



Magtronics Technology Inc.

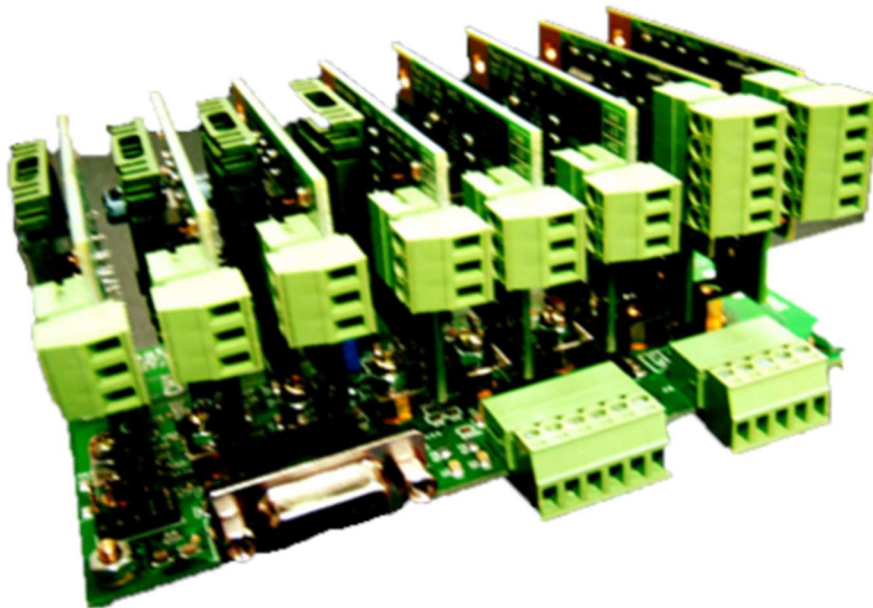
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SmartLED controller 2.0 For AOI

Model: SmartLED-MB2.0-V2

Camera handshake version

User's Manual
Version: 2.0 2022-12-01



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1. Features

- **Reduce the burden of host (CPU)**

This version of MB achieves real time capturing and changing brightness through digital interface. The host starts successive brightness change and capturing by only one digital output signal. Then the CPU can focus solely on image receiving and manipulation. When the all the image capturing finished, the MB will output a signal to inform camera the procedure is completed. Up to 8 pictures can be captured in a sequence since MB has 8 registers for brightness combination.

- **Modularized compact design, 8 channels available :**

The design of this driver uses one mother board to control 8 daughter boards. According to the application, you could select any number of daughter boards with different voltage and current ratings to be inserted to the mother board. The driver with 8 channels installed can be realized within the size of 130 x 70 x 70 mm³.

- **Fast response, no blinking at extra low brightness :**

This driver employs special current control loop such that there is no blinking at extremely low brightness. The current ripple is **0.01%FS**. The response time for channel 0、1 : 25 us, channel 2~7 : 500 us.

- **Three models of daughter boards :**

There are three models of daughter board for different LED light source 0005: 5V, 700mA, 1224: 12/24V, 650mA, 2416: 12/24V, 1600 mA. The daughter board can be furthermore programmed by DIP switch to select adequate maximal current level so that the resolution of the brightness can be increased.

- **Two serial interface implemented :**

RS232 or RS422 interface can be used to pre-program the value of the registers and the combination active index of 8 channels.

- **8 registers per channel and 8 combinations per capturing :**

There are 8 registers of 8-bit for each channel which can be programed through RS232 or RS485 interface. In addition, there are also 8 combination registers which used for storing the combination of 8 channel active index.



2. Description

SmartLED-MB2.0-V2 is a LED driver designed for high performance AOI application. It realizes the successive brightness change and image capture between driver and camera without host CPU intervening. Each image can be illuminated with a unique combination of 8 channels of different brightness.

The mechanism of handshake between driver and camera is described as follows. The host issues a RUN signal to driver to start the successive process. Upon receiving the RUN signal from host, the first combination of brightness of 8 channels are prepared by the driver. Then, the driver sends a UPD signal to camera which triggers camera to capture the first image. When camera finishes the first capturing, it issues a CPR signal to driver. Upon receive CPR, the driver then prepares the next combination of brightness for the next image. The process continues the same UPD-CPR sequence until the last image is captured. When all the images are captured, the driver then send a SEQ signal to host to end the whole process.

Consequently, the burden of the host is reduced. The host only focus on the analysis of captured image without frequently to communicate with the LED driver and the camera. In addition, the system cost is much lower, because data acquisition card is eliminated, and the wiring is much simpler.

The dimmer mode as V1 is also provided to simplify experiment of brightness combination test for the specific image.

This driver employs novel current control scheme so that the current ripple is very small (only 0.01% of full scale) as compared to conventional PWM current loop (1% of full scale). Hence, there is no blinking at very low brightness which is an easy way to check how stable the brightness is.

There is total 64 registers with 8-bit resolution for brightness control in which each mother board has 8 channels and each channel has 8 registers. Those registers can be pre-programed through RS232, and only one register of each channel can be activated to set the brightness of the specific channel.



