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1 Scope

This document is to provide a definition for the communication Protocol and hardware requirement of the LED Display System.

2. Applicable System

Any LED Display Board that transfer data from a PC via the RS232 communication port or equivalent equipment is applicable to this document. System could use whole or part of this protocol.

3. Interfacing Method

RS232 Baud Rate : 9600 (8,N,1.)

4. Data Structure

All Data will have an ID no., Data Content, Xor Result and an ending code, except ID setting, there will not have xor Result.

4.1 ID Setting

Each sign needs to have an ID, so you should set the sign ID first by the using PC software, (Use this command only when you want to change the sign ID) only one sign could be set at a time.

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Command Format

PC -> MCU : **<ID><XX><E>**

<, >	Are ASCII code 3C, 3D
ID	Are character "I" & "D" (Upper case)
XX	Are the Hex number 01 to FF in ASCII format (i.e. maximum 255).

MCU -> PC : **XX**

XX	Are the Hex number 01 to FF in ASCII format return from MCU

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4.2 Message / Control

There are 6 kind of message / control transfer

- Real Time Clock Setting
- Sending Page Message
- Sending Schedule
- Sending Graphic Bolock
- Delete => Page
  => Schedule
  => All
- Sending Default

Format :

PC -> MCU **<IDXX> | Data packet | CS | <E>**

<IDXX>	are the ID of the designated LED board
<, I,D & >	are ASCII character “<”, “I”, “D” & “>”
XX	denotes the ID of the designated LED Board Values are two ASCII character from 00-FF
Data packet	denotes data content of this transmission string
[CS]	denotes the Xor Result of the data content(Data Package).
[,C,S &]	are two ASCII character from 00-FF
<E>	Denotes the Ending code of transmission
<,E & >	are ASCII character “<”,”E”, and “>”

MCU -> PC ACK /NACK /No Response

1. ACK : Message with the correct Xor Result for the designated ID is received
2. NACK : Wrong xor result for the designated ID is received
3. No Response : ID not match(Message for another LED on the same transmission line) or data format is not recognized.

Data Packet

4.2.1 Real Time Clock Setting <SC>

Format :

<SC>	YYWWMMDDHHmmSS

<SC>	Denotes the code for Real Time Clock setting
<,S,C & >	Are ASCII characters “<”,”S”,”C” & “>”
YY	Denotes the Year will be set into the LED Board
	Values are two ASCII character from 00-99
WW	Denotes the Week will be set into the LED Board
	Values are Two ASCII character from 01-07, 01=Monday and 07=Sunday
MM	Denotes the Month will be set into the LED Board
	Values are two ASCII character from 01-12, 01= January and 12=December
DD	Denotes the Day will be set into the LED Board
	Values are two ASCII character from 00-31
HH	Denotes the Hour will be set into the LED Board
	Values are two ASCII character from 00-23
mm	Denotes the Minute will be set into the LED Board
	Values are two ASCII character from 00-59
SS	Denotes the Second will be set into the LED Board
	Values are two ASCII character from 00-59

4.2.2 Sending Page content <Ln><Pn>

Format :

<Ln>	<Pn>	<FX>	<MX>	<WX>	<FY>	… MESSAGE…

4.2.2.1 <Ln>

Denotes which Line this message belongs to :

<, L & >	Are ASCII character “<”,” L” & “>” .		
n	The Line number in ASCII character, i.e.		
	1	=	Line 1
	2	=	Line 2
	3	=	Line 3
	4	=	Line 4
		:	
	8	=	Line 8

** **Height for 1 line is 8 pixels**

4.2.2.2 <Pn>

Denotes which page this message belongs to

<,P&> Are ASCII characters “<”,”P” & “>”

n The Page number in ACSII character, ie.

A	=	Page A
B	=	Page B
	:	
Z	=	Page Z

4.2.2.3 <FX>

Denotes the leading command of this page

<,F&> Are ASCII characters “<”,”F” & “>”

X Code for the leading command in ACSII character, ie.

