



1 Overview

- (1) Based on T5L0 dual-core ASIC, both GUI and OS cores run at 200MHz main frequency with very low power consumption.
- (2) 8Mbytes low-cost SPI Flash, JPEG image and icon compressed storage. The size of background image storage can be specified.
- (3) 512Kbytes Nor Flash on-chip user database, 128Kbytes data variable space.
- (4) Support standard T5 DWIN OS platform or 8051 development OS CPU core.
50Pin FPC leads to 22 IOs, 3 UARTs, 1 CAN, 5 ADs and 2 PWMs.
Customization services are available.
4 AD values are passed to the OS core in real-time via UART3 at up to 16KSPS sampling rates each. Real-time control of 2 PWMs via UART3 updated as fast as 32uS.
- (5) 20mS DGUS cycle, extremely smooth UI. Support pre-installed configuration module development mode, which greatly improves UI development speed and quality.
- (6) Display variables can be turned on, off or modified in the application to achieve complex display combination functions.
- (7) Touch variables can be turned on, off or modified in the application to achieve complex touch combination functions.
- (8) Support download and configuration by SD interface and display of download file.
- (9) Support CTP sensitivity adjustment, convenient for user applications of front-mounted panel (up to 6mm thick tempered glass)
- (10) Ultra-thin, highly integrated COF structure, providing the extremely price-performance ratio and design simplification.
- (11) Support ED4 USB downloader.

2 External Interface(50Pin 0.5mmFPC)

PIN#	Definition	I/O	Description
1	+5V	I	Power supply, DC3.6-5.5V.
2	+5V	I	
3	GND	GND	
4	GND	GND	GND
5	GND	GND	
6	AD7	I	
7	AD6	I	5 input ADCs. 12-bit resolution in case of 3.3V power supply. 0-3.3V input voltage. Except for AD6, the rest data is sent to OS core via UART3 in real-time with a 16KHz sampling rate. AD1 and AD5 can be used in parallel, and AD3 and AD7 can be used in parallel, which equals to two 32KHz sampling AD. AD1, AD3, AD5, AD7 can be used in parallel, which equals to a 64KHz sampling AD; the data is summed 1024 times and then divided by 64 to obtain a 64Hz 16bit AD value by oversampling.
8	AD5	I	
9	AD3	I	
10	AD2	I	
11	+3.3	O	
12	SPK	O	External MOSFET to drive buzzer or speaker. The external 10K resistor should be pulled down to the ground to ensure that the power-on is low level.
13	SD_CD	IO	SD/SDHC interface. The SD_CK connects a 22pF capacitor to GND near the SD card interface.
14	SD_CK	O	
15	SD_D3	IO	
16	SD_D2	IO	
17	SD_D1	IO	
18	SD_D0	IO	
19	PWM0	O	2 16-bit PWM output. The external 10K resistor should be pulled down to the ground to ensure that power-on is low level. The OS core can be controlled in real-time via UART3.
20	PWM1	O	
21	P3.3	IO	If using RX8130 or SD2058 I2C RTC to connect to both IOs, SCL should be connected to P3.2, and SDA connected to P3.3 in parallel with 10K resistor pull-up to 3.3V.
22	P3.2	IO	
23	P3.1/EX1	IO	It can be used as an external interrupt 1 input at the same time, and supports both low voltage level or trailing edge interrupt modes.
24	P3.0/EX0	IO	It can be used as an external interrupt 1 input at the same time, and supports both low voltage level or trailing edge interrupt modes.
25	P2.7	IO	
26	P2.6	IO	
27	P2.5	IO	
28	P2.4	IO	
29	P2.3	IO	
30	P2.2	IO	
31	P2.1	IO	
32	P2.0	IO	
33	P1.7	IO	
34	P1.6	IO	
36	P1.4	IO	
37	P1.3	IO	
38	P1.2	IO	
39	P1.1	IO	
40	P1.0	IO	
41	UART4_TXD	O	UART4
42	UART4_RXD	I	
43	UART5_TXD	O	UART5
44	UART5_RXD	I	
45	P0.0	IO	
46	P0.1	IO	
47	CAN_TX	O	CAN interface
48	CAN_RX	I	
49	UART2_TXD	O	UART2 (UART0 of OS core)
50	UART2_RXD	I	

The HDL662S adapter board can be used to connect the USB interface to the SD card interface and lead the signal out to the 2.54mm adapter board.