3. Electrical Specification and dimensions

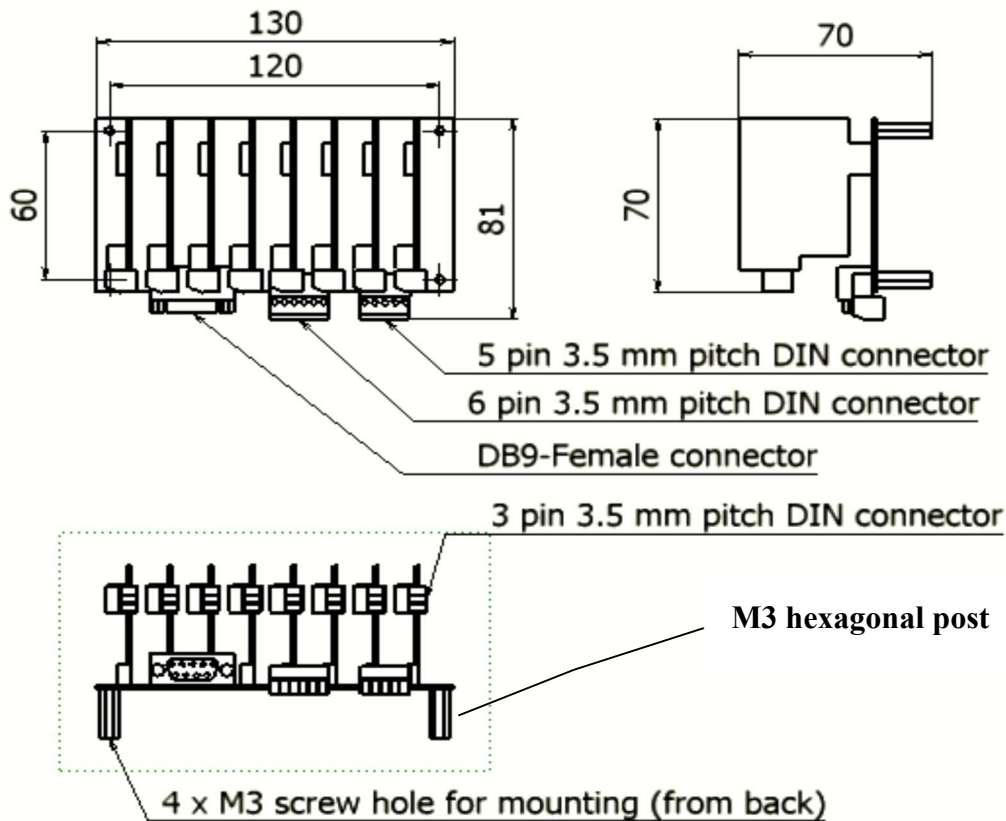
3.1 Electrical specification

Item	Value	Unit
Control supply voltage	8~24	V
RS232 interface	57600 baud rate, N-8-1	Echo ON.
RS422 interface	57600 baud rate, N-8-1	Echo OFF.
Digital input high voltage※	>3.5	V
Digital input low voltage※	<1.5	V
Digital output sink current※※	20	mA
Operation condition	0~70 °C	20~90% Humidity

※ All digital inputs are pull high to 5V through a 10K resistor. We recommend driving those inputs by open collector or dry contact outputs. (Not 5V TTL compatible)

※※ All digital outputs are open collector, the maximal pull high voltage is 24V.

3.2 Dimensions





4. Pin definition

J10 : Power connector

Pin No.	Name	Function
1	VCTL	Positive input of mother board (8~24V, 50mA)
2	GND	Common Ground
3	V5	5 V voltage positive input (power for 5V daughter board)
4	V12	12V voltage positive input (power for 12V daughter board)
5	V24	24 V voltage positive input (power for 24V daughter board)

J9 : Digital I/O

Pin No.	Name	IO type	Function
1	MOD	Input	Mode switch(Low: handshake mode, High: dimmer mode) °
2	RUN	Input	Signal from host to start sequence of changing brightness and image capturing (falling edge trigger) °
3	CPR	Input	Signal from camera representing capturing finish. (programable falling or rising edge trigger) °
4	SEQ	Output	Signal to host representing the sequence is finished (active low).
5	UPD	Output	Signal to camera representing the brightness change is finished (active low).
6	GND	Power	Digital common ground, internal connected to GND

P1: RS-232/422 (DSUB 9-pin, female)

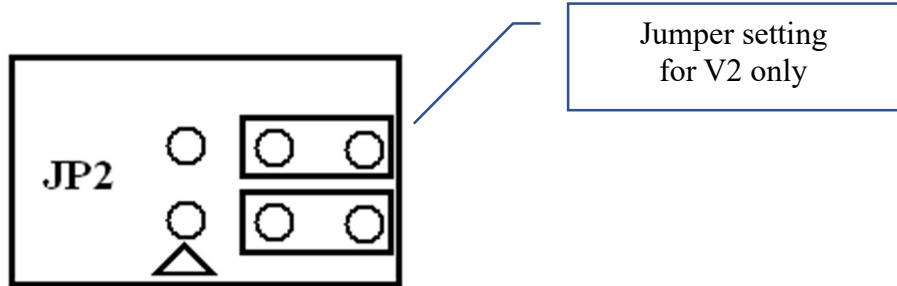
Pin No.	Name	Function
RS - 232		
2	TX	RS232 transmit (connected to HOST RX) °
3	RX	RS232 receive (connected to HOST TX) °
5	GND	Digital common ground, internal connected to GND
RS - 422		
6	T+	RS422 transmit positive
7	T-	RS422 transmit negative
8	R+	RS422 receive positive
9	R-	RS422 receive negative



SW1: mode switch

Pin No.	Name	Function
1	TST	Test mode (should be OFF when normal operation) °
2	MOD	RS-232/RS-422 selection(ON: RS-232 , OFF: RS-422) °
3	TER	RS-422 terminal resistor (ON : connected , OFF : disconnected) °

JP2: I/O JUMPER



※ Do not plug or remove daughter board, I/O pins and jumpers when power is on, otherwise, the board may be damaged permanently.



