EEI TECHNOLOGY ElecStudio | 05P-FLUORITE

EPC-INBM32V1607UD

PRODUCT SPECIFICATION

VACUUM FLUORESCENT DISPLAY MODULE

P/N : EPC-INBM32V1607UD
MODEL : EVC16X02-DWP2K

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REV	DATE	Description	REMARK
REV 1.0	JUN-09-2023	ORIGNAL	
REV 1.1	JUN-11-2023	Add CGRAM operation instructions	
REV 1.2	JUN-12-2023	Change BUSY signal timing	
REV 1.3	JUN-14-2023	Change SPI communication timing and Write DCRAM,ADRAM,CGRAM Command	0x10,0x20, 0x30,0x40 Change 0xCA,0xCB 0xCC,0xCD
REV 1.4	JUN-25-2023	Change BUSY signal timing	

Document status	Drawn By	Checked By	Confirmed by
Public	X.A.C.T	Rise	X.A.C.T

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EPC-INBM32V1607UD

16x2ROW UNIVERSAL VFD 5X7 CHARACTER DOTMATRIX

Features

- On board ultra fast Cortex-M0+ CPU.
- On board wide voltage IO level shift (1.65-5.5V).
- Standard ASCII Font CGROM with 16x2Group CGRAM.
- 255 Step Brightness Adjust.
- Maximum Power consumption as low as 2W.
- Wide Voltage Input 4.5 - 24V.
- Optional UART or SPI Communication Interface.

Applications

- Audio equipment.
- industrial equipment
- Instrumentation.
- Alarm clock
- Car Radio

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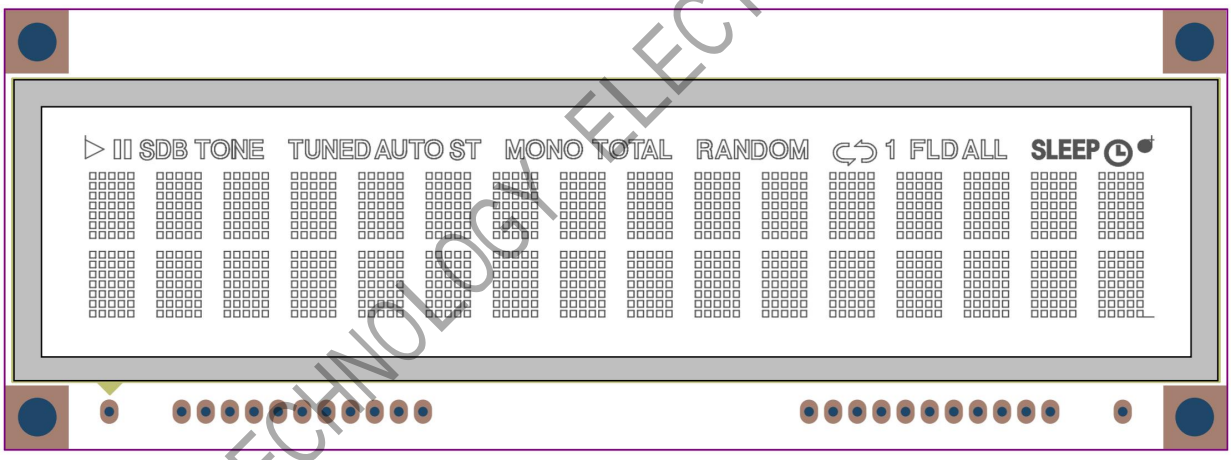
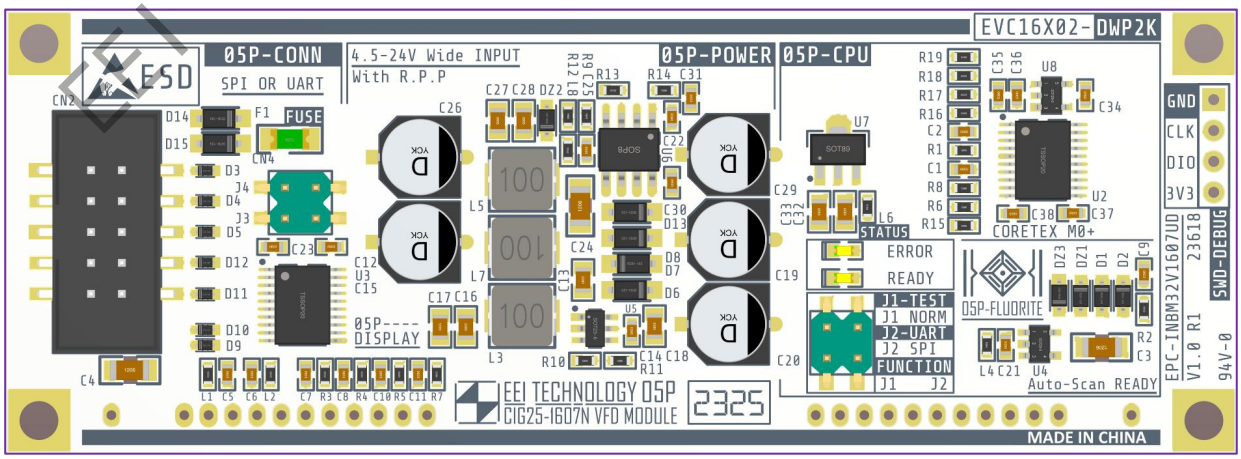
MODULE DIAGRAM (TOP)