3 DGUS Functions

3.1 Display Variables

No.	Function code	Function	Data length (Word)	Description
01	0x00	Variable icon display	1	The change range of a data variable linearly corresponds to a group of ICON display; when the variable changes, the icon automatically switches accordingly. It is mostly used for detailed dashboard and progress bar display. Support background overlay and transparency settings, background filter intensity can be set.
02	0x01	Animation icon display	2	A fixed value data variable corresponds to 3 different icon indication states: no display, display fixed icon, and display animated icon. It is mostly used for variable alarm prompts. The variable occupies 2-word positions, and the (VP+1) position is reserved; the icon ID cannot exceed 255 (0xFF). Support background overlay and transparency settings, you can set the animation speed. Support single play mode, background filter intensity can be set.
03	0x02	Slider Display	1	The change range of a data variable corresponds to the change of the display position of an icon (slider). It is mostly used for the indication of liquid level, dial and a progress meter. Support background overlay and transparency settings, background filter intensity can be set.
04	0x03	Artistic variable display	1/2/4	Use ICON to replace font library to display variable data, support background overlay and transparency setting, background filter intensity can be set.
05	0x04	Picture Animation display	No	Play a group of full-screen pictures at the specified speed. It is mostly used for boot interface or screen saver.
06	0x05	Icon rotation display	1	Corresponding linearly to the angle data of the variation range of a data variable, and then rotating an ICON according to the corresponding angle data to display it. The background filter intensity can be set. It is mostly used for pointer dashboard display.
07	0x06	Bit variable icon display	3	The 0/1 state of each bit of a data variable corresponds to two of the 8 different display schemes, and the ICON (or icon animation) is used for the corresponding display. The background filter intensity can be set. It is mostly used to display the switch status, such as the operation (animation) and stop (stationary icon) of the fan.
08	0x07	JPEG icon panning display	4	The JPEG icon page that exceeds the screen resolution is displayed by panning up and down or left and right on the screen window. Cooperate with 0x0C touch variable to realize icon sliding selection. The background filter intensity can be set.
09	0x08	Variable data JPEG icon overlay display	Max 120KB	The JPEG icon of the variable buffer is superimposed and displayed in the specified area of the current page, and the display brightness and transparency can be set. VP=5AA5 turns on the display, VP+1=JPEG data buffer length, VP+2=JPEG data start. The background filter intensity can be set.
10	0x09	Fast batch data icon copy and paste	Max 64KB	According to the definition of the variable buffer, the icon is quickly copied from the background or video memory and displayed to the specified location.
11	0x10	Data variable display	1/2/4	Display a data variable according to the specified format (integer, decimal, whether with the unit) with the specified font and size of Arabic numerals. Support character spacing adjustment/non-adjustment selection, support integer bit invalid zero display/non-display selection. Supports sawtooth optimized 8bit encoding font library.
12	0x11	Text display	Max 2K	Display the character string in the specified text box display area in the specified format (decided by the selected font). Supports sawtooth optimized 8bit encoding font library.
13	0x12_00	Text format RTC display	No	Display RTC in the text according to user edit format. Supports sawtooth optimized 8bit encoding font library.
14	0x12_01	Dial format RTC display	No	Use the ICON to rotate, and display the Gregorian calendar RTC with the pointer dial mode.
15	0x13	HEX data display	Max 8	The variable data is displayed at intervals of ASCII characters specified by the user in byte HEX mode. It is mostly used for timing display, such as displaying 0x1234 as 12:34. Supports sawtooth optimized 8bit encoding font library.
16	0x14	Text scrolling display	User defined	Scroll the text stored in the variable space in the designated area of the screen.

17	0x15	Data window indication	2	Display the data variable in a designated display window, and highlight the selected value. Combined with the touch screen sliding or incremental adjustment, the data can be scrolled and displayed. It can also be controlled by DWIN OS to adjust the speed. Supports sawtooth optimized 8bit encoding font library. The variable occupies 2-word positions, and the (VP+1) position is reserved.
18	0x16	DGUSII text display (Text display without jaggies)	Max 2K	Based on DGUS II font, display the string in the specified text box with no scaling support. Compared to 0x11 text display, this function mainly displays text without sawtooth and display multiple languages with direct font change.
19	0x17	Configuration icon font library scrolling wheel display	4	The basic functions are the same as the data window instructions.
20	0x18	GTF icon font text display	Max 128	Highly efficient display of icon characters.
21	0x20	Real-time curve (trend graph)	2K per channel	Based on the curve buffer data to automatically match and display the real-time curve (trend graph). You can specify the display area, center axis coordinates, display scale (enlarge/reduce), and set the direction of the curve.
22	0x21_01	Drawing_point	User defined	Set point (x, y, color)
23	0x21_02	Drawing_End Connection		End point connection (color, (x0, y0), ... (xn, yn))
24	0x21_03	Drawing_rectangle		Display rectangle, color, position and size are controllable.
25	0x21_04	Drawing_Rectangle Fill		Fill the specified rectangular area with controllable filling color, position and size.
26	0x21_05	Drawing_Picture Copy and Paste		Copy an area from the specified picture and paste it on the currently displayed page.
27	0x21_06	Drawing_ICON display		The ICON is displayed, and the icon library can be selected.
28	0x21_07	Plot_spectrum display		Set point (x, y, color)
29	0x21_08	Drawing_Closed Area Fill		Select the seed location and fill the closed solid color area with the specified color.
30	0x21_09	Plot_spectrum display		The frequency spectrum (vertical line) is displayed according to the variable data, and the line color and position are controllable.
31	0x21_0D	Drawing_Rectangular Domain xOR		Perform xOR operation on the bitmap data of the specified rectangle field with the specified color, which is mostly used for highlighting.
32	0x21_0E	Drawing_two-color bitmap display	Each bit represents 1 point, and the two-color bitmap display can be quickly performed in the designated area.	
33	0x24	Area scrolling	1	Circulate the content of the designated area, and the moving direction can be set. It is used for the simple realization of dynamic operation effects such as a flow chart and progress bar on the screen. Variables are occupied by the system and should not be used by users.
34	0x25	QR code display	Max 259	Display the QR code graphics on the screen according to the specified content.
35	0x26	Adjust the area display brightness	1	Adjust the display brightness of the designated display area to highlight or dilute the background display.
36	0x30	Data variable transfer	Max 11	After the page switch, the predefined data is transferred to the variable or UART once.

Remark

- For more specific function description, please refer to " DGUS LCM Development Guide".
- VP refers to the storage location (pointer) of the user variable storage.
- When setting the variable description pointer in the PC configuration software development, the display variable configuration information will be stored in the user variable space pointed by the variable description pointer, which can be accessed through UART or DWIN OS to dynamically turn on, turn off or modify the variable configuration information to realize complex display variable combination functions.