5. Command List

All commands are ASCII code. Each field is separated by [Space] and CR(ASCII-13) should be at the end of command.

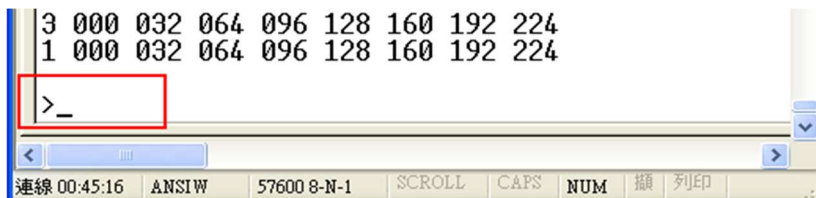
Command	Opt1	Opt2	Value	Function
RD	0~7	0~7	※X	Read the value of (channel, register)
RA	0~7	0~7	X	Read the value of (channel, register) then activate
WT	0~7	0~7	0~255	Write the value of (channel, register)
WA	0~7	0~7	0~255	Write the value of (channel, register) then activate
WC	0~7	0~7	0~7	Write the value of (combination index, channel)
RC	0~7	0~7	X	Read the value of (combination index, channel)
AC	0~7		X	Activate the specific combination command
PR	0、1		X	Print all the register values to screen (0: channel register list, 1: combination register list)
SV			X	Save all the register values to EEPROM for next power up
NC	0~7		X	Set no. successive capturing
AL	0、1		X	Setting the trigger edge option of CPR 0: Rising edge 1 : Falling edge
DL	0~65535		X	Setting the delay time of capturing
ST	0~15		X	Set listening station under RS422 mode.
SS	0~15		X	Set the station number of this board. Only can be changed when TST is ON and MOD is ON.
VN			X	Read the version number

※ X represents no value needed.

5.1 Command prompt :

5.1.1 RS-232 mode :

After pressing [Enter] to send the command, the MB will return “>” (ASCII=0x3e) back to the terminal.

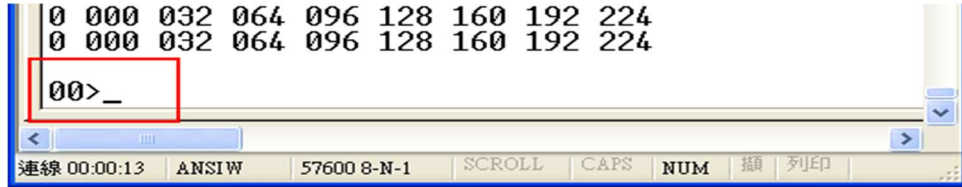


5.1.2 RS-422 mode :

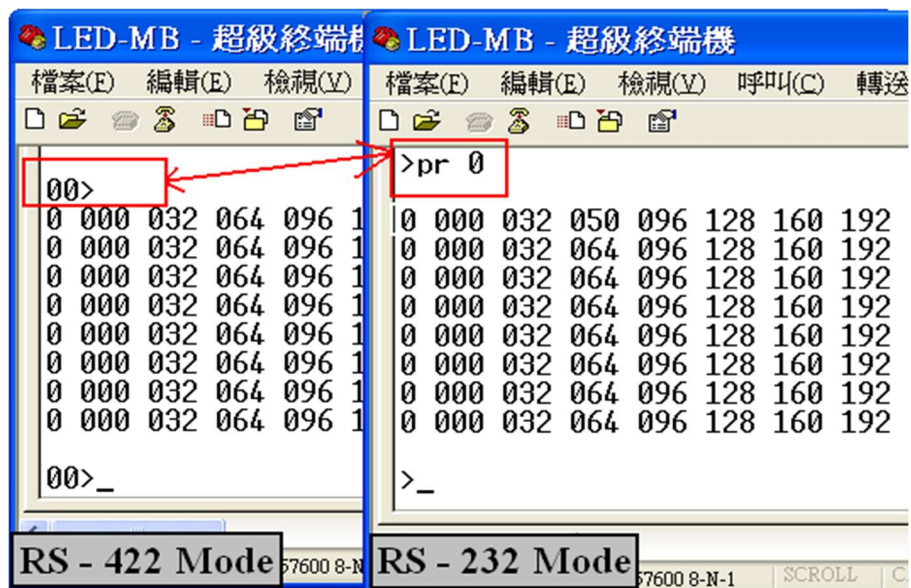
After pressing [Enter] to send the command, the MB will send “Station no.” and “>”



(ASCII=0x3e) back to the terminal. Ex. “00>” represents the station 0 now is the listener.



Note : There is no echo when using RS-422 mode as shown in the following figure.





6. Examples of command operation (use Windows Hyper-terminal)

6.1 Modify the value of number 2 register of channel 0 to be 50 :

Key in “WT 0 2 50” then press [enter] after the prompt “>”.



The controller responds “:” + CR + LF + “>”

Key in “PR 0” then press [enter] to check whether the value is modified.

PR 0 is to print the register table.

You can see the value in row 1 and column 4 is changed to 50.