MODULE DIAGRAM (BOTTOM)



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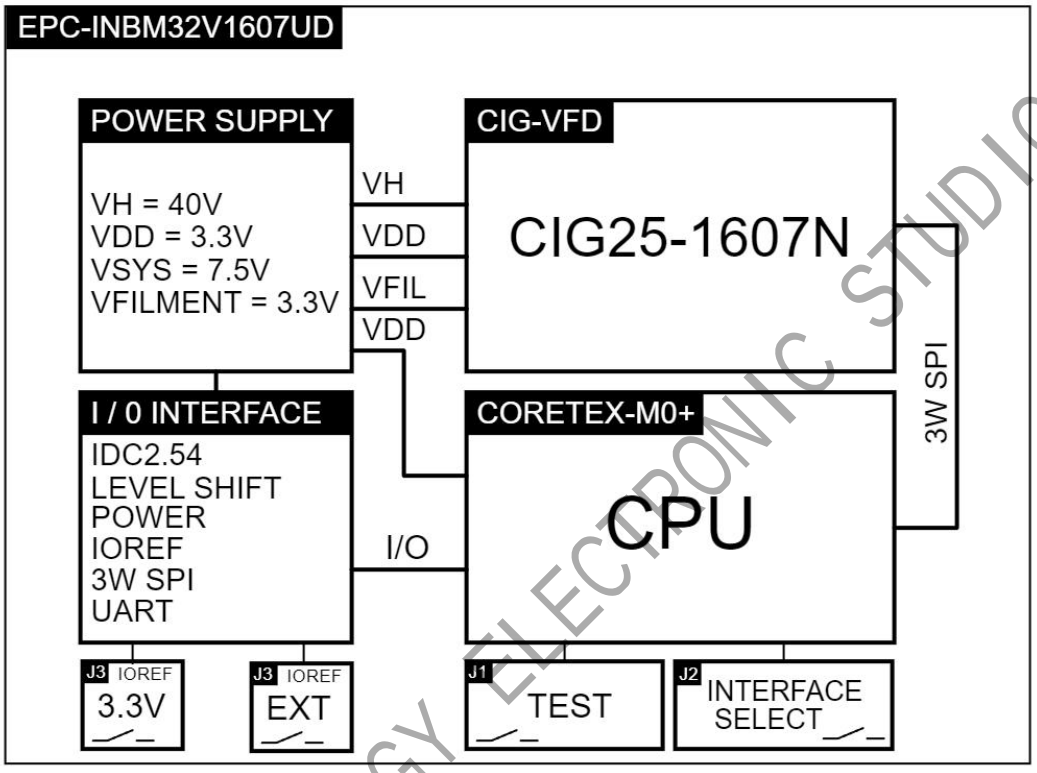
Function DIAGRAM