3.2 Touch Variables

No.	Function code	Function	Data length (Word)	Description
01	00	Variable Data Input	1/2/4	Record various data such as integers and fixed-point decimals into the specified variable storage space. Pop-up keyboard transparency can be set. Support configuration touch control.
02	01	Popup window	1	Click to trigger a pop-up menu that returns the key code of the menu item. Pop-up menu transparency can be set.
03	02	Incremental Adjustment	1	Click the button to perform +/- on the specified variable, and you can set the step and the upper and lower limits. Set 0-1 range cyclic adjustment to enable column checkbox function.
04	03	Drag Adjustment	1	Drag and drop slider to achieve variable data input. The scale range can be set.
05	05	Return Key code	1	Click the button to return the button value to the variable directly, and support bit variable return. Support press time threshold setting function.
06	06	Text Input	Max 127	ASCII or GBK Chinese character text input method supports cursor movement and editing. You can set the input status and input length to be saved at the (VP-1) position. ASCII input mode pop-up keyboard transparency can be set.
07	08	Synchrodata Return	User defined	Click on the touch screen to return data to the variable as specified. Return to UART mode is not supported, but it is possible to realize touch data uploaded automatically.
08	09	Rotation Adjustment	1	Drag adjustment of circular categories.
09	0A	Sliding Adjustment	2	The touch screen slides in the X- or Y-axis direction according to the specified area and returns the relative adjustment value in real-time. Combined with the data window indication display variable, dynamic scrolling word adjustment can be achieved. VP holds and return data is at (VP+1) position.
10	0B	Page Sliding	No	The touch screen slides in the X-axis or Y-axis direction according to the specified area to achieve dynamic page dragging. You can set the target and area of the page switch, and the variable display of the current page will be dragged along. If there are other touch buttons on the sliding page and the whole page (including dragging touch buttons) needs to be turned by gestures, the touch priority of sliding gesture to turn the page must be set to the highest. Support animated actions at the end of the gesture.
11	0C	Sliding Icon Selection	4	Combined with the 0x07 display variable (JPEG icon panning display) to achieve icon page sliding selection.

Remark

- For more specific function description, please refer to "T5L_DGUSII Application Development Guide".
- The touch configuration file (13*.BIN) cannot exceed 256Kbytes.
- The touch command access interface defined in the 0x00B0 variable space can be accessed through UART or DWIN OS to dynamically turn on, turn off or modify the variable configuration information to realize complex display variable combination functions.

3.3 UART Communication Protocol(UART2)

The system debugging UART2 mode is fixed to 8N1, and the baud rate can be set. The data frame consists of 5 data blocks.

Data block	1	2	3	4	5
Definition	Frame Header	Length	Command	Data	CRCCheck(optional)
Length	2	1	1	N	2
Description	0x5AA5	Including command, data and CRC	0x80/0x81/0x82/0x83		
Sample(without check)	5A A5	04	83	00 10 04	
Sample(check)	5A A5	06	83	00 10 04	25 A3

The CRC check on/off is controlled by bit **0x05.6** of the configuration file.

The UART2 debug interface commands are described as follows.

Command	Data	Description
0x80	Send: Register page (0x00-0x08)+register address (0x00-0xFF) + data written	Specify the address to start writing the data string to the register.
	Answer: 0x4F 0x4B.	The write command is answered.
0x81	Send: Register page (0x00-0x08) + register address (0x00-0xFF) + byte length of the read data(0x01-0xFB)	Start reading data from the specified register.
	Answer: Register page (0x00-0x08) + register address (0x00-0xFF) + data length + data	The data is answered.
0x82	Send: Variable space first address (0x0000-0xFFFF) + written data	Write data string (word data) to variable space starting from the specified address. Do not write the space reserved by the system.
	Answer: 0x4F 0x4B.	Write instruction answer.
0x83	Send: Variable space first address (0x0000-0xFFFF) + byte length of the read data(0x01-0x7D)	Read word data of the specified length from the specified address of the variable space.
	Answer: Variable space first address + byte length of the variable data + the read variable data	The data is answered.

The register pages are defined as follows.

Register Page ID	Definition	Description
0x00-0x07	Data register	256 per group, R0-R255
0x08	Interface register	DR0-DR255. For details, please refer to "DWIN OS Development Guide based on T5" 3.4 Interface register definition description.

3.4 UART Communication Protocol(UART3)

(1) The GUI core sends AD1, AD3, AD5, AD7 data (12-bit) to the OS core in the following command frame format.

0xAA + AD1 high 4-bit:AD3 high 4-bit + AD1 low byte + AD3 low byte + AD5 high 4-bit:AD7 high 4-bit + AD5 low byte +AD7 low byte + 7 bytes accumulation and low byte from 0xAA.

If AD1 data is 0x0123, AD3 data is 0x456, AD5 data is 0x0789, AD7 data is 0x0ABC, then the GUI core send AA **14 23 56 7A 89 BC** F6 to the OS core.

(2) The OS core sends PWM0 and PWM1 duty cycle data (16-bit) to the GUI core in the command frame format: 0xAA + PWM0 value + PWM1 value + 5 bytes of accumulation and low byte from 0xAA.

If the PWM0 data is 0x1234 and PWM1 data is 0x5678, then the OS core sends AA **12 34 56 78** BE to the GUI core.

4 System Variable Interface(system variable address range of x0000-0x0FFF)

Data with the same background color in the table is updated at the same time, and rewriting must be completed at one time.

