1.

Protocol Document for Double side Platform Display.

Document Title	Protocol Details
Document Number	V7.1
Purpose	Protocol details for main controller.
From	Chemito InfoTech Pvt. Ltd.
To	
Date	13 April 2022

Prepared By	Reviewed By	Approved By
Name: Ms.Shivanjali Mutadak. Signature:	Name: Mr. Dinesh More. Signature:	Name: Mr. Naresh Panchal Signature:

Revision History

Revision No	Date	Title / Brief Description of Changes	Prepared By	Reviewed By	Approved By
1.1	07/03/2022	Original Document	Miss.Shivanjali Mutadak	Mr. Dinesh more	Mr. Naresh Panchal
1.2	08/03/2022	Added command ● Led Test Pattern	Miss.Shivanjali Mutadak	Mr. Dinesh more	Mr. Naresh Panchal
1.3	09/03/2022	● Link check Response Function.	Miss.Shivanjali Mutadak	Mr. Dinesh more	Mr. Naresh Panchal
1.4	10/03/2022	● Response function for Display Data	Miss.Shivanjali Mutadak	Mr. Dinesh more	Mr. Naresh Panchal
1.5	13/04/2022	● Sample Testing packets added ● RTC function code.	Miss.Shivanjali Mutadak	Mr. Dinesh more	Mr. Naresh Panchal

Table of Contents

1.1 Purpose:

This Document contains Detail description for any Double Sided Platform Display. The document provides communication details of displays and required protocols.

1.2 Introduction:

The main function of Platform Display Board is to display Expected Time of Arrival in Minutes, Arrival Time and Destination. In case there is no train during a certain span of day it will display information related to special events, public information items. It will show messages in emergency situations.

DSPF will display information for approaching train as well as emergency messages and advertisements. It will be useful and entertaining for passengers waiting at station. The types of information will mainly consist of route number, destination, and expected time of arrival. Destination will be displayed in English & Regional languages.
Service provider will design the layout of display area by selecting the types of information and their sequence.

2. Function Code:

Function code will represent different type of packets and functions. The range of function code is limited to $80 - $ 96. The range $C0 - $D5 shall be only used for giving response to any of the packet. This is dried by adding $40 to any of the function code received. From this it can be identified that the packet is response packet or not.

Function Code	Command	Description
80	Link Check	Link Check status for display connectivity
81	Display Data	To display Route/Emergency/Adhoc data on display
82	STOP	Blank display
83	START	Start displaying last display data frame
8C	Led Test Pattern	To test the LED patterns on Display board
96	RTC	Real time display

2.1 Response Function Code:

Response Function Code	Command	Description
C0	Link Check	Link Check status for display connectivity
C1	Display Data	To display Route/Emergency/Adhoc data on display
CC	Led Test Pattern	To test the LED patterns on Display board
D6	RTC	Real time display

2.2 Packet Status:

Sr. No.	Value	Description (Packet status)
1	01	Packet received and processed successfully
3	02	CRC fail
7	06	Invalid function code
17	23	Invalid data length
18	24	Invalid data
20	26	Due to other conditions

3. Protocol Format of Display Data

Header MSB	Header MSB	Packet length (LOP) MSB to Data last		Serial number	Packet Status	Function code	Data	Footer MSB	Footer LSB	Checksum MSB	Checksum LSB	CRC bytes - length MSB to last data byte
1 Byte	1 Byte	2 Bytes		1 byte	1 byte	1 byte	N bytes	1 byte	1 byte	1 byte	1 byte	
0xAA	0x99	MSB length	LSB length	Packet no.	0x00/0xFF	0x81	Data byte	0xFF	0xFF	MSB byte	LSB byte	
					0x00 packet in continuation							
					0xFF last Packet							

3.1 Details of Individual Bytes of V7.1 Protocols:

Byte Name	Size	Detail
Header MSB	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header LSB	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet length	2 Byte	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial Number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII “ 01” and increments by one count up to “99”
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Function Code	1 Byte	Bit indicates a function code of packet i.e. Display Data. Function code 0x81.
Data Data Bytes	N Byte	This is a Data byte.
Footer MSB	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer LSB	1 Byte	Least significant bit of Header. (Hex value -0xFF)

Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in BLOCK 2. CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

3.2 Data Byte (N byte)

Data														
Video speed	Delay	Message Type	STX	Line Number	Screen 1 Data	ETX	Line Number	Screen 2 Data	ETX		STX	Line Number	Screen N Data	ETX
1 Byte	1 Byte	1 Byte	0x02	1 Byte		0x03	1 Byte		0x03	.....	0x02	1 Byte		0x03
Default value 0x00		0x00: normal data --- train message data 0x01: default Data												

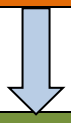
- **Data Field**

Byte Name	Size	Detail
Video Speed	1 Byte	Default Value 0x00
Delay	1 Byte	0x00 (it is delay time to refresh a displayed data)
Message Type	1 Byte	0x00 : normal data Train data and Message data 0x01 : default data
STX	1 Byte	0x02 (Start of transmission)
Line Number	1 Byte	Line number should be 1 byte. It Shows Screen Data.
ETX	1 Byte	0x03 (End of transmission)

Note: Table consist of Data field which shown on screen, so as shown in figure B we can multiple screen in same packet.

3.3 Screen Data

Screen Data					
Field data start indicator	Field 1 Data	Field data End indicator	Field data start indicator	Field 2 Data	Field data End indicator
1 Byte, byte for {		1 Byte, byte for }	1 Byte, byte for {		1 Byte, byte for }



Field Data											
Start column number	End column number	Attributes for fields								Address / Data	
3 bytes	3 bytes	1 bytes	1 byte	1 bytes	1 bytes	1 bytes	1 bytes	1 bytes	1 bytes	N bytes/10 bytes	Bitmap data limit is maximum 50 ASCII character and bitmap address limit is 10 ASCII character.
		AD (Address/Data)	Effect	Speed	Freeze time	FONT MSB	FONT LSB	Line data	language	N bytes for Bitmap data	
		A- Address	F- Freeze	0 to 9	00xFF			U- Upper	E- English	10 bytes for address.	
		D- Data	R- Rolling	0- Slowest				L- lower	G - Hindi		
								N - no division			
			B- Blinking	9- Fastest					M - Marathi		
			U - Scroll up								
			D - Scroll Down								

- **Screen Data field**

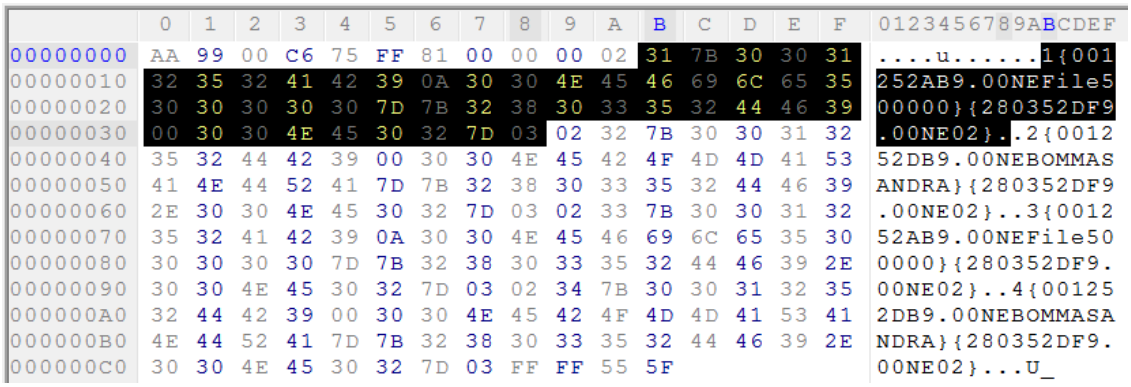
Byte Name	Size	Detail
1st Field Data Start Indicator	1 Byte	1 digit ASCII char '{' (Hex Value – 0x7B) indicates starting of line field for display.
Field 1 Data		**In Field data you can add maximum 2 field.**
1. Start of column number.	3 Byte	3 digit ASCII value indicate starting column no. of field for display. It's range is "000" to "999" and should be in 3-digit form.
2. End Column Number	3 Byte	3 digit ASCII value indicate ending column number of field for display. It's range is "000" to "999" and should be in 3-digit form.
Attributes for field	**8 Byte**	1st Byte – A for address, D for Data.*Note 1 2nd Byte – Effect: F-Freeze, R – Rolling, B – Blinking / Flashing, U-Scroll UP D- Scroll Down 3rd Byte – Speed of rolling or flashing combination in steps of **0** for slowest to **9** for fastest 4th Byte - freeze time for language (0x00 to 0xFF) 5th Byte-Font size MSB Font size applicable to English only. 6th Byte-Font size LSB Font size applicable to English only. 7th Byte-Upper or lower line data ("U" for upper, "L" for lower line and "N" for complete 16 row (no Division)) 8th byte –Language ("E" for English, "H" for Hindi, "M" for Marathi)
Address /Data	Variable Bytes	Bitmap data in maximum 50 ASCII characters. Bitmap address in 10 ASCII characters. e.g. ETA – Expected Time of Arrival in minutes in 2 ASCII digits ROUTE – Root Number in ASCII digits DESTINATION – Status of arrival in ASCII letters Sequence of the fields on the display will be as per the sequence in telegram. 1st byte in the attribute will decide that the data in telegram which is following is to be treated as file name or ASCII data.
1st Field Data End	1 Byte	1 digit ASCII char '}' (Hex Value – 0x7D) indicates ending of line field data for display.
2nd Field Data Start	1 Byte	1 digit ASCII char '{' (Hex Value – 0x7B) indicates starting of line field for display.

