5A A5 00 CC 33 C3 3C
Rx: AA 33 4F 4B CC 33 C3 3C
Display direction adjustment 0x34
Issued: 0x5A, 0xA5, Dis_CFG
Response: 0xA5 0x4F 0x4B
Dis_CFG is defined as follows:
0x00=0 degrees, no rotation. 0x01=90 degree rotation.

0x02=180 degrees, the viewing angle is flipped. 0x03=270 degree rotation.
For example:
Tx: AA 34 5A A5 02 CC 33 C3 3C
Rx: AA 34 4F 4B CC 33 C3 3C
Expansion serial port
Configuration
0x38 Bode_Set
Bode_Set: Set the baud rate of the extended serial port, 0x0001-0x03FF.
Bode_Set= 15667200/baud rate, the lowest baud rate is 15300.
The power-on default value is 0x0088, which corresponds to a baud rate of 115200bps.
For example:
AA 38 03 30 CC 33 C3 3C
Set the baud rate of the extended serial port to 19200bps.
Expansion serial port
Data sending
0x39 Datas
Send the Datas packet from the extended serial port.
For example:
AA 39 31 32 33 34 35 36 37 38 39 CC 33 C3 3C
Send the string "123456789" from the extended serial port.
Expansion serial port
Data reception
0x3A Len_Data, Datas
The screen actively uploads the data received by the extended serial port.
Len_Data: The length of the data uploaded this time.
Datas: The data uploaded this time.
For example:
Assuming that the extended serial port receives a byte of data 0x55, the screen will automatically upload AA 3A 01 55 CC 33 C3 3C.

(2) Drawing related instructions

instruction
data
Description
0x01 Color
Clear the screen; processing time 1.5mS (corresponding to 400MHz main frequency, the same below).
Color: Clear screen color.
Example: AA 01 00 1F CC 33 C3 3C

0x02 Color,Nx,Ny,(X0,Y0)……(Xn,Yn)
Set point; processing time=0.4*Nx*Ny*number of set points uS.
Color: Set point color.
Nx: Actual pixel size in X direction, 0x01-0x0F.
Ny: actual pixel size in Y direction, 0x01-0x0F.
(Xn, Yn): Set point coordinate sequence.
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)
End connection; processing time=0.5*Max (length of line segment in X direction, length of line segment in Y direction) uS.
Color: Connection color, 2Bytes.
(Xn, Yn): the coordinates of the end point of the line segment.
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 area display; processing time=0.14*number of pixels uS.
Mode:
0x00=Color color displays a rectangular frame.
0x01=Color fills the rectangular area with color.
0x02=Color XOR rectangle area data, mostly used for menu selection/unselection coloring.
Color: color.
(Xs,Ys),(Xe,Ye): The coordinates of the upper left and lower right corners of the rectangle.
Example: AA 05 02 07 E0 00 40 00 40 01 00 01 00 CC 33 C3 3C
0x08 (x,y), Wide, Color1, Color0, data
Two-color bitmap filling; processing time=0.22*number of filled pixels uS.
(X,y): the starting point coordinates of the upper left corner of the bitmap filled area
Wide: the width of the filled area in the X direction, 0x0001-0x01E0;
Color1: fill color corresponding to bit1;
Color0: fill color corresponding to bit0;
data: Fill the data, note that the data needs to be left-aligned to 1Byte in the width direction.
For example, to fill the width of 6 pixels, it also needs to occupy 1Byte space, and the high 6bit is effective.
For example:
AA 08 0004 0004 00 08 0000 FFFF 7C C6 C6 C6 7C C6 C6 C6 C6 7C CC 33
C3 3C
0x09 Mode, DIS, Color, (Xs, Ys), (Xe, Ye)
The screen area moves; processing time=0.20*the number of pixels in the moving area uS.
Mode: mobile mode
.7: Movement mode, 0=circular movement. 1=Translation, the vacant area is filled with color.
.6-.4: Write 0.
.3-.0: moving direction, 0x00=left. 0x01=To the right. 0x02=Up. 0x03=Down.
DIS: moving distance, number of pixel dots, 0x0000-horizontal resolution/2, 2Bytes.
Color: Fill color, only valid when DIR.7=1.
(Xs, Ys): The coordinates of the upper left corner of the selected area.
(Xe, Ye): The coordinates of the lower right corner of the selected area.
Example: AA 09 00 00 08 FF FF 00 40 00 40 01 00 01 00 CC 33 C3 3C