VP	Definition	Length (word)	Description
0x00	Reserved	4	Undefined
0x04	System_Reset	2	Writing 0x55AA 5AA5 resets the T5L CPU once.
0x06	OS_Update_CMD	2	D3: write 0x5A to enable DWIN OS once (write into 1MB Nor Flash), clear after operation. D2: File type 0x10: DWIN OS program must start from 0x1000, update 28KB at every time. 0xA5: 8051 code, update 64KB at every time. D1:0: Start address of SRAM to save program to update, it must be even.
0x08	NOR_FLASH_RW_CMD	4	D7: Mode: 0x5A=read 0xA5=write, clear after operation. D6:4: Start address of Nor Flash. Must be even. 0x000000-0x03:FFFE, 256KWords. D3:2: Start address of data variable space. Must be even. D1:0: Data length to read/write. Must be even.
0x0C	Reserved	3	
0x0F	Ver	1	Application software version. D1 stands for GUI version, D0 stands for DWIN OS version.
0x10	RTC	4	D7=Year (0-0x63) D6=month(0-0x0C), D5=day(0-0x1F), D4=week(0-0x6), D3=hour(0-0x17), D2=minute(0-0x3B), D1=second(0-0x3B), D0 undefined. Data format is HEX. Need hardware support. If there is no RTC on hardware, user can write RTC data.
0x14	PIC_Now	1	Display current page ID.
0x15	GUI_Status	1	GUI status feedback: 0x0000=free, 0x0001=processing 13.bin and 14.bin.
0x16	TP_Status	4	D7: 0x5A=touch panel data is updated. D6: touch panel status. 0x00=release, 0x01=first press, 0x02=lift, 0x03=pressing D5:D4=X coordinate D3:D2=Y coordinate D1:D0=0x0000
0x1A-0x30	Reserved	23	Undefined
0x31	LED_Now	1	D1: 0x5A : backlight brightness value, AD0-AD7 instant value has updated. D0: Current backlight brightness value, 0x00-0x64.
0x32	AD0-AD7 Instantaneous value	8	Instantaneous value of AD0-AD7, 1 word per AD. Voltage=AD value*3300/4095 mV. Voltage = AD value*3300/65520 mV, AD4 is the voltage of the backlight current sampling resistor.
0x3A-0x79	Reserved	64	Undefined
0x7A	LCD_HOR	1	Horizontal resolution of the screen
0x7B	LCD_VER	1	Vertical resolution of the screen
0x7C-0x7F	Reserved	4	Undefined
0x80	System_Config	2	D3: 0x5A = enable the parameter configuration once, clear after operation. D2: touch panel sensitivity configuration value, read only. D1: touch panel mode configuration value, read only. D0: system status setting. 7: Serial port CRC check 0=off 1=on, read only. 6: Reserved, write 0. 5: Power on load 22 file to initialize variable space. 1= load 0= no load, read only. 4: Variable automatic upload setting 1= on, 0= off, read and write. 3: Touch panel audio control 1= on 0= off, read and write. 2: Touch panel backlight standby control 1-0: Display direction 00=0° 01=90° 10=180° 11=270°, read and write.
0x82	LED_Config	2	Set standby backlight. D3= Turn on brightness, 0x00-0x64; When backlight standby control is off, D3 can be used for brightness adjustment interface. D2= Turn off brightness, 0x00-0x64; D1:0=wait time /10 ms.
0x84	PIC_Set	2	D3: 0x5A = enable page operation once, clear after operation. D2: Mode. 0x01=page switch (Display the image specified in the image storage area to the current background page). D1:D0: picture ID.
0x86	PWM0_Set	2	D3=write 0x5A to enable PWM0 setting once, clear after operation. D2=the frequency division coefficient D1:D0=PWM0 accuracy PWM0 carrier frequency=825.7536MHz/(the frequency division coefficient*PWM0 accuracy)