Column number for Field_2 Start	3 Byte	3 digit ASCII value indicate starting column no. of field for display. It's range is "000" to "999"
Column number for Field_2 End	3 Byte	3 digit ASCII value indicate end column no. of field for display. It's range is "000" to "999"
Attributes	8 Bytes	Attributes are applicable for the data before next 'ETX'
Address /Data	Variable Bytes	Bitmap data in maximum 50 ASCII characters. Bitmap address in 10 ASCII characters.

*Note1 : The data in the protocol will be either ASCII which need ASCII to font conversion or address of the BMP file. This basic nature is to be declared in the attributes for the field.
This decides which way the data is to be processed.
A suitable frame or screen is then prepared for overall line area. If it fits into matrix of the display then acknowledge is given. No of columns are thus automatically adjusted.

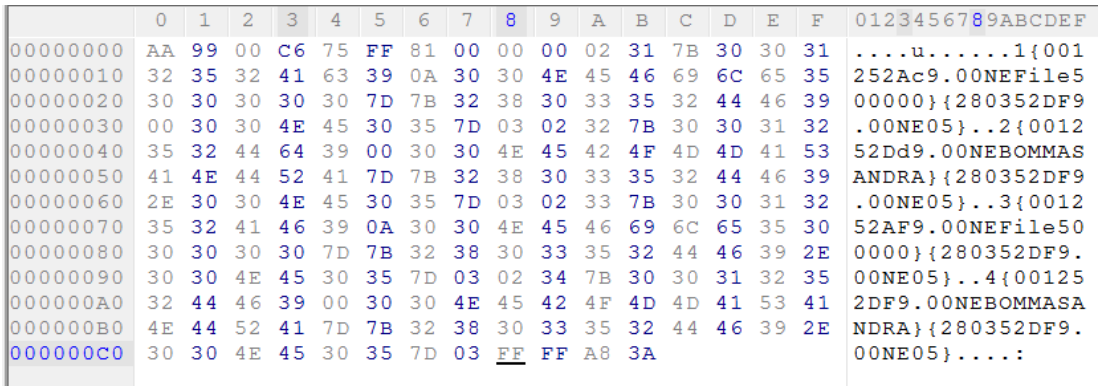
3.4 Sample Packets:

1. Four line and 2 field packet.



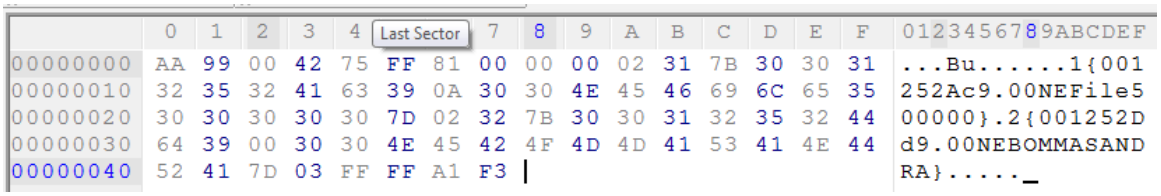
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
00000000	AA	99	00	C6	75	FF	81	00	00	00	02	31	7B	30	30	31	....u.....1{001
00000010	32	35	32	41	42	39	0A	30	30	4E	45	46	69	6C	65	35	252AB9.00NEFile5
00000020	30	30	30	30	30	7D	7B	32	38	30	33	35	32	44	46	39	00000}{280352DF9
00000030	00	30	30	4E	45	30	32	7D	03	02	32	7B	30	30	31	32	.00NE02}..2{0012
00000040	35	32	44	42	39	00	30	30	4E	45	42	4F	4D	4D	41	53	52DB9.00NEBOMMAS
00000050	41	4E	44	52	41	7D	7B	32	38	30	33	35	32	44	46	39	ANDRA}{280352DF9
00000060	2E	30	30	4E	45	30	32	7D	03	02	33	7B	30	30	31	32	.00NE02}..3{0012
00000070	35	32	41	42	39	0A	30	30	4E	45	46	69	6C	65	35	30	52AB9.00NEFile50
00000080	30	30	30	30	7D	7B	32	38	30	33	35	32	44	46	39	2E	0000}{280352DF9.
00000090	30	30	4E	45	30	32	7D	03	02	34	7B	30	30	31	32	35	00NE02}..4{00125
000000A0	32	44	42	39	00	30	30	4E	45	42	4F	4D	4D	41	53	41	2DB9.00NEBOMMASA
000000B0	4E	44	52	41	7D	7B	32	38	30	33	35	32	44	46	39	2E	NDRA}{280352DF9.
000000C0	30	30	4E	45	30	32	7D	03	FF	FF	55	5F					00NE02}...U_

2. Four line and 2 field packet.



	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
00000000	AA	99	00	C6	75	FF	81	00	00	00	02	31	7B	30	30	31	....u.....1{001
00000010	32	35	32	41	63	39	0A	30	30	4E	45	46	69	6C	65	35	252Ac9.00NEFile5
00000020	30	30	30	30	30	7D	7B	32	38	30	33	35	32	44	46	39	00000}{280352DF9
00000030	00	30	30	4E	45	30	35	7D	03	02	32	7B	30	30	31	32	.00NE05}..2{0012
00000040	35	32	44	64	39	00	30	30	4E	45	42	4F	4D	4D	41	53	52Dd9.00NEBOMMAS
00000050	41	4E	44	52	41	7D	7B	32	38	30	33	35	32	44	46	39	ANDRA}{280352DF9
00000060	2E	30	30	4E	45	30	35	7D	03	02	33	7B	30	30	31	32	.00NE05}..3{0012
00000070	35	32	41	46	39	0A	30	30	4E	45	46	69	6C	65	35	30	52AF9.00NEFile50
00000080	30	30	30	30	7D	7B	32	38	30	33	35	32	44	46	39	2E	0000}{280352DF9.
00000090	30	30	4E	45	30	35	7D	03	02	34	7B	30	30	31	32	35	00NE05}..4{00125
000000A0	32	44	46	39	00	30	30	4E	45	42	4F	4D	4D	41	53	41	2DF9.00NEBOMMASA
000000B0	4E	44	52	41	7D	7B	32	38	30	33	35	32	44	46	39	2E	NDRA}{280352DF9.
000000C0	30	30	4E	45	30	35	7D	03	FF	FF	A8	3A					00NE05}....:

3. 2 line and 1 field packet.