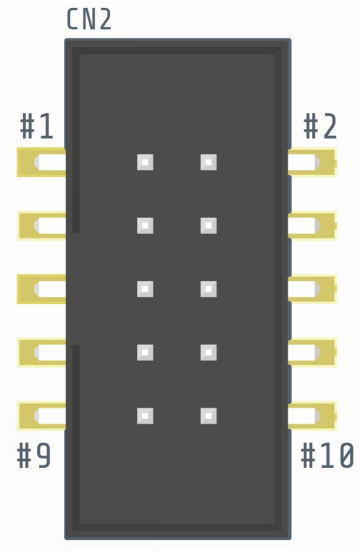


INTERFACE DIAGRAM(CN2)

Pin NO.	NAME	Pin NO.	NAME
1	VIN+	2	BUSY
3	IOREF	4	UART_RX
5	VIN-	6	UART_TX
7	SPI_CS	8	SPI_DIN
9	RESET	10	SPI_SCK

Note:

* Do not hot plug this connector.
* Attention to electrostatic protection.
* When using an external IO reference, the "IOREF" pin must not be left floating.



B-3000N10P-0110(Ckmtw)

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Pin Function

Pin		I/O	Description
Name	NO.		
VIN+	1	INPUT	Power input
BUSY	2	OUTPUT	Busy signal output,high active.
IOREF	3	INPUT	IO Port reference voltage input.
UART_RX	4	INPUT	USART Data input.
VIN-	5	--	Ground.
UART_TX	6	OUTPUT	USART Data output.
SPI_CS	7	INPUT	SPI chip select,low active.
SPI_DIN	8	INPUT	SPI data input,LSB First.
RESET	9	INPUT	Module reset,low active.
SPI_SCK	10	INPUT	SPI clock input.

Absolute Maximum Ratings

*Exceeding absolute maximum ratings can cause permanent damage to the module

Item	Min	Max	Unit
VIN+ to GND	-0.3	24	V
IOREF to GND	-0.3	5.5	V
BUSY,IOREF,UART(TX,RX),SPI(DIN,SCK,CS),RESET	-0.3	IOREF+0.3	V
Working temperature	-20	70	°C
Storage temperature	-40	80	°C

Recommended Operating Conditions

Item	Min	Max	Unit
Power input	4.5	20	V
IOREF	1.8	5	V
BUSY,IOREF,UART(TX,RX),SPI(DIN,SCK,CS),RESET	1.8	IOREF	V
Working temperature	-20	55	°C
Storage temperature	-20	70	°C

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Electrical Characteristics

Parameter		Test Conditions	Min	Typ	Max	Unit
DISPLAY POWER SUPPLY						
I_{STDBY1}	VIN Standby Current	VIN = 5V, Power OFF	--	30	35	mA
I_{STDBY2}	VIN Standby Current	VIN = 5V, Power ON, ALL Clear, DIMMING Set 255	--	360	380	mA
I_{ON}	VIN POWER ON Current	VIN = 5V, Power ON, ALL Light, DIMMING Set 255	--	400	420	mA
		VIN = 12V, Power ON, ALL Light, DIMMING Set 255	--	160	165	mA
		VIN = 24V, Power ON, ALL Light, DIMMING Set 255	--	70	72	mA
UNDERVOLTAGE PROTECTION						
V_{UVP}	UVLO Voltage		2.9	3.8	--	V
IO PORT REFERENCE						
V_{IOREF}			1.65	--	5.5	V
LOGIC LEVEL						
V_{IL} max	Logic Low Threshold	V_{IOREF} = 1.65 - 5.5V	0	--	0.15	V
V_{IH} min	Logic High Threshold	V_{IOREF} = 1.65 - 1.95V	V_{IOREF} -0.2	--	V_{IOREF}	V
		V_{IOREF} > 1.95V	V_{IOREF} -0.4	--	V_{IOREF}	V
I_I	Input leakage current	V_{IOREF} = 1.65 - 5.5V	1	--	1.5	uA
I_{OK}	Output clamp current		--	--	25	mA
DATA INTERFACE						
B_{URAT}	USART Baud rate		--	115200	--	bps
F_{CLK}	SPI Clock Frequency		--	--	5	MHz
T_{PR}	Power on Reset Time		20	--	--	ms
T_{RW}	Reset Hold Time		1	--	--	ms
T_{RTH}	Reset Wait Time		55	--	--	ms
DISPLAY						
Scan frequency			--	97	--	Hz
Luminance		DIMMING Set 255	390	400	420	lux
		DIMMING Set 100	130	150	155	lux
ESD RATINGS						
V_{ESD}	Electrostatic discharge	Per human-body model	--	--	16	KV
		Air discharge	-15	--	15	KV
		Contact discharge	-8	--	8	KV