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0x88	PWM1_Set	2	D3=write 0x5A to enable PWM0 setting once, clear after operation. D2=the frequency division coefficient D1:D0=PWM0 accuracy PWM0 carrier frequency=825.7536MHz/(the frequency division coefficient*PWM0 accuracy)
0x8A-0x9B	Reserved	18	Undefined
0x9C	RTC_Set	4	D7:D6= write 0x5AA5 to enable RTC setting once;D5:D0=year, month, day, hour, minute, second, all in HEX format. Need hardware RTC support.
0xA0	WAE Music_Play_Set	2	The on-chip Flash saves WAE music playback settings: D3: Segment ID of this playback, 0x00-0xFF. WAE file location is specified by CFG configuration file.D2: Number of segments, fixed 0x01. Clear after DGUS operation. Under buzzer mode, it is buzz time, unit: 8 ms. D1: Volume, unit: 1/64; Initial value is 0x40(100%). D0:Feedback, 0x00=stop, 0x01=pause, 0x02=playing.
0xA2-0xA9	Reserved	8	Undefined
0xAA	External 16Mbytes FLASH write operation	6	D11: 0x5A= enable external memory operation, clear after operation. D10: Operation mode D10=0x10, read 16MB SPI NOR FLASH data D9:font library ID, 0x10-0x1F, 256Kbytes per font library, maximum 4Mbytes D8:D6: the starting address of data in the font library is defined according to the Word, 0x0000-0x01FFFF D5:D4: The first address of the read data variable space, which must be even. D3:D2: The length of the data read, defined according to the Word, must be even. D1:D0: undefined, write 0x00. For D10=0x02 write 32Kbytes data block into 16MB SPI NOR FLASH. D9:D8: 32Kbytes memory block address, 0x0000-0x01FF, correspond to 16Mbytes memory. D7:D6: The first address of the update data stored in the data variable space must be even. D5:D4: After the completion of this operation, the time of delay waiting for the next write operation, unit: 1ms. DGUS refresh will stop during the delay wait to prevent errors caused by incomplete updates. D3:D0: Undefined, write 0x00. D10=0x03, font copy D9:D8: Source font ID, 0x0000-0x001F, 256Kbytes per font library, maximum 4Mbytes. D7:D6: Target font ID, 0x0000-0x003F. D5-D4: Number of font to copy, 0x0000-0x0010. D3:D0: Undefined, write 0x00.
0xB0	Touch instruction access interface	36	0xB0: 0x5AA5= enable accessing touch control interface once. Clear after CPU operation. 0xB1: Page ID of touch control. 0xB2: High byte: touch control ID (set in DGUS II development software), 0x01-0xFF; Low byte: touch control code, 0x00-0x7F. 0xB3: Access mode 0xB4-0xD3: data to modify of mode 0x02, 0x03. Mode 0x0000: turn off this touch control. Mode 0x0001: turn on this touch control. Mode 0x0002: Read this touch control and write it to SRAM that 0xB4 pointing to. Mode 0x0003: update current touch control with data that 0xB4 pointing to, the format and data length must be the same.
0xD4	TP operation simulation	4	0xD4: 0x5AA5=enable the operation once, clear after operation. 0xD5: press mode. 0x0001=press, 0x0002=release, 0x0003=keep pressing, 0x0004=touch (press + release) 0xD6: X coordinate of press position. 0xD7: Y coordinate of press position. After simulating mode 0x0001 and 0x0003, must simulate 0x0002. When the assembly touch function is running, x= 0xAA:KH y=0xA5:KL will directly return the key values KH and KL to the assembly touch. For example, when variables are input in assembly mode, the coordinates (0xAAF0, 0xA5F0) will cause the input to end immediately. When the 13 touch file is designed with keying function, X coordinate = 0xFF: key code y coordinate = 0x0001 will trigger the corresponding keying function.
0xD8	Pointer icon overlay display	4	0xD8_H: 0x5A = enable the overlay display. 0xD8_L: the position of ICL file which the pointer icon is saved at. 0xD9: the pointer icon ID. 0xDA: the X coordinates of pointer icon. 0xDB: the Y coordinates of pointer icon. The pointer icon is always displayed in the background filtering mode, and the background filtering intensity is fixed at 0x08.

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0xDC	Reserved	4	Undefined
0xE0	Memory CRC check	2	<p>D3: write 0x5A to enable the CRC checking once, clear after operation. D2: memory type selection 0x00= font space (16Mbytes memory) 0x02=DWIN OS code 0x03=Nor flash database (LIB file). D1:D0: data interface. ▶ Enable the CRC Font check mode: D1= start font ID (256KB for each font); D0= the number of 4KB blocks checked, 0x00-0xFF. OS code check mode: D1:D0= starting at 0x1000, the byte length of OS code to be checked is 0x0001-0x7000. Nor flash database mode: D1:D0=Nor flash database ID, fixed validation of 4KB data each time. ▶After checking Return CRC value.</p>
0xE2	Monochrome bitmap export of specified areas of the screen	6	<p>0xE2_H: 0x5A initiates a single color bitmap export and clears after CPU operation. 0xE2_L: write 0x00. 0xE3: X-coordinate in the upper left corner of the screen area. 0xE4: Y-coordinate in the upper left corner of the screen area. 0xE5: X-coordinate in the lower right corner of the screen area. 0xE6: lower right Y-coordinate of the screen area; 0xE7: the starting address of the variable memory where the output bitmap is stored, must be an even number. The bitmap data stored in the variable memory follows the MSB, double word alignment pattern.</p>
0xE8-0xEF	Reserved	8	Undefined
0xF0	Interface of playing music flow data	4	<p>D7: 0x5A = enable the music playback operation, clear after operation. D6: mode, 0x00 = stop(clear the buffer), 0x01 = suspend(reserve the buffer), 0x02 = start. D5:D4: undefined, write 0x00. D3:D2: Variable memory address for storing music data, even. D1:D0: Music data word length, maximum 8KWords, even; data is 16bit integer format.</p>
0xF4	Painting interface	8	<p>D15: 0x5A = enable the drawing touch window. D14: operation mode, 0x00 = normal mode, 0x01 = initialization (clear after initialization). D13: parameter configuration. 7-2 reserved, write 0. 1-0 painting buff processing mode after page changing. 0x00 = close, 0x01 = re-initialization, others = unchanged. D12: reserved, write 0x00. D11: line width, from 0x01 - 0x0F. D10:D8: painting color, D6=RED D5=GREEN D4=BLUE</p>
0xFC	Reserved	4	Write 0x00
0x100-0x2FF	Reserved	512	Undefined
0x300-0x37F	Dynamic curve interface	128	<p>0x300-0x30F: state feedback for 8 channel curve buffers (read only advised), 2 words per channel, high word is the storage pointer location (0x0000-0x07FF) where curve data is stored, and low word is the effective data length of curve buffer (0x0000-0x0800). Writing 0x0000 to the effective data length of the curve buffer will cause the curve unable display. 0x310-0x311: start writing curve buffer data D3: D2:0x5AA5 enable the writing curve buffer data operation once, and clear after operation. D1: the number of data blocks, 0x01-0x08. D0: undefined, write 0x00. 0x312-0x37F: data block written to the curve buffer, which is 16 bits unsigned. Single data block: data channel ID (0x00-0x07) + data word length (0x01-0x6E) + data. With dynamic curve display enabled, start at 0x1000 and create a data buffer for each curve according to 2Kwords per channel. The CH0 buffer is 0x1000-0x17FF, the CH1 buffer is 0x1800-0x1FFF, and so on, the unused curve buffer zones can be used as user variables. Also users can directly overwrite the curve buffer data and then modify 0x300-0x30F corresponding storage pointer position and data length to ensure the correct display of the curve.</p>
0x380-0xEFF	Reserved	3044	Undefined
0xF00	Variable change	2	<p>After setting variables to change the automatic upload function, this function is enabled. D3=5A means variable change, D2:D1= variable memory pointer, D0= variable length (word).</p>
0xF02-0xFFF	Reserved	254	Undefined