A/a	=	Immediate (Image will be immediately appeared)
B/b	=	Xopen (Image will be shown from center and extend to 4 side)
C/c	=	Curtain UP (Image will be shown one line by one line from bottom to top).
D/d	=	Curtain Down(Image will be shown one line by one line from Top to Bottom
E/e	=	Scroll Left (Image will be scrolled from Right to Left)
F/f	=	Scroll Right (Image will be scrolled from Right to Left)
G/g	=	Vopen (Image will be shown from center to top and Bottom one line by one line)
H/h	=	Vclose(Image will be shown from Top and Bottom to Center one line by one line.)
I/i	=	Scroll Up(Image will be scroll from Bottom to Top)
J/j	=	Scroll Down ((Image will be scrolled from Bottom to Top)
K/k	=	Hold (Previous Screen will be kept)
L/l	=	Snow (Pixels will be dropped down from top and stack up to build the image)
M/m	=	Twinkle (a blank diagonal line will be scrolling on the image)
N/n	=	Block Move (8 pixel width display block will be moved from right to left one by one)
P/p	=	Random (Random Pixel will be appeared to build the image)
Q/q	=	Pen writing ‘Hello World’
R/r	=	Pen writing ‘Welcome’
S/s	=	Pen writing ‘Amplus’

- Leading command will have two display method, Capital letter/Small letter. Only Line 1 (L1) will have the small letter leading command. If the command is in capital letter, L1 will take the control of the whole image, leading effect of the whole display will be shown simultaneously as the effect selected by L1. If the leading effect of L1 is in small letter, Each line will use its own leading effect and display one by one and from top to bottom.

4.2.2.4 <MX>

Denotes the Display method while waiting & effect speed

<,M&> Are ASCII characters “<”,”M” & “>”

X Code for the Display Method & Speed in ACSII character, ie.

Set A Speed Level 1 (4XH)

A(41H) = Normal (Display stay steady while waiting)
B(42H) = Blinking (Display Blinking while waiting)
C(43H) = Play pre-defined song 1
D(44H) = Play pre-defined song 2
E(45H) = Play pre-defined song 3

Set A Speed Level 1 (4XH) Fastest

A(41H) = Normal (Display stay steady while waiting)
B(42H) = Blinking (Display Blinking while waiting)
C(43H) = Play pre-defined song 1
D(44H) = Play pre-defined song 2
E(45H) = Play pre-defined song 3

Set B Speed Level 2 (5XH) Middle fast

Q(51H) = Normal (Display stay steady while waiting)
R(52H) = Blinking (Display Blinking while waiting)
S(53H) = Play pre-defined song 1
T(54H) = Play pre-defined song 2
U(55H) = Play pre-defined song 3

Set C Speed Level 3 (6XH) Middle slow

a(61H) = Normal (Display stay steady while waiting)
b(62H) = Blinking (Display Blinking while waiting)
c(63H) = Play pre-defined song 1
d(64H) = Play pre-defined song 2
e(65H) = Play pre-defined song 3

Set A Speed Level 1 (4XH) Slowest

q(71H) = Normal (Display stay steady while waiting)
r(72H) = Blinking (Display Blinking while waiting)
s(73H) = Play pre-defined song 1
t(74H) = Play pre-defined song 2
u(75H) = Play pre-defined song 3

4.2.2.5 <WX>

Denotes the waiting time

<,W&> Are ASCII characters “<”,”W” & “>”

X Code for the waiting time in ACSII character, ie.

A	=	0.5 sec
B	=	1 sec
C	=	2 sec
D	=	3 sec
	:	
Z	=	25 sec

4.2.2.6 <FY>

Denotes the lagging command of this page

<,F&> Are ASCII characters “<”,”F” & “>”

Y Code for the lagging command in ACSII character, ie.

A/a	=	Immediate (Image will be immediately disappeared)
B/b	=	Xopen (Image will be disappeared from center and extend to 4 side)
C/c	=	Curtain UP (Image will be disappeared one line by one line from bottom to top).
D/d	=	Curtain Down(Image will be disappeared one line by one Line from Top to Bottom
E/e	=	Scroll Left (Image will be scrolled from Right to Left and disappeared)
F/f	=	Scroll Right (Image will be scrolled from Right to Left and disappeared)
G/g	=	Vopen (Image will be disappeared from center to top and Bottom one line by one line)
H/h	=	Vclose(Image will be disappeared from Top and Bottom to Center one line by one line.)
I/i	=	Scroll Up(Image will be scrolled from Bottom to Top and disappeared)
J/j	=	Scroll Down (Image will be scrolled from Bottom to Top and disappeared)
K/k	=	Hold (Screen will be kept)

- Lagging command will have two display method, Capital letter/Small letter. Only Line 1 (L1) will have the small letter lagging command. If the command is in capital letter, L1 will take the control of the whole image, lagging effect of the whole display will be shown simultaneously as the effect selected by L1. If the lagging effect of L1 is in small letter. Each line will use its own lagging effect and display one by one and from top to bottom.