	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
00000000	AA	99	00	42	75	FF	81	00	00	00	02	31	7B	30	30	31	...Bu.....1{001
00000010	32	35	32	41	63	39	0A	30	30	4E	45	46	69	6C	65	35	252Ac9.00NEFile5
00000020	30	30	30	30	30	7D	02	32	7B	30	30	31	32	35	32	44	00000}.2{001252D
00000030	64	39	00	30	30	4E	45	42	4F	4D	4D	41	53	41	4E	44	d9.00NEBOMMASAND
00000040	52	41	7D	03	FF	FF	A1	F3									RA}....._

4. 2 line and 1 field packet.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
00000000	AA	99	00	46	75	FF	81	00	00	00	02	31	7B	30	30	31	...Fu.....1{001
00000010	32	35	32	41	63	39	0A	30	30	4E	45	46	69	6C	65	35	252Ac9.00NEFile5
00000020	30	30	30	30	30	7D	02	32	7B	30	30	31	32	35	32	44	00000}.2{001252D
00000030	64	39	00	30	30	4E	45	70	75	6E	65	20	74	6F	20	6D	d9.00NEpune to m
00000040	75	6D	62	61	69	00	7D	03	FF	FF	D5	20					umbai.}...._

5. 1 line and 1 field packet.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
00000000	AA	99	00	24	75	FF	81	00	00	00	02	31	7B	30	30	31	...$u.....1{001
00000010	32	35	32	41	63	39	0A	30	30	4E	45	46	69	6C	65	35	252Ac9.00NEFile5
00000020	30	30	30	30	30	7D	FF	FF	9A	2D							00000}._.-

3.5 Response function:

Header 1	Header 2	Packet status		Serial number	Packet status	Response code	Data	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
0xAA	0x99	MSB byte	LSB byte	Packet no.	0x00/0xFF	0xC1	Response packet status	0xFF	0xFF	MSB byte	LSB byte
					0x00 packet in continuation						
					0xFF Last Packet						

- **Details of Individual Bytes of V7.1 Protocols:**

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Response Code	1 Byte	Bit indicates a function code of packet i.e. Display Data response code 0x0C
Data	1 Bytes	1 Byte: (Note: consider Table 2.2 Packet Status)
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

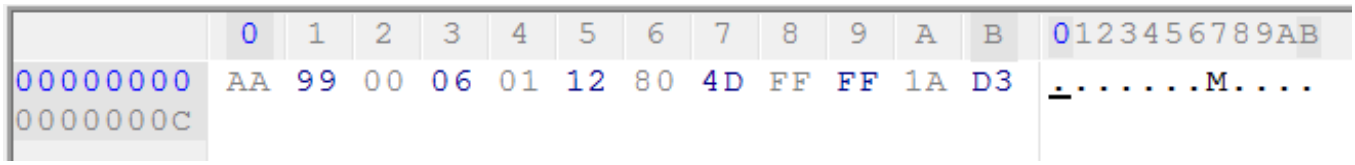
4. Protocol Format of Link Check.

Header 1	Header 2	Length (LOP MSB to Data)		Serial number	Packet status	Response code	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 byte
0xAA	0x99	MSB byte	LSB byte	Packet no.	0x00/0xFF	0x80	0xFF	0xFF	MSB byte	LSB byte

4.1 Details of Individual Bytes:

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Function Code	1 Byte	Bit indicates a function code of packet i.e. link check Response code 0x80.
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

Sample Packet:



	0	1	2	3	4	5	6	7	8	9	A	B	0123456789AB
00000000	AA	99	00	06	01	12	80	4D	FF	FF	1A	D3	.....M....
0000000C													

4.2 Response function:

Header 1	Header 2	Packet length		Serial number	Packet status	Response code	Data -4 byte				Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte first byte	1 byte 2nd byte	1 byte- 3rd byte	1 byte- fourth byte	1 byte	1 byte	1 byte	1 byte
0xAA	0x99	MSB byte	LSB byte	Packet no.	0x00/ 0xFF	0x0C	Line 1 status	Line 2 status	Line 3 status	Line 4 status	0xFF	0xFF	MSB byte	LSB byte

Details of Individual Bytes:

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Response Code	1 Byte	Bit indicates a function code of packet i.e. link check Function code 0xC0.
Data	4 Bytes	1st Byte: line 1 status (00 line failure, 01 line Ok, 02 matrix failure) 2nd Byte: line 2 status (00 line failure, 01 line Ok, 02 matrix failure) 3rd Byte: line 3 status (00 line failure, 01 line Ok, 02 matrix failure) 4th Byte: line 4 status (00 line failure, 01 line Ok, 02 matrix failure)
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)

Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is “x16+x12+x5+1” and its hex value is 1021

6. Protocol Format for start command.

Header 1	Header 2	Packet length		Serial Number	Packet status	Response code	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
0xAA	0x99	MSB byte	LSB byte	Packet No.	0x00/0xFF	0x83	0xFF	0xFF	MSB byte	LSB byte

Details of Individual Bytes:

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Response Code	1 Byte	Bit indicates a function code of packet i.e. start command Function code 0x83.
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

Sample Packet :

```
          0  1  2  3  4  5  6  7  8  9  A  0123456789A
00000000  AA 99 00 05 FF 1F 03 FF FF 41 04 .........A.
0000000B
```

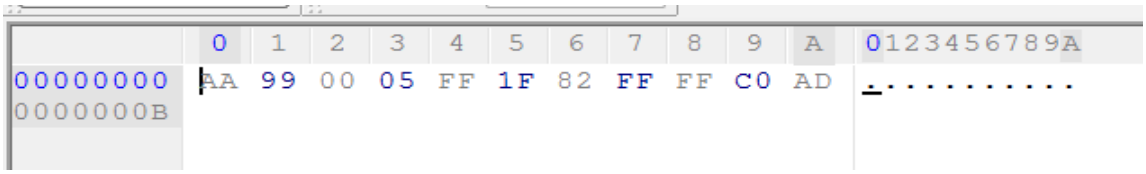
6. Protocol Format for stop command.

Header 1	Header 2	Packet length		Serial Number	Packet status	Response code	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
0xAA	0x99	MSB byte	LSB byte	Packet No.	0x00/0xFF	0x82	0xFF	0xFF	MSB byte	LSB byte

Details of Individual Bytes:

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Response Code	1 Byte	Bit indicates a function code of packet i.e. start command Response code 0x82.
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in. CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

Sample Packet :



7 . Protocol Format for LED Test Pattern

Header 1	Header 2	Packet Length (LOP MSB to Data Last		Serial Number	Packet Status	Function Code	Data	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes	1 Byte	1 Byte	1 byte	1 byte
0xAA	0X99	MSB byte	LSB byte	Packet No	0x00/0xFF	0x8C		0xFF	0xFF	MSB byte	LSB byte

1st byte	2nd byte	
0x00	0x00	All LED On
	0x01	All LED off
	0x02	Alternate Row on
	0x03	Alternate row off
	0x04	Alternate column on
	0x05	Alternate column off
	0x06	Diagnol row on
	0x07	Diagnol row off

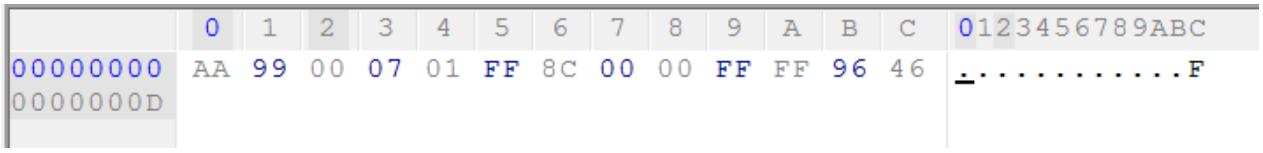
- **Details of Individual Bytes:**

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Function Code	1 Byte	Bit indicates a function code of packet i.e. LED Test Pattern Function code 0x8C.

Data	2 Bytes	1st byte : Hex Value 0x00 2nd byte : All LED On (Hex Value: 0x00) All LED off (Hex Value: 0x01) Alternate Row on (Hex Value: 0x02) Alternate row off (Hex Value: 0x03) Alternate column on (Hex Value: 0x04) Alternate column off (Hex Value: 0x05) Diagnol row on (Hex Value: 0x06) Diagnol row on (Hex Value: 0x07)
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is “x16+x12+x5+1” and its hex value is 1021

Sample packets:

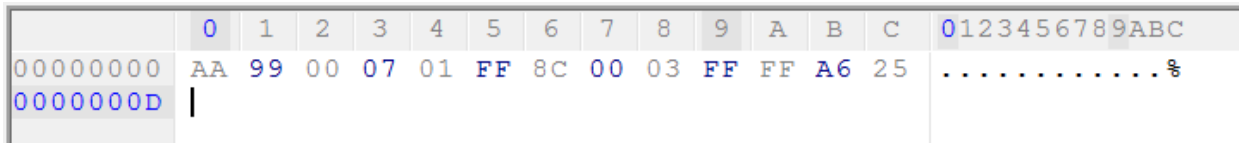
1. All LED On.