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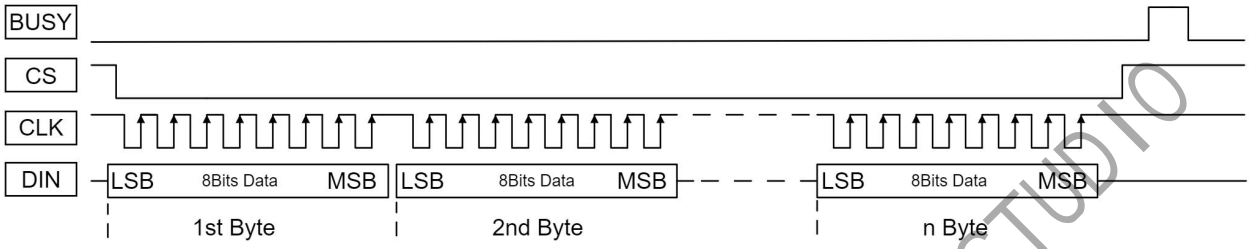
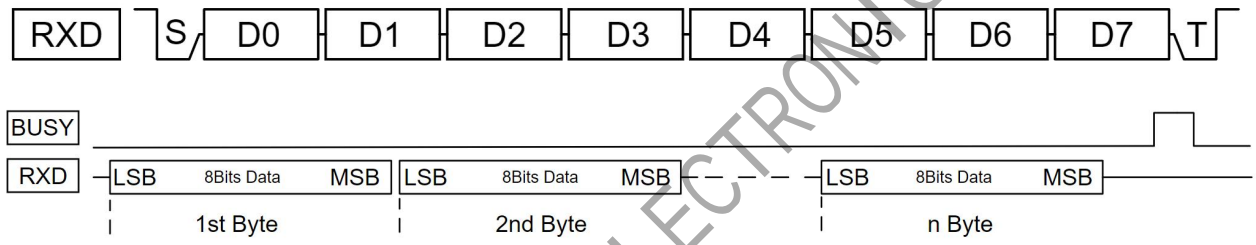
Serial Data Transmission Timing Chart

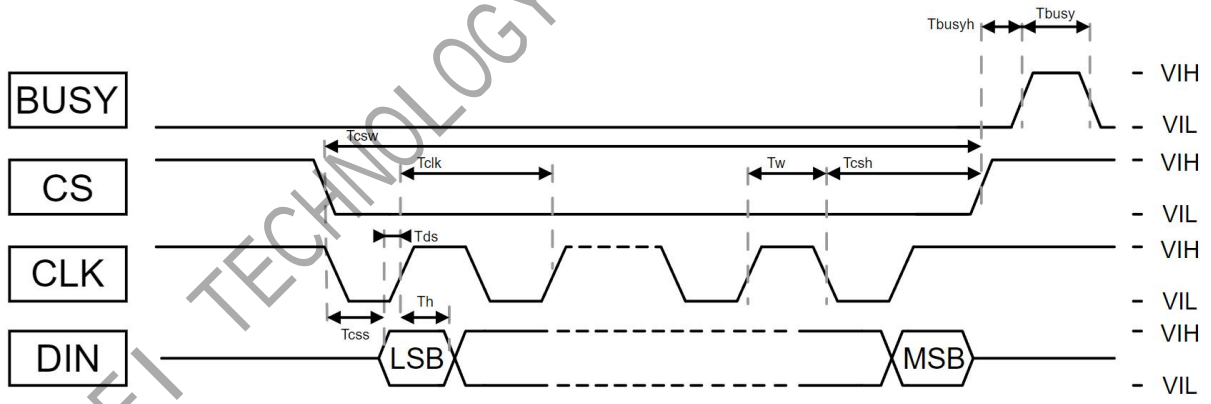
SPI(One Command)