4.2.2.7 ---Message---

Contents message data of page including display data (ASCII 20H-7FH) and **<AX>** (Font code), **<BX>** (Bell code), **<CX>**(Color Code), <GXn> (Graphic Block), **<KX>**(Date & Time) and **<UXX>** European Character.

4.2.2.7.1 <AX>

Denotes the Font of the following characters

<,A&> Are ASCII characters “<”,”A” & “>”

X Code for the Font, ie.

A	=	5X7 (Normal size)
B	=	6X7 (Bold size)
C	=	4X7 (Narrow size)
D	=	7X13 (Large size) (for 16 pixel height or more LED display only.)
E	=	5X8 (Long Size)

4.2.2.7.2 <BX>

Enable the Bell and denotes the duration

<,B&> Are ASCII characters “<”,”B” & “>”

X Duration of the Bell, ie.

A	=	0.5 sec
B	=	1 sec
C	=	1.5 sec
	:	
Z	=	13sec

4.2.2.7.3 <CX>

Denotes the Color of the following characters

<,C&> Are ASCII characters “<”,”C” &” >”

X Color for the characters , ie.

A	=	Dim Red	B	=	Red
C	=	Bright Red	D	=	Dim Green
E	=	Green	F	=	Bright Green
G	=	Dim Orange	H	=	Orange
I	=	Bright Orange	J	=	Yellow
K	=	Lime	L	=	Inversed Red
M	=	Inversed Green	N	=	Inversed Orange
P	=	Red on Dim Green	Q	=	Green on Dim Red
R	=	R/Y/G	S	=	Rainbow

4.2.2.7.4 <GXn>

Denotes the Graphic Block to be inserted

<,G&> Are ASCII characters “<",”G” & “>”

X Graphic page to be inserted , i.e.

A = Page A

B = Page B

:

Z = Page Z

n Graphic block (32X8 pixels) no. in a Graphic Page

1 = Block 1

2 = Block 2

:

12 = Block 12

4.2.2.7.5 <KX>

Denotes the Date or Time to be inserted

<,K&> Are ASCII characters “<”,”K” & “>”

X Date or Time to be inserted , i.e.

D = Date in format [DD/MM/YY]

Where DD=Date, MM=Month & YY=Year

T = Time in format [hh:mm]