User variable occupancy address range: 0x1000-0xFFFF

4.1 Network communication interface (0x0400-0x04FF)

VP	Definition	Length (word)	Description	Reference value
Network Interface Switch	0x400	1	0x5AA5 indicates that the network communication interface is enabled.	5AA5
RMA Alarm	0x401	3	D5:D4=0x5AA5 indicates that the specified RMA space data is uploaded to the server once immediately and cleared after processing. D3:D2=Address of the RMA variable memory word to be uploaded. D1:D0=Length of the RMA variable memory word to be uploaded.	All 00
Reserved	0x404	12	Reserved.	All 00
Device Description (Device Description)	0x410	1	High byte=0x5A means the device description is valid. Low byte=Encoding method and length of device description text. .7-.6:Encoding method 0x00=UNICODE 0x01=GBK(recommended). .5-.0:Description text length 0x00-0x34	5A4C
	0x411	2	4Bytes Device Manufacturer ID, allocated by DWIN, 0xFFFF:0000-0xFFFF:FF segment reserved.	00000001
	0x413	1	2Bytes The classification of each manufacturer's equipment, as per the DWIN Classification Standard, is done by the equipment manufacturer.	0001
	0x414	2	4bytes Device number under each classification given by the manufacturer.	User-defined
	0x416	26	Device description text, up to 52 Bytes.	
Device Description (RMA mapping)	0x430	1	The interval for RMA to automatically refresh the server, 0x0000-0xFFFF, in 0.1 seconds. 0x0000 means no automatic refresh.	012C
	0x431	1	RMA (variable memory mapped to the server) read space start address, word address. Unreadable when out of bounds.	1000
	0x432	1	RMA read space size in 128Words, maximum 64KWords; 0x0000 means unreadable.	0004
	0x433	1	RMA write space start address, can overlap with the read space. Unwritten when out of bounds.	2000
	0x434	1	RMA write space size in 128Words, maximum 64KWords; 0x0000 means unwritten.	0004
	0x435	3	Reserved.	All 00
Device Description (Remote Upgrade)	0x438	1	Remote upgrade interface enable. 0x5AA5 means the device is enabled for remote upgrade interface, the system will automatically detect Buffer.	5AA5
	0x439	1	The packet timeout timer configuration for remote upgrades in 0.1 seconds.	0064
	0x43A	4	The 1st remotely upgradeable space of the device (corresponding to 1MB Flash of T5L, aligned to 4KB) is defined as follows. D7=0x5A indicates that the remote upgrade space is enabled. D6-D3: 32bit start address of upgradeable space (lower 12bit is 0), up to 4GB. D2-D0: Size of upgradeable space in 4KB, up to 4GB.	5A00 0100 0000 00F0
	0x43E	4	The 2nd remotely upgradeable space of the device corresponds to 16MB-64MB of image and font memory.	5A00 0000 0000 1000
	0x442	4	The 3rd remotely upgradeable space of the device. Not used.	All 00
	0x446	4	The 4th remotely upgradeable space of the device. Not used.	All 00
	0x44A	2	Remote Upgrade Buffer Interface Definition. D7=0x5A means the remote upgrade buffer is valid. D6=Upgrade mode 0x00=Communication end for checking the data CRC, and the host is notified to resend the error frame. D5=The number of buffer that can be used for remote upgrade, 0x01-	5A 00 0B B0

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			<p>0x10, up to 16.</p> <p>D4=Higher byte (word address) of the start address of Buffer0; the lower 8bit of this address is 0x00.</p> <p>Each Buffer takes up a fixed space of descending 2304 words (0x900).</p> <p>Single Buffer Definition (the first 512 bytes are the control interface, and the next 4KB are data)</p> <p>D0: 0x5A indicates that the remote upgrade of this buffer is started once and cleared after CPU processing.</p> <p>D1: Select one of the 4 remote upgrade spaces (0x00-0x03) for 4KB block write operation.</p> <p>D2-D5: Write remote upgrade space target address; low 12bit is 0.</p> <p>D6-D7: data byte length, 0x0001-0x1000.</p> <p>D8-D9: data CRC checksum.</p> <p>D10-D511: Reserved.</p> <p>D512: Data start, up to 4096 bytes.</p>	
	0x44C	4	Reserved.	
Device Description Reserved	0x450	48	Reserved.	All 00
Communication Device Description	0x480	16	<p>D31:0x5A indicates that the communication device description data is valid.</p> <p>D30:Encoding method and length of the device description text.</p> <p>.7-.6:Encoding method 0x00=UNICODE 0x01=GBK(recommended).</p> <p>.5-.0:Description text length 0x00-0x14</p> <p>D29:Communication device category 0x01=WiFi D28:Communication device status, bit definition:</p> <p>.7 Device operating status 0=Configuring 1=Normal.</p> <p>.6-.3 undefined, write 0.</p> <p>.2-.0 Signal quality, 0x00-0x07 for 8 levels, 0x00 means worst, 0x07 means best.</p> <p>D27-D20=8Bytes MAC address of communication device, low (D20) alignment.</p> <p>D19-D0: Communication device description information in text format, up to 20Bytes.</p>	User-defined
Communication Device Reserved	0x490	112	Communication device customization, such as WiFi username, password, etc.	User-defined

The device description information is configured by the corresponding contents of the 22 initialization file 0x0800-0x09FF address (with or without the 22 file initialization variable buffer enabled).