(3) Text related instructions

instruction
data
Description
0x11 Mode, Color, Bcolor, (x, y), Strings
Character string display; the processing time of a 16*16 dot matrix Chinese character is 76uS, and the rest are converted according to the ratio of the dot matrix number.
Mode: Display mode.
.7 Character width adjustment setting 1=adjust 0=no adjustment.
.6 Background color display setting 1=display 0=not display.
.5-.4 Write 0.
.3-.0: font size, 0x00-0x09, the corresponding font size is as follows:
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 display color.
Bcolor: The color of the character background display.
(X, y): The coordinates of the upper left corner of the string display.
Strings: Strings to be displayed, non-ASCII characters are displayed according to Chinese characters in GB2312 encoding format.
For 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
Mode, Color, Bcolor, Num_I, Num_F,
(X, y), Datas
Data variable display; processing time is the same as 0x11 instruction calculation.
Mode: Display mode.
.7 Background color display setting 1=display 0=not display.
.6 1=signed number 0=unsigned number.
.5 1=invalid 0 display 0=invalid 0 not display.
.4 1=Invalid 0 is displayed as 0 0=Invalid 0 is displayed as a space.
.3-.0: font size,
0x00-0x09, same as 0x11 command;
0x0A-0x0F Use font library 0x02:7400-0x02: BBFF special dot matrix size of 18KB font library space Small characters are arranged in the order of 0-9, ., -, +, SP (space).
0x0A=64*120 dot matrix;
0x0B=44*80 dot matrix.
Color: Character display color.
Bcolor: The color of the character background display.
Num_I: The number of integer digits displayed, 0x01-0x14.
Num_F: The number of decimal places displayed, 0x00-0x14, the sum of Num_I+Num_F cannot exceed 20.

(X, y): The coordinates of the upper left corner of the variable display.
Datas: Data variables, 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) Instructions related to pictures and icons

instruction
data
Description
0x21
(X,Y), QR_Pixel, DATA
QR code display; QR_Pixel=4 QR code processing time is 7.5mS.
(X, y): the coordinate position displayed by the QR code;
QR_Pixel: The size of pixels occupied by each point of the QR code, 0x01-0x0F;
DATA: Display data, up to 154 bytes.
The size of the QR code is (46*QR_Pixel)*(46*QR_Pixle) dot matrix.
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
JPEG picture display; 480*272 resolution 4:1:1 format compression processing time is 250mS.
Display JPEG pictures saved in 512Kbytes picture memory.
The picture is also cached to the 0# virtual display area (0x27 command operation can be used).
JPEG_ID: 0x00-0x0F, corresponding to the starting ID of the picture stored in JPEG.
Example: AA 22 00 00 CC 33 C3 3C
0x23
(X,y), Mode, Icon_IDs
Icon library icon display; 1 28*45 icon, background display mode, processing time 3.2mS.
(X, y): The starting position of the first icon, corresponding to the upper left corner of the icon.
Mode: Icon display mode.
.7 Icon background display settings: 0=Background filtering is not displayed, 1=Background display.
When setting the background filter to not display, the background must be pure black.
.6 Background picture restoration settings (only valid when .7=0):
0=Background pictures are not restored, 1=Automatically use 0# virtual display area pictures for background restoration.
.5 Background filtering intensity selection (only valid when .7=0) 0=normal, 1=enhanced
.4 Undefined, write 0.
.3-.0 Icon library storage location, 0x00-0x0F.
Icon_IDs: Icon IDs that need to be displayed, each ID is represented by 1 Byte, 0x00-0xFF.