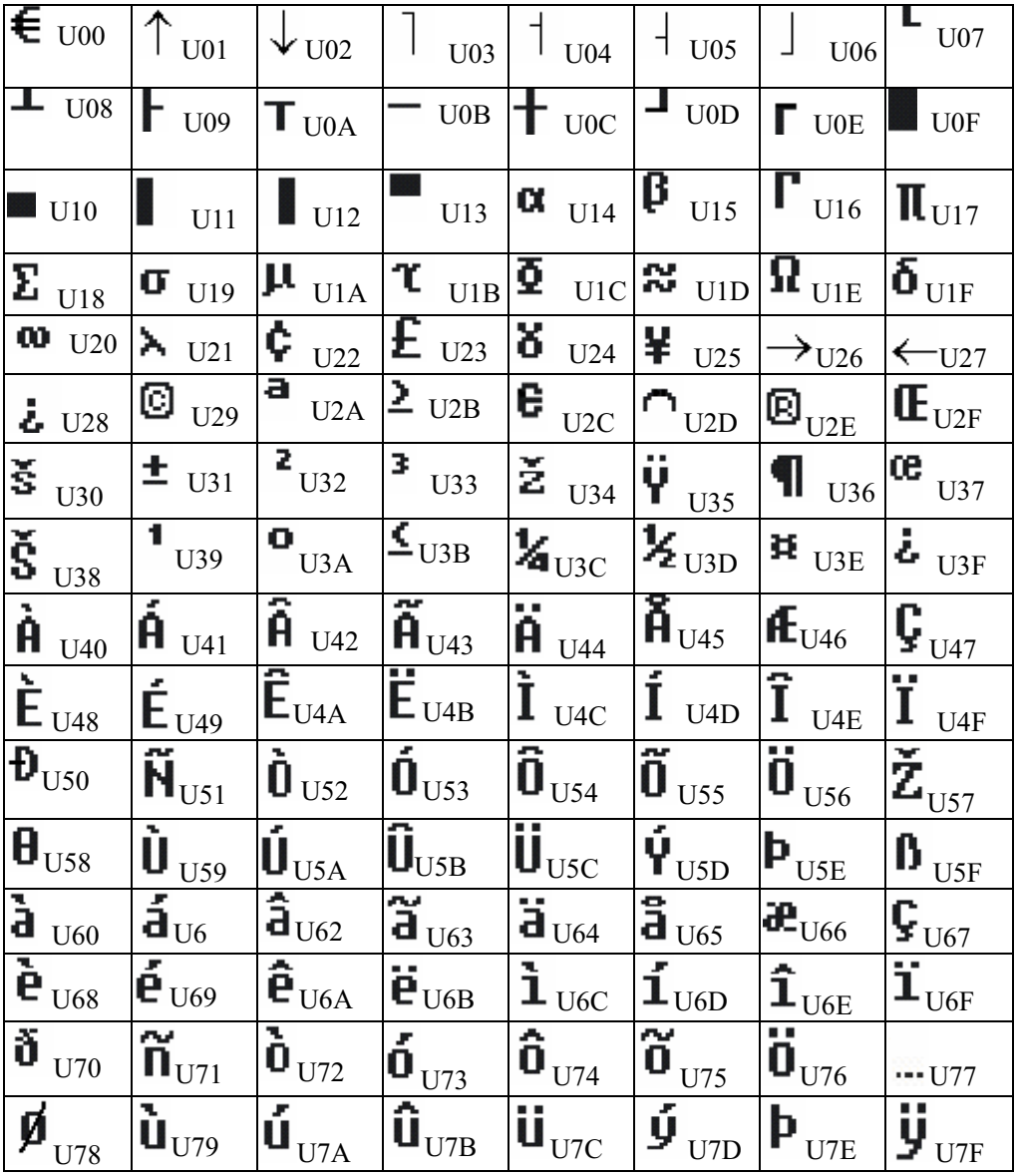
Where hh =Hour & mm = month

4.2.2.7.6 <UXX>

Denotes the European characters

<,C&> Are ASCII characters “<”,”U” & “>”

XX Denotes European Character no. from ASCII character 00 to 7F.



4.2.2.7.7 **<NXX>**

Denotes the Column location of the message

<,C&> Are ASCII characters “<”,”N” & “>”

XX Denotes Starting location of the MESSAGE in a row

ASCII character 00 to FF

The Location will be re-defined if another <NXX> is met

e.g. <N00> TEST -> Message ‘TEST’ will be displayed on the most left hand side.

TEST

e.g. <N1F> TEST -> Message ‘TEST’ will be display on 31 pixel from Left

4.2.3 Sending Schedule <Tn>

<Tn>	**YYMMDDHHmm**	*YYMMDDHHmm*	**..PPP…**

<Tn> Denotes the code for Sending schedule

<,T, & > Are ASCII characters “<”,”T”& “>”

n Denotes the schedule no. form A-E

YY Denotes the Schedule starting Year
Values are two ASCII character from 00-99

MM Denotes the schedule starting Month
Value are two ASCII character from 01-12, 1= January and 12=December

DD Denotes the schedule starting Day
Values are two ASCII character from 00-31

HH Denotes the schedule starting Hour
Values are two ASCII character from 00-23

mm Denotes the schedule starting Minute
Values are two ASCII character from 00-59

YY Denotes the Schedule ending Year
Values are two ASCII character from 00-99

MM Denotes the schedule ending Month
Value are two ASCII character from 01-12, 1= January and 12=December

DD Denotes the schedule ending Day
Values are two ASCII character from 00-31

HH Denotes the schedule ending Hour
Values are two ASCII character from 00-23

mm Denotes the schedule ending Minute
Values are two ASCII character from 00-59

…PPP… Denotes Page no. A-Z in this schedule, Total there could have 31 pages inside one schedule. Sequence of the pages could be random and same.

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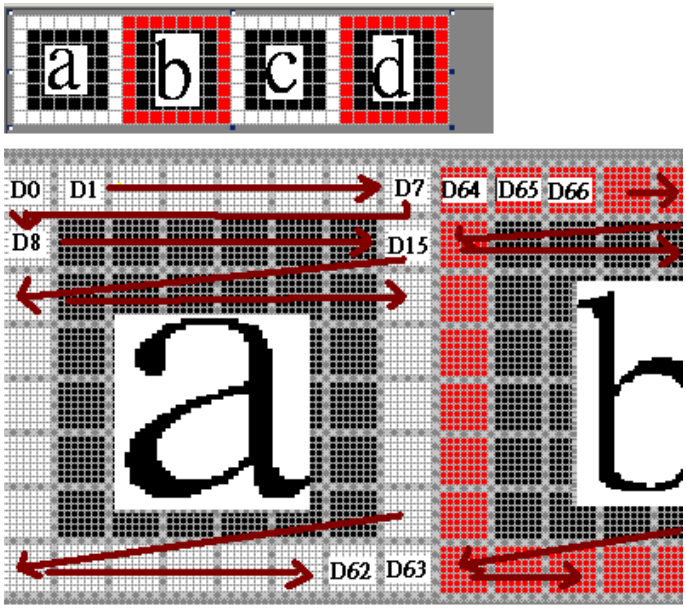
4.2.4 Send Graphic Block <GXn>