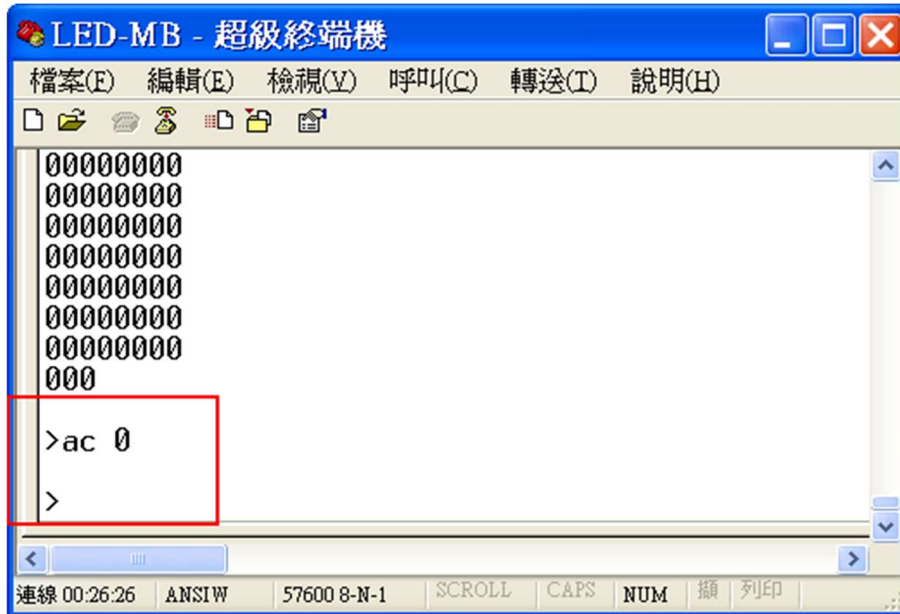


6.3 Activate the combination of capture 0 to active register column

The following figure showing the combination of capture 0 is “51473631”.

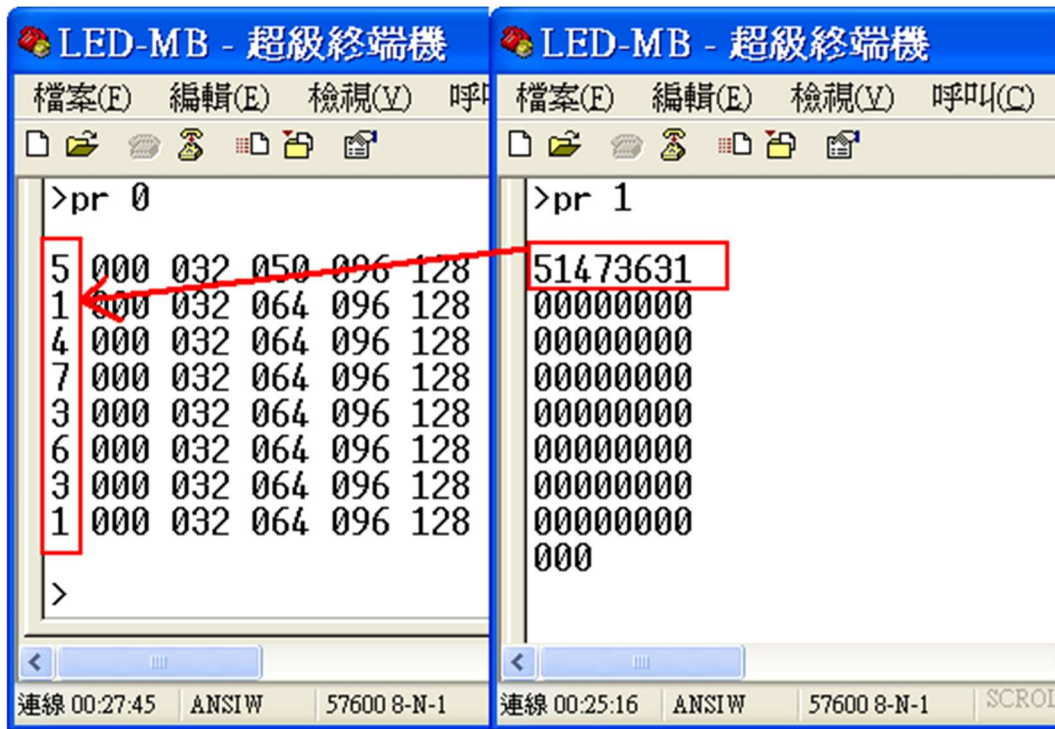


Key in “AC 0” then press [enter] after the prompt “>” to activate combination 0.



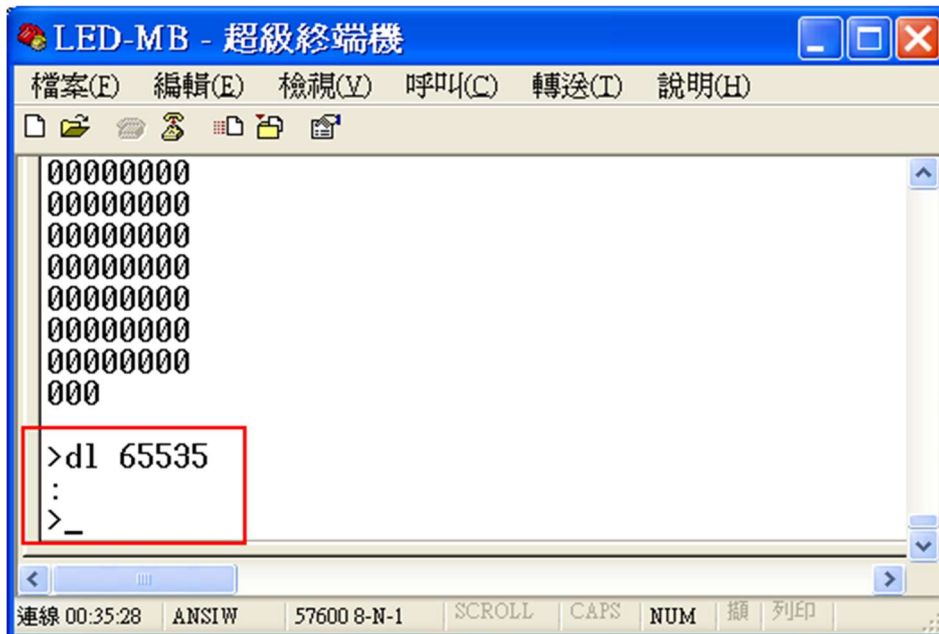
Key in “PR 0” then press [enter] to check whether the value is modified.