Example: AA 23 00 10 00 10 08 00 01 02 03 CC 33 C3 3C
0x24
(X,y), Mode, Address
SRAM memory icon display; 1 28*45 icon, background display mode, processing time 3.1mS.
(X, y): icon display position, corresponding to the upper left corner of the icon.
Mode: Icon display mode.
.7 Icon background display settings: 0=Background filtering is not displayed, 1=Background display.
When setting the background filter to not display, the background must be pure black.
.6 Undefined, write 0.
.5 Background filtering intensity selection (only valid when .7=0) 0=normal, 1=enhanced
.4-.0 is not defined, write 0.
Address: The starting address of SRAM memory to store JPEG icon data, 0x0000-0x7FFF.
Example: AA 24 00 10 00 10 00 00 00 CC 33 C3 3C
0x25
0x01, JPEG_ID
The JPEG picture is decompressed to 1# virtual display area.
480*272 resolution 4:1:1 format compression processing time is 240mS.
Decompress the JPEG pictures saved in the 512Kbytes picture memory to the 1# virtual display area, which is convenient
Copy, paste and other operations of the icon.
JPEG_ID: 0x00-0x0F, corresponding to the starting ID of the picture stored in JPEG.
Example: AA 25 01 01 CC 33 C3 3C
0x26
(Xs,Ys), (Xe,Ye), (x,y)
1# Copy and paste the designated area of the virtual display area to the current display interface.
256*256 pixel area processing time is 12.5mS (0.2uS per pixel).
(Xs, Ys): 1# The coordinates of the upper left corner of the selected area of the virtual display area icon.
(Xe, Ye): 1# The coordinates of the lower right corner of the area specified by the icon in the virtual display area.
(X, y): When pasting to the current display area, the coordinate position of the upper left corner.
Example: AA 26 00 40 00 40 01 00 01 00 00 20 00 20 CC 33 C3 3C
0x27
Mode, (Xs, Ys), (Xe, Ye), (x, y)
Copy and paste from the designated area of the virtual display area to the current display interface.
256*256 pixel area processing time is 12.5mS (0.2uS per pixel).
Mode: Display mode.
.7 Background display setting 0=Background filter is not displayed, 1=Background display.
When setting the background filter to not display, the background must be pure black.
.6 Background picture restoration settings (only valid when .7=0 and .1=1):
0=Background pictures are not restored, 1=Automatically use 0# virtual display area pictures for background restoration.
.5 Background filtering intensity selection (only valid when .7=0) 0=normal, 1=enhanced
.4-.1 Reserved, write 0.
.0 Virtual display area selection 0=0#virtual display area, 1=1#virtual display area.
(Xs, Ys): The coordinates of the upper left corner of the selected area of the icon in the virtual display area.
(Xe, Ye): The coordinates of the lower right corner of the icon area in the virtual display area.
(X, y): When pasting to the current display area, the coordinate position of the upper left corner.
Example: AA 27 01 00 40 00 40 01 00 01 00 00 40 00 40 CC 33 C3 3C

0x28
(X,y), Mode, Icon_Lib, Icon_IDs,
Icon_IDe, Delay_Time
The icon animation automatically displays the command settings.
(X, y): The starting position of the animation icon, corresponding to the upper left corner of the icon.

Mode: Animation icon display mode.
.7 Switch control 1=This group of animation is on 0=This group of animation is off; it can be controlled by 0x29 command.
.6 Start mode 1=start from the start icon 0=start from the last stop position.
.5-.4 Undefined, write 0.
.3-.0 The command position of this group of animation icons, 0x00-0x0F, there are a total of 16 groups of animation commands.
Icon_lib: icon library storage location, 0x00-0x0F.
Icon_IDs: the starting icon position of the animation, 0x00-0xFF.
Icon_IDe: the position of the animation termination icon, 0x00-0xFF.
Delay_time: The display time interval of the animation icon, 0x00-0xFF, the unit is 10mS.
Example: AA 28 00 10 00 10 80 09 00 09 0A CC 33 C3 3C Set the 0th group animation
0x29
Cartoon_Set
Icon animation automatically displays command control.
Cartoon_Set: ICON animation command switch control;
Each bit corresponds to a set of instructions, 1=on, 0=off;
.15 corresponds to the 15th group of animation commands, and .0 corresponds to the 0th group of animation commands.
Example: AA 29 00 05 CC 33 C3 3C Turn on group 0 and group 2 animation commands.
0x2A
(X,Y), DATA
EAN-13 bar code display, the processing time is about 0.5mS.
(X, y): The coordinate position displayed by the barcode must be an even number.
DATA: 12Bytes barcode data, the data is HEX encoding mode (0x00-0x09).
The width of the barcode bit module is fixed to 2 pixels, and the size of the entire barcode area is 222*94 dot matrix.
For example:
AA 2A 00 08 00 08 09 07 08 07 05 03 09 09 08 03 02 04 CC 33 C3 3C

3 SD/SDHC interface

The downloaded file must be placed in the DWIN_SET folder in the root directory of the SD card , and must be a 4KB sector, FAT32 format SD or SDHC card.