<GXn>	…Graphic Data …

<GXn>	Denotes the code for Sending schedule		
<,G&>	Are ASCII characters “<”,”G” & “>”		
X	Graphic page no. , i.e.		
	A	=	Graphic A
	B	=	Graphic B
	:		
	H	=	Graphic H
n	Graphic block (32X8 pixels) no. in a Graphic Page		
	1	=	Block 1
	2	=	Block 2
	:		
	8	=	Block 8

Each Graphic Block built by 4 8x8 dots units
Sequence of data is shown below.



Graphic data mapping

Graphic Pixels : D0,D1,D2,…D255,
Four Pixel is represented by 1 Byte.
Byte 1 = D0..D3
Byte 2 = D4..D7
Byte 3 = D8..D11
:
:
Byte 63 = D252..256

Structure of each Data :
Each Pixel composite by 2 bit
MSB is the most Left Bit

e.g. the first dot is RED ,the second dot is GREEN, the third dot is yellow and the forth dot is black.

Data = 10 01 11 00
| | | |
| | | - Black
| | ----- Yellow
| --------- GREEN
---------- RED

After you have sent the graphic block. You should insert the Graphic block label into the Message to display it.

e.g. to display a single graphic block <GA1> on Line one and immediately appear and normal stay for 1 second and then disappear immediately

<ID01><L1><PA><FA><MA><WC><FA><GA1>XX<E>

where XX is the checksum

Delete

To Delete a Page, a Schedule or all contents

4.2.5.1 Delete Page <DLXPn>

Format : **<DLXPn>**

<DLXPn> Denotes the command for Delete a Line in a page
<,D,L,P&> Are ASCII characters “<”,”D”,”L”,”P” & “>”
X The Line number that will be deleted in ASCII character, i.e.

1	=	Line 1
2	=	Line 2
	:	
8	=	Line 8

n The Page number that will be deleted in ACSII character, i.e.

A	=	Page A
B	=	Page B
	:	
Z	=	Page Z

4.2.5.2 Delete Schedule <DTn>

Format : **<DTn>**

<DTn> Denotes the command for Delete a Schedule
<,D,T &> Are ASCII characters “<”,”D”,”T” & “>”
n The Schedule number that will be deleted in ACSII character, i.e.

A	=	Page A
B	=	Page B
	:	
E	=	Page E

4.2.5.3 Delete All <D*>

Format : **<D*>**

<D*> Denotes the command for Delete All the memory contents, including Pages, Schedules, Graphics pages & Default Run pages, The Display will be blanked
<,D, * &> Are ASCII characters “<”,”D”,”*” & “>”

4.2.6 Assign a default Run Page <RPn>

Format : **<RPn>**

<RPn> Denotes the command for assign a default run page, This page will be shown if no any schedule is playing

<,R, P &> Are ASCII characters “<”,”R”,”P” & “>”

n The Page no. that will be set as default run i.e.

A	=	Page A
B	=	Page B
	:	
Z	=	Page Z

4.2.7 Assign Display Brightness level <BX>

Format : **<BX>**

<BX> Denotes the command for assign Display Brightness level

<,B &> Are ASCII characters “<”,”B” & “>”

X The Brightness level.

A	=	100%
B	=	75%
C	=	50%
D	=	25%

Important notes:

1. **For the Xor Result of the message send, Refer to Item 4.1 & 4.2**
   ID setting is not Xor result sent and the feedback is the ID no.
   All message other than ID setting should have a Xor result (2 digit from 00-FF hex number)for the data package placed before the Ending code ‘ <E>’.

2. **When it is first time initialize, ?You should first set the follow parameters**
   - **ID**
   - **Time/Date**
   - **Run Clear all command**

3. **If you want the Message display continuously. You can set a schedule with Start year is 00 and the stop year 99 and insert the pages into this schedule, it will always display.**

- END -