5 SD Interface

SD card upgrade does not support online hot-swappable updates. In order to prevent hot-swapping from affecting Flash operations, you must strictly follow the instructions to power off the screen first, insert the SD card, and then power on to download

The T5L-based UART LCM SD/SDHC interface supports the following file downloads and updates

File Type	Naming rule	Description
Program files	T5L_UI*.BIN T5L_OS*.BIN	Application.
DWIN OS program	DWINOS*.BIN	DWIN OS program and code must start from 0x1000.
OS CPU 8051 program	T5L51*.BIN	Applications developed by users based on the OS 8051 platform.
NOR Flash database	ID+(optional) filename.LIB	Each ID corresponds to 2KWords of memory with ID range 0-79.
Font files	Font ID+(optional) filename. BIN/DZK/HZK/GTF	The database is located in the on-chip NOR Flash and is 160KWords in size and can be used for user data or DWIN OS program library file storage.
DGUS input method files	12*.BIN	Stored in the 12 Font library.
DGUS touch files	13*.BIN	Stored in the 13 Font library, cannot exceed 32KB.
DGUS variable files	14*.BIN	Stored in the 14 Font library, cannot exceed 256KB and must be in DGUS2 format.
DGUS variable initialization files	22*.BIN	Stored in the 22 Font library, load 0x2000-0x1FFFF address and initialize the variable space of 0x1000-0xFFFF.
JPEG image and icon files	Font ID + (optional) filename. ICL	Must be JPEG ICO file format in DGUS2 format. In case of multi-chip Flash extension, make sure 1 image data is stored in each Flash. DGUS2 V4.0 and above must use DGUS V7.623 and above to generate ICL files.
Music files	Font ID + (optional) filename. WAE	It must be in DGUS2 format and generated by DWIN special tool.
UI configuration files	Configuration module number ID + (optional) file name. UIC	Configuration module number from 0x0000-0xFFFF and each ID corresponds to 32KB memory space. In case of multiple Flash expansion, make sure that 1 configuration module data is stored in each Flash.
Hardware configuration files	T5LCFG*. CFG	Don't download incompatible CFG files that may cause screen malfunction. Users can contact customer service to get the CFG files needed.
CRC checksum files	T5*. CRC	CRC32 checksum after SD card download data.

The 8MB Flash memory is divided into 32-word libraries by 256Kbytes each, which can be used to store word libraries, icon libraries, and configuration files, and the background image ICL file is usually named as 23.ICL. (DMG10600F070_01W has 16MB Flash and its memory is divided into 64-word libraries. For 16MB Flash products, the background image ICL file is usually named as 32.ICL.)

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

5.1 T5LCFG*.CFG configuration file

Category	Address	Length	Definition	Description
Recognition configuration	0x00	5	0x54 0x35 0x4C 0x43 0x31	Fixed content
System configuration	0x05	1	Parameter configuration	7: UART CRC checksum 0=Off 1=On 6: Buzzer / music playback selection, 0=Buzzer 1=Music playback 5: Power-on load file initialization variable space 1= Load 0= No Load 4: touch variable automatic upload setting 1=On 0=Off 3: touch panel audio control 1=On 0=Off 2: touch panel backlight standby control 1=On 0=Off 1-0: display direction 00 = 0°, 01 = 90°, 10 =180° ,11 = 270°
	0x06	1	Parameter configuration 1	7-6: Reserved. Write 0. 1: OS CPU user 8051 program download encryption setting, 0=unencrypted 1=encrypted. If you select encrypted, the user 8051 program should be encrypted by DWIN's special tool before download. 0: Reserved. Write 0.
	0x07	1	Music WAE file save position	0x00-0x3F(00-63)
	0x08	1	Background picture ICL file save position	0x10-0x3F(16-63), correspond to 12MB-4MB background picture space
	0x09	1	Touch panel reporting point rate setting	Set range 0x01-0xFF , by default 0x28 , reporting point rate =400Hz/set value
	0x0A	2	Serial port baud rate setting	Baud rate setting value=3225600/baud rate 115200bps, set value=0x001C, maximum value 0x03FF
	Backlight standby configuration	0x0C	1	Normal operation and startup brightness
0x0D		1	Standby brightness	0x00-0x64, unit 1%
0x0E		2	Wake up time after standby	0x0001-0xFFFF, unit 10 ms
LCD configuration	0x10	2	Display_Config_En	0x5AA5= Enable the configuration. It has been configured at the factory. Users do not need to configure it again.
	0x12	1	PCLK_PHS	Data latch phase setting: 0x00=PCLK falling edge 0x01=PCLK rising edge
	0x13	1	PCLK_DIV	PCLK frequency=206.4/PCLK_DIV setting:PCLK frequency (MHz)
	0x14	1	H_W	
	0x15	1	H_S	
	0x16	2	H_D	Horizontal (X direction) resolution
	0x18	1	H_E	
	0x19	1	V_W	
	0x1A	1	V_S	
	0x1B	2	V_D	Vertical (Y) resolution
	0x1D	1	V_E	
	0x1E	1	TCON_SEL	0x00= do not need to configure TCON
	0x1F	1	Reserved	Write 0x00
TP configuration	0x20	1	TP_Set_En	0x5A= Enable the configuration. It has been configured at the factory. Users do not need to configure it again