PR 0 is to print register table. You can see the value in column 1 is changed to be the same as capture 0. Then the LED will output the brightness of the combination of capture 0.



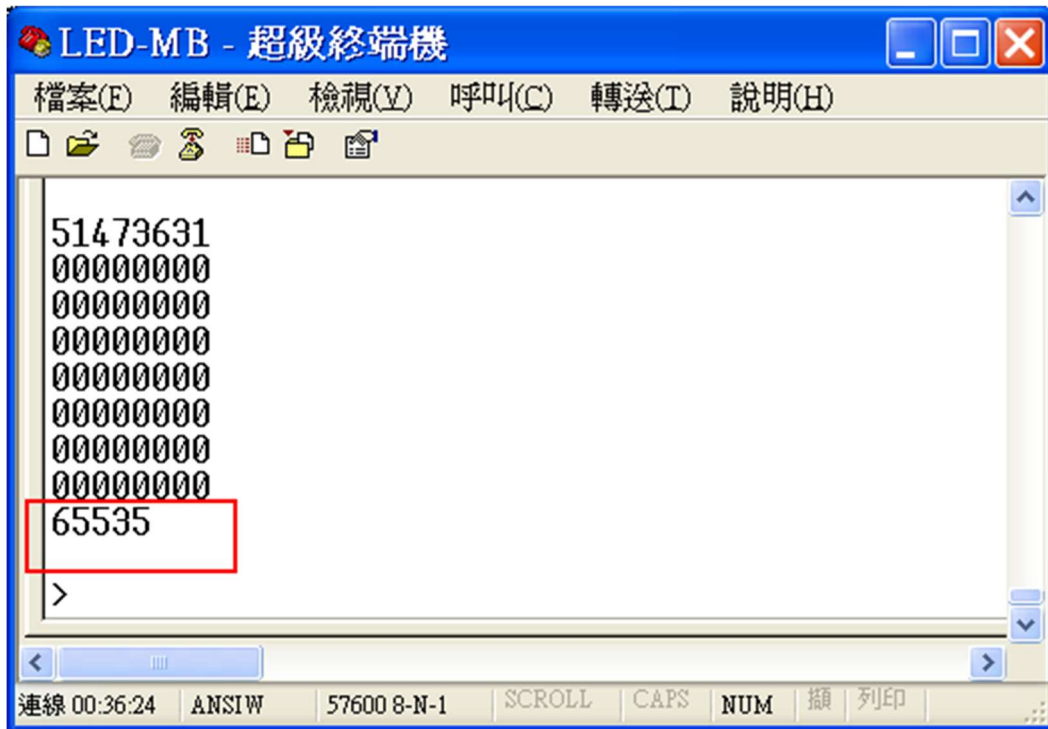
6.4 Modify the delay time before sending UPD to camera

Key in "DL 65535" then press [enter] after the prompt ">".





Key in “PR 1” then press [enter] to check whether the value is modified. PR 1 is to print combination table.



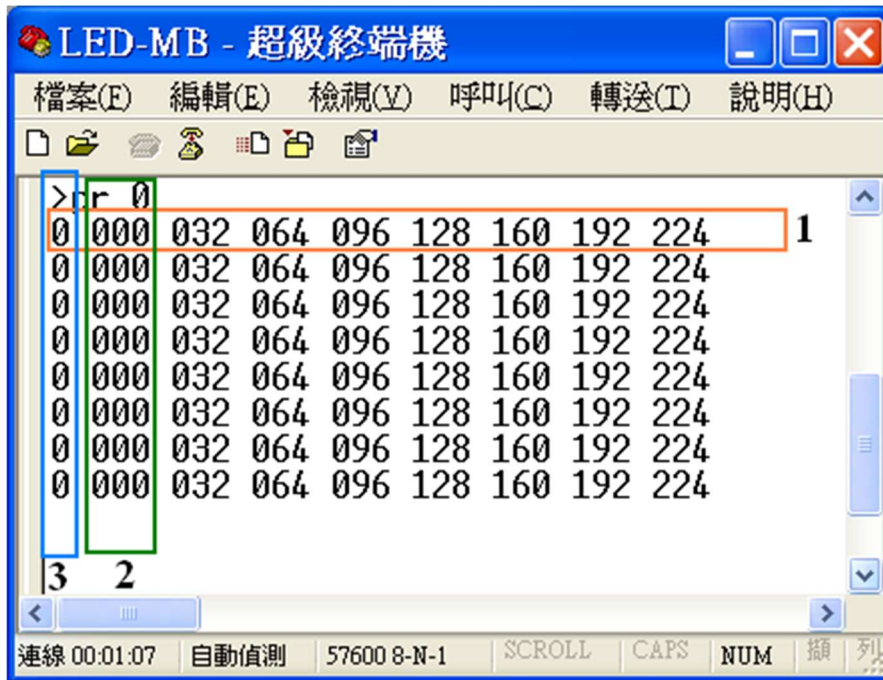
Note :

- 1. You must key in “SV” [enter] to save the modification after changing values. Hence, these values would be valid on next power up.**
- 2. If the command is invalid, the controller will respond “ER” +<CR>+<LF>.**

7. Format of register matrix

The format of the registers is explained below.