USART(One Command)



AC Characteristics(SPI)



Item	Symbol	Condition	Min	Max	Unit
CLK Frequency	Tclk	SPI Mode,IOREF=3.3V	--	5	MHz
CLK Pulse width	Tw		200	--	ns
Data Setup Time	Tds		100	--	ns
DIN Hold Time	Th		10	--	ns
CS Setup Time	Tcss		200	--	ns
CS Hold Time	Tcsh		200	--	ns
CS Wait Time	Tcsw		120	--	ns
Data Processing Time	Tbusy		--	120	us
Data Wait Time	Tbusyh		5	10	ns

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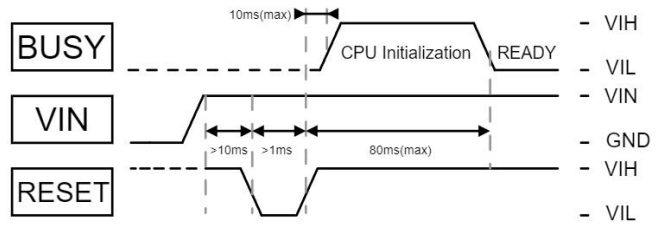
RESET Timing Chart

Timing Chart



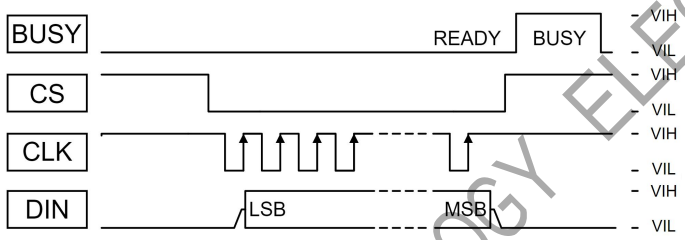
Note:

(1)A reset is required before the module is powered on.

(2)After completing the reset operation, it is necessary to wait for the CPU initialization to be completed. At this time, the "BUSY" signal will be enabled. During this period, the data received by the CPU will be invalid. Therefore, it is necessary to send data to the module after "BUSY" is disabled.

BUSY Signal output

Timing Chart



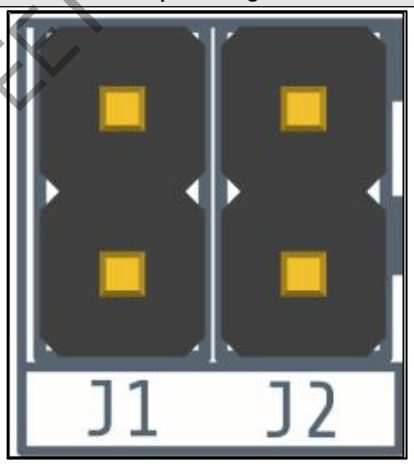
Note:

(1) When the data transmission is completed, the signal output indicates the data processing status.

(2) While the signal is enabled, any data received by the CPU will be invalidated, so be sure to transmit data after the signal is disabled.

Function configuration(1-2)

Interface & test mode configuration

Jumper diagram	Configuration	Function
	J1 OPEN	Power on entry normal mode
	J1 SHORT	Power on entry test mode
	J2 OPEN	Select SPI Interface
	J2 SHORT	Select USART Interface
	Note: (1) Attention to electrostatic protection. (2) Do not move the jumper while working. (3) If it is configured in the power-on state, the configuration will take effect after reset.	

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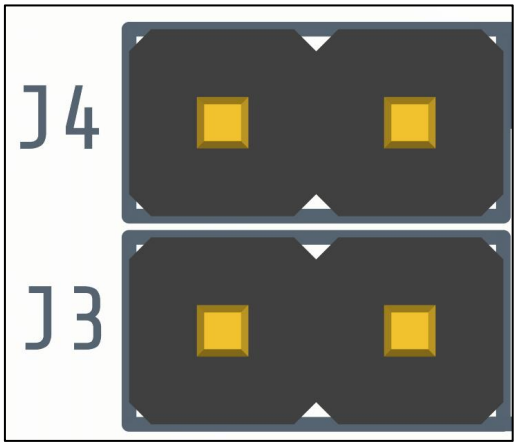