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	0x21	1	TP_Mode	<p>Touch panel mode configuration 7-4(high 4bit), select touch panel type: 0x0*= 4-wire resistive touch panel 0x1*= Driving IC capacitive touch panel such as GT911, GT9271 or GT9110 IC 0x2*=ILI9881H Incell CTP 0x3*=ILI driving IC capacitive touch panel such as ILI2117 0x4*= ILI driving IC capacitive touch panel such as ILI2130 0x5*=Betterlife driving IC capacitive touch panel such as BL8825 0xF*= 5-wire resistive touch panel 3 Resistive touch panel calibration: 0=off; 1=on, enable when SD card downloading is in process 2-.0 (low 3bit) Coordinate setting: 2 X coordinate selection: 0= from 0 to Xmax; 1=from Xmax to 0; 1 Y coordinate selection: 0= from 0 to Ymax; 1=from Ymax to 0; 0 X,Y exchange: 0=XY; 1=YX When the RTP is calibrated, the screen display cannot be configured as a deflection display.</p>
	0x22	1	TP_Sense	<p>TP sensitivity setting: 0x00-0x1F, 0x00 lowest sensitivity, 0x1F highest sensitivity. Default sensitivity is 0x14, which is higher sensitivity. (ILI9881 is 0x01-0x06). 0xFF will not configure touch (using the hardware initial value).</p>
	0x23	1	TP_Freq	<p>TP frequency selection, suitable for ILI9881H. Fixed frequency ranges from 0x01 to 0x14, and 0x00 represents frequency hopping.</p>
Clock output configuration	0x24	1	Reserved	Write 0x00.
BUZZ configuration	0x27	1	BUZZ_Set_En	0x5A= Enable the configuration.
	0x28	1	BUZZ_Freq_DIV1	Buzzer frequency=BUZZ_Freq_DIV1) KHz.825753.6 BUZZ_Freq_DIV1
	0x29	2	BUZZ_Freq_DIV2	Factory settings: DIV1=0x6E, DIV2=0x0BB8, correspond to the 2.5KHz frequency.
	0x2B	2	BUZZ_Freq_Duty	Buzzer duty ratio settings: High level duty ratio=BUZZ_Freq_Duty / BUZZ_Freq_DIV2. Factory settings: 0x00F0 corresponds to 8% high level duty ratio.
	0x2D	1	BUZZ_Time	Buzzing time after touch action, unit 10 ms; Factory setting: 0x0A
Power-up initialization variables File ID	0x2E	1	Init_File_Set_En	0x5A Start once to configure the power-up initialization variable file ID.
	0x2F	1	Init_File_ID	The configured power-up initialization variable file ID and the default is 0x16.
Reserved	0x30	16	Reserved	Write 0x00.
Setting for name of download folder	0x40	2	SD_Set_En	0x5AA5 means setting the name of SD download folder once, which are saved in the device Flash. It will not be lost after power off.
	0x42	1	Character length of download folder name	0x01-0x08
	0x43	8	Folder name	Up to 8 ASCII characters (only 0-9, a-z, A-Z, -, _). Invalid character setting will use "DWIN_SET" as the default value, which is effective after power off and restart.
	0x4B	37	Reserved	Write 0x00.

Attention: Users can configure the parameters in the green background of the CFG file as needed, but if you feel uncertain or need to modify the parameters in the white background, never hesitate to contact customer service. We are always willing to offer assistance.

5.2 T5*.CRC file format

Category	Address	Length	Definition
File identification	0x0000	4	Fixed to 0x43 0x52 0x43 0x10 .
CRC result	0x0004	4	Specify the final result of the checksum location data, after CRC32 checksum in order.
Reserved	0x0008	7	Write 0x00.
OS kernel code	0x000F	1	Write 0x5A means the OS core code CRC check is performed.
LIB file check	0x0010	2	0x10 = ID of the LIB file to be verified.0x11 = number of files to be verified starting with this ID. 0x00 indicates the end of LIB file checksum.
Font file check	0x0012	62	The remaining 31 defined positions.
Reserved Category	0x0050	2	0x50 = ID of the font file to be verified. 0x51= number of files to be verified starting from this ID, 0x00 indicates the end of the font file checksum. For off-chip NOR Flash, the font file size is 256KB.For off-chip NAND Flash, the font file size is 8MB; and the last file should not be used or verified due to the presence of bad blocks.
	0x0052	254	The remaining 127 defined locations.
File identification	0x0150	176	Write 0x00.

CRC32 is calculated using the polynomial $X^{32}+X^{26}+X^{23}+X^{22}+X^{16}+X^{12}+X^{11}+X^{10}+X^8+X^7+X^5+X^4+X^2+X+1$.



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Appendix 1 Record of Revision

Date	Content	Version
2021.12.02	First release	V1.0
2022.05.05	Add 4.1 Network Communication Interface. Update chapter 1.	V1.1
2022.06.10	Update chapter 5 CFG configuration attention, background ICL file naming method and 16MB Flash product memory description.	V1.2

If you have any questions about the use of this document or any DWIN product, or if you would like more information about DWIN products, please contact us.

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Thank you all for continuous support of DWIN, and your approval is the driving force of our progress!