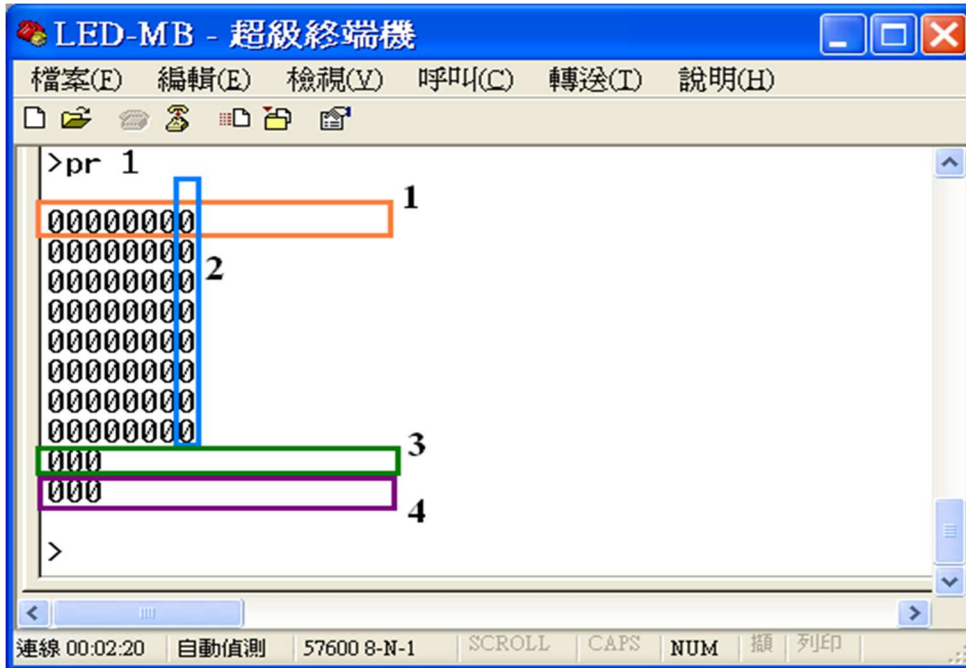
7.1 Brightness register table (PR 0)



Description :

Item	Name	Function
1	Channel(row)	The orange box encloses the 8 registers plus 1 active register index of the Channel 0. Hence, row index is channel index. There are 8 rows in the list representing 8 channels. The channel index is from 0 to 7.
2	Register(column)	The green box encloses the first register (register no. 0) of each 8 channel. Hence, column index is the register index and range from 0 to 7.
3	Index of active register	The blue box encloses the index of active register of each channel. The above picture shows every channel uses register 0 as the active register.

7.2 Combination register table (PR 1) :



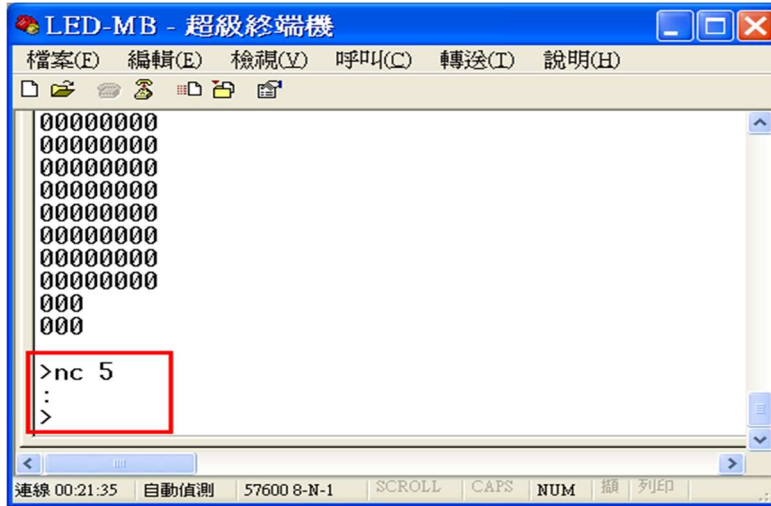
Description :

Item	Name	Function
1	Combination (row)	Each row is the active index combination of 8 channels of a capture.
2	Channel (column)	Each column contains the 8-capture active index of the specific channel.
3	Delay time	Delay time before sending UPD to camera for capturing. 65535 can delay 6553.5 mS °
4	Maximal index of capturing number	Maximal index of capturing number. This number should be smaller than 8. (from 0 to 7)