2. All LED Off.

3. Alternate Row On

4. Alternate row off

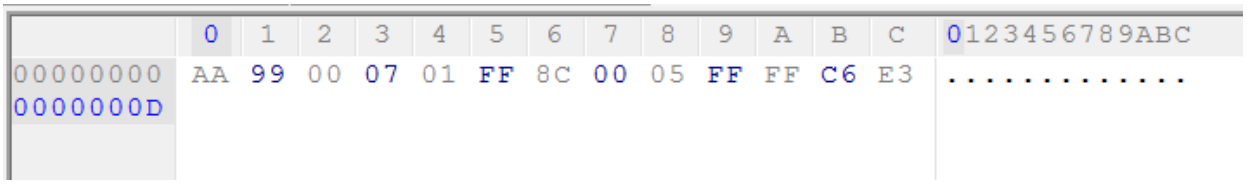


	0	1	2	3	4	5	6	7	8	9	A	B	C	0123456789ABC
00000000	AA	99	00	07	01	FF	8C	00	03	FF	FF	A6	25	.....%
0000000D														

5. Alternate column on

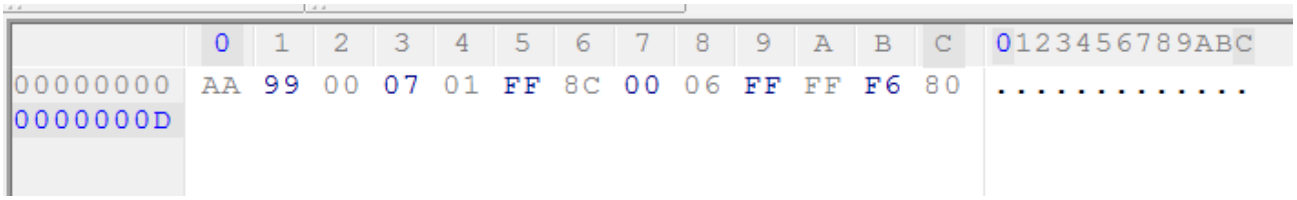
	0	1	2	3	4	5	6	7	8	9	A	B	C	0123456789ABC
00000000	AA	99	00	07	01	FF	8C	00	04	FF	FF	D6	C2	.....
0000000D														

6. Alternate column off



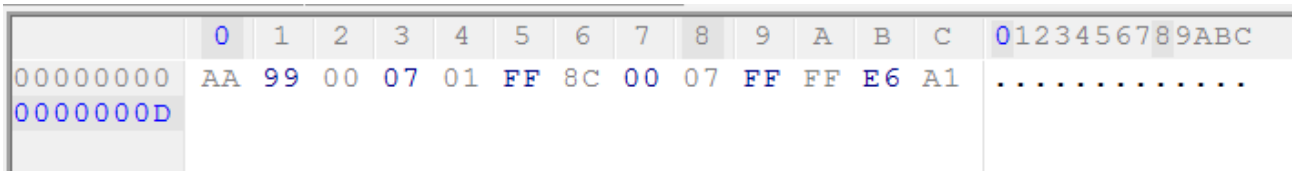
	0	1	2	3	4	5	6	7	8	9	A	B	C	0123456789ABC
00000000	AA	99	00	07	01	FF	8C	00	05	FF	FF	C6	E3	.....
0000000D														

7. Diagnol row on



	0	1	2	3	4	5	6	7	8	9	A	B	C	0123456789ABC
00000000	AA	99	00	07	01	FF	8C	00	06	FF	FF	F6	80	.....
0000000D														

8. Diagnol row on



	0	1	2	3	4	5	6	7	8	9	A	B	C	0123456789ABC
00000000	AA	99	00	07	01	FF	8C	00	07	FF	FF	E6	A1	.....
0000000D														

7.1 Response Code For LED Test Pattern.

Header 1	Header 2	Packet length		Serial Number	Packet status	Response code	Data	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
0xAA	0x99	MSB byte	LSB byte	Packet No.	0x00/0xFF	0xCC	Response packet status	0xFF	0xFF	MSB byte	LSB byte