The file naming instructions are as follows:

file type
Naming rules
Description
Program upgrade file
T5UIC1_*.BIN
Hardware profile
T5UIC1.CFG
Font file
0T5UIC1.HZK
T5UIC1 font library special extraction software generation.
JPEG file
Image storage ID + (optional) file name.JPG
(For example, 0 boot interface.JPG)
JPEG icon file
ICON storage ID + (optional) file name.ICO
(For example, 8 icon library.ICO)
The image or icon library stores ID 0-15.
The JPEG file must be the same as the physical resolution of the screen,
Baseline mode, 4:4:4 or 4:1:1 format.
The file size of a single JPEG image cannot exceed 32Kbytes.

The T5UIC1.CFG hardware configuration file adopts binary data format, and write 0x00 for the unused data, which can be edited by software such as UltraEdit.

Edit, the description is as follows:

category
Address length
definition
Description
Configuration recognition
0x00
4
0x54 0x35 0x43 0x31 Fixed content.
System Configuration
0x04

1
System Configuration
.7 CPU frequency selection 0=250MHz 1=400MHz
.6 Power-on display settings 0=display the 0th# picture 1=black clear screen, backlight off
.5 Serial port CRC check switch 0=off 1=on
.4-.2 Undefined, write 0
.1-.0 Display direction setting
0x00 (00) = 0 degrees, no rotation.
0x01(01)=90 degree rotation.
0x02(10)=180 degrees, the viewing angle is reversed.
0x03(11)=270 degree rotation.
Screen selection
0x05
1
Display selection
0x00=480*272 DMT48270C043_04WN
0x01=240*320 DMT32240C028_04WN (old model LCD screen)
0x02=320*240 DMT32240C035_04WN
0x03=240*320 DMT32240C028_04WN
0x04=320*480 DMT48320C035_04WN
0x05=240*320 DMT32240C024_04WN (EWTN screen)
0x06=320*480 DMT48320C035_04WN*(IPS screen)
0x07=240*320 DMT32240C024_04WN* (IPS screen)
0x08=240*320 DMT32240C020_04WN*(IPS screen)
System clock calibration
0x06
2
System clock calibration
Write 0x5AA5 to start the system clock calibration.
During the calibration process, the UART2 serial port is 115200bps, 8N1 mode, 30mS interval timing
Send more than 30 data packets with 0x55 data per packet.
It has been calibrated before leaving the factory, so no additional calibration is required during use.
Baud rate setting
0x08
2
Serial port baud rate setting
Setting value=7833600/set baud rate.
Setting value range = 1-1023, the lowest baud rate is 7757bps.
0x0044=115200bps.
Screen selection enable
0x0A
1
Screen selection enable
0x5A=0x05 The screen selection configuration of the address is valid.
Other=The configuration is invalid.

During the download process, the screen displays blue, and the screen resets or displays red after the download is complete.

Appendix 1 Revision History

date
modify the content
version
2017.04.17 First release.
V1.0
2017.09.25 Unified into the T5UIC1 platform.
V1.0
2018.02.23
Flash expands by 512Kbytes, adds 16*16 dot matrix GB2312 Chinese character library, and expands the number of pictures to 16;
Add 0x21 QR code display instruction.
V1.1
2018.03.14 Added support for 480*320 display screen.
V1.2
2018.04.13 Use the 16*16 dot matrix Chinese characters as the benchmark to zoom to expand the display range of Chinese characters to 12*12-64*64.
V1.3
2018.11.21
Added 250MHz/400MHz main frequency selection;
Added the option to display 0# picture or black screen at boot;
Added reference for instruction processing time under 400MHz main frequency, 250MHz time*1.6 times calculation;
Added 0x23 icon library ICON display instruction;
Added 0x24 SRAM memory ICON display command for real-time JPEG image display;
Added 0x27 0# copy and paste instructions in virtual display area;
Added 0x28, 0x29 animation icon commands;
Added 0x31, 0x32 read and write data memory (16KB Flash or 32KB SRAM) instructions;
Added 0x33 to write the contents of 32KB SRAM data memory into picture memory command for online picture update;
Added 0x34 display direction adjustment command.
V2.0
2019.12.02 Added CRC check option to the serial port.
V2.1
2020.04.07
Added 0x08 two-color bitmap filling command.
Added 0x2A EAN-13 barcode display.
V2.2

2021.03.03 CFG file 0x0A address adds the screen selection enable setting.
V2.3

If you have any questions during the use of this document or Diwen products, or if you want to know more about the latest information about Diwen products, please contact us in time:

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Thank you for your continued support to Diwen, your support is the driving force for our progress!

thank you all!