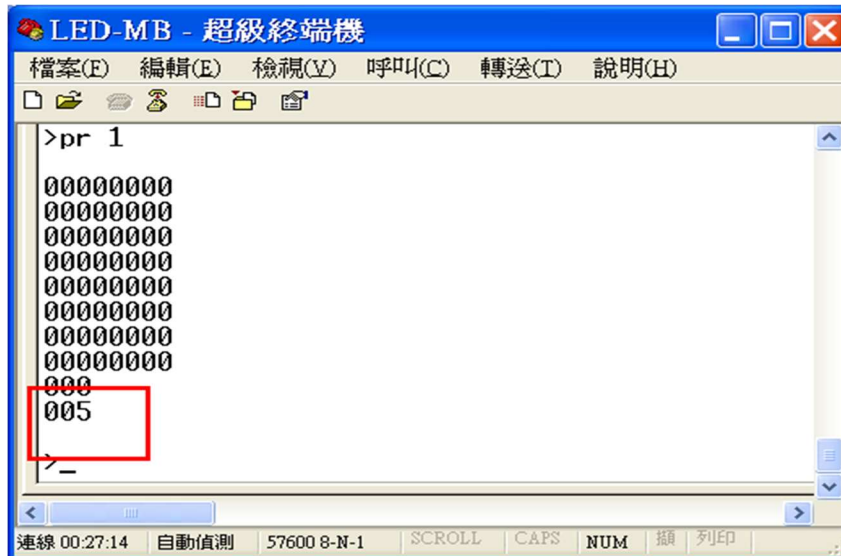


7.2.1 Modify the maximal number of capturing

Key in “NC 5” then press [enter] after the prompt “>”.

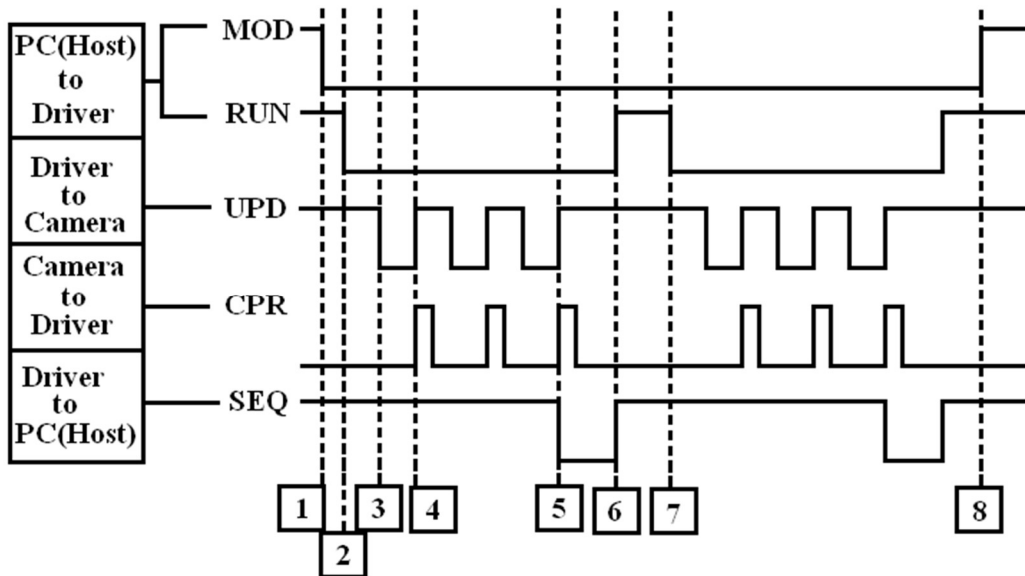


Key in “PR 1” then press [enter] to check whether the value is modified.
PR 1 is to print combination table.





8. Timing diagram of digital input/output for handshake



Explanation :

1. Host send MOD to driver by pulling low the MOD signal. Upon receiving MOD signal, the driver enters handshake mode.
2. Host then send RUN signal to driver by pulling low the RUN signal. Upon receiving RUN signal, the driver prepares the 8-channel combination of capture 0 and output to active register.
3. When the combination is prepared completely, the driver sends the UPD signal to camera by pulling low the signal. Upon receiving the UPD signal, the camera will capture the first image. Note that the load of LED may be very heavy so that the current rising is considerable slow. You can set the adequate value of DELAY so that the UPD signal will be postponed until the delay is complete.
4. When camera finishes capturing the first image, it should send a CPR signal to driver to inform driver that the capture is completed. Upon receiving this CPR signal, the driver will pull high the UPD signal, increase the combination index to capture 1, and prepare the combination of brightness for the next image. Then the process returns to step 3, and repeat the same procedure until the last image is captured.
5. Upon receiving the last CPR signal from camera, the driver will pull high the UPD signal, clear the combination index to 0, and send a SEQ to host so that the host knows all the images are captured.
6. Upon receiving the SEQ signal, the host will pull high the RUN signal. The driver sees RUN is pulled high, it will pull high the SEQ signal at the same time.



7. The host then move the target to the next position and pull the RUN signal again and the driver will start the successive image capture on the next position.

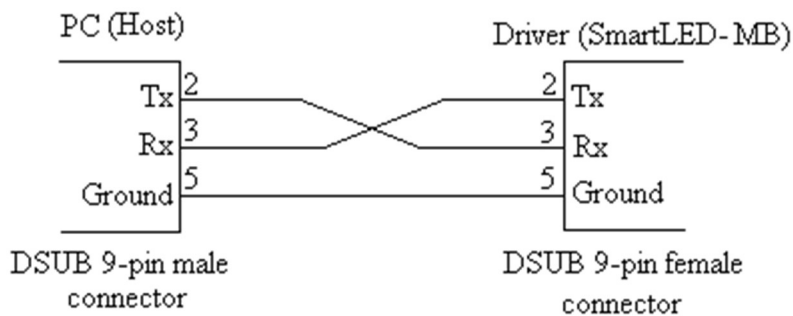
8. When all the image capture of all positions are finished, the host needs to pull high the MOD signal so that the driver goes back to normal dimmer mode.