- **Details of Individual Bytes:**

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Response Code	1 Byte	Bit indicates a Response code of packet i.e. LED Test Pattern Response code 0xCC.
Data	1 Bytes	1 byte : Packet status
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1.MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

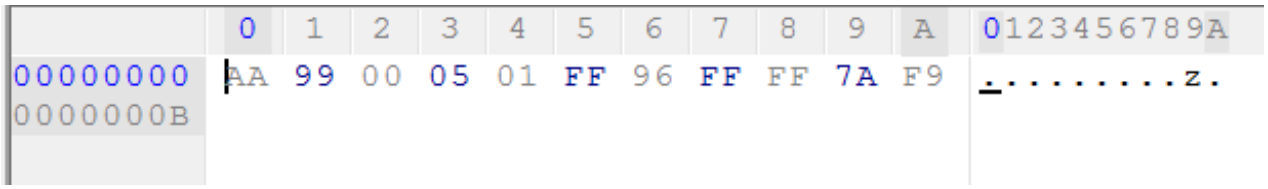
9. Protocol Format for RTC Function code.

Header 1	Header 2	Packet length (LOP MSB to LOP LSB)		Serial number	Function code	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
0xAA	0x99	MSB byte	LSB byte	Packet no.	0x96	0xFF	0xFF	MSB byte	LSB byte

- **Details of Individual Bytes:**

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Function Code	1 Byte	Byte indicates a function code of packet i.e. RTC Function code 0x96.
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 1. Checksum MSB 2. Checksum LSB	2 Byte	1. MSB is a bit of the highest digit in checksum. 2. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the Bytes starting from Length MSB to last byte stored in. CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

Sample Packets:



- **Response Function Code for RTC**

Header 1	Header 2	Packet length		Serial number	Packet status	Response code	Data -1 byte	Footer 1	Footer 2	Checksum MSB	Checksum LSB
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
0xAA	0x99	MSB byte	LSB byte	Packet no.	0x00/ 0xFF	0xD6	0x00	0xFF	0xFF	MSB byte	LSB byte

Byte Name	Size	Detail
Header 1	1 Byte	Most significant Bit of Header (Hex Value - 0xAA)
Header 2	1 Byte	Least significant bit of Header. (Hex value -0x99)
Packet Length (LOP MSB to Data Last byte)	1 Byte (MSB) 1 Byte (LSB)	It is a length of Packet and it is calculated as select line of packet it contain 2 bytes LSB and MSB, MSB is a bit of the highest digit, and the LSB is a bit of the lowest digit
Serial number	1 Byte	2 digit ASCII value indicate current packet number. In case of multiple packet telegram, It starts with ASCII " 01" and increments by one count up to "99"
Packet Status	1 Byte	It Shows packet status it can be 0x00/0xFF. 0x00 Packet in continuation 0xFF Last Packet
Response Code	1 Byte	Bit indicates a function code of packet i.e. RTC response code 0xD6
Footer 1	1 Byte	Most significant Bit of Header (Hex Value - 0xFF)
Footer 2	1 Byte	Least significant bit of Header. (Hex value -0xFF)
Checksum 3. Checksum MSB 4. Checksum LSB	2 Byte	3. MSB is a bit of the highest digit in checksum. 4. LSB is a bit of the lowest digit in Checksum. CRC is 16-bit value. This is calculated as CRC of all the bytes starting from Length MSB to last byte stored in CRC-16-CCITT (also known as CRC-CCITT) is used for data integrity. The polynomial of CRC-16 is "x16+x12+x5+1" and its hex value is 1021

9. Steps for sending the packet with Hercules Tool is mentioned below:

1. Here our system works as a server.
2. Enter module IP address **"192.168.1.xyz"**, and port **"5000"**
3. And click on connect.
2. Paste the copied hex code in the hex option of the Hercules Tool.
3. Then send the packet by clicking on the send option next to Hex.