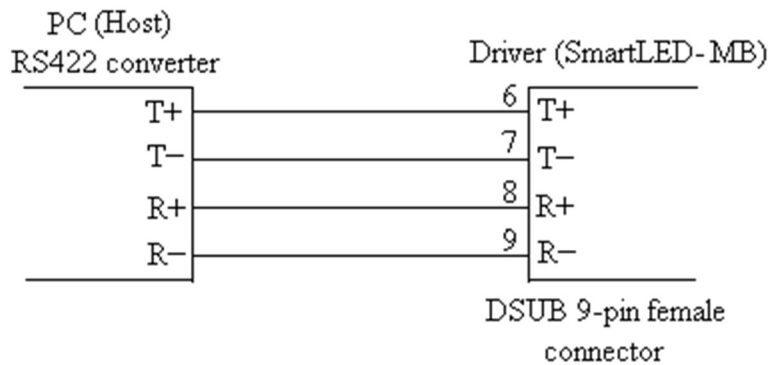
9. RS232/RS422 wire connection

9.1 RS232

The connection of PC to MB uses cable with pin2 pin3 swap version as shown below.



9.2 RS 422





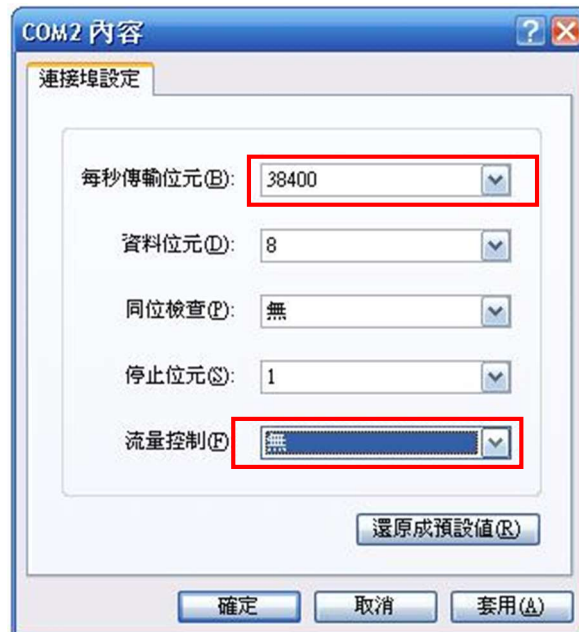
Appendix A. How to setup Hyper-terminal for communication

The setting of Hyper-terminal is explained in this page so that the communication between Host PC and SmartLED-MB can be built.

- Step1. Double click “Hypertrm.exe
- Step2. Select COM port, then press [OK]



- Step3. Set the baud rate to 38400 and flow control to “NONE” then press [OK].

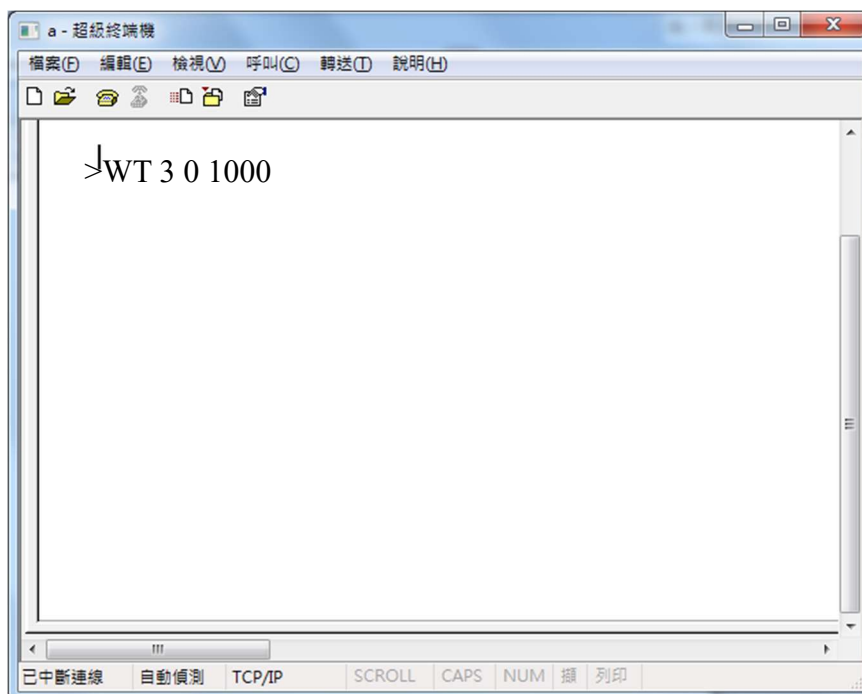




Step4. Check the settings as shown in the following diagram.



Step5. Now you can enter command into the popup window.





Appendix B. Example Code in VB

The following code uses VB as the IDE.

- 1.COM port number is COM1 ◦
- 2.Modify the register 0 of channel 0 to be 50.

B.1 Port setting

```
MSComm1.CommPort = 1 // Set port no. to 1

MSComm1.Settings = "38400,N,8,1" // Set parameters of port1

MSComm1.PortOpen = True // Open the port
```

B.2 Sending command

```
Dim LED_MB_Command As String // Declare a string variable

LED_MB_Command = "WT 0 0 50" // Put the command text into the string variable

MSComm1.Output = LED_MB_Command & Chr(13) // Send the string variable to output
// and CR(ASCII 13) as the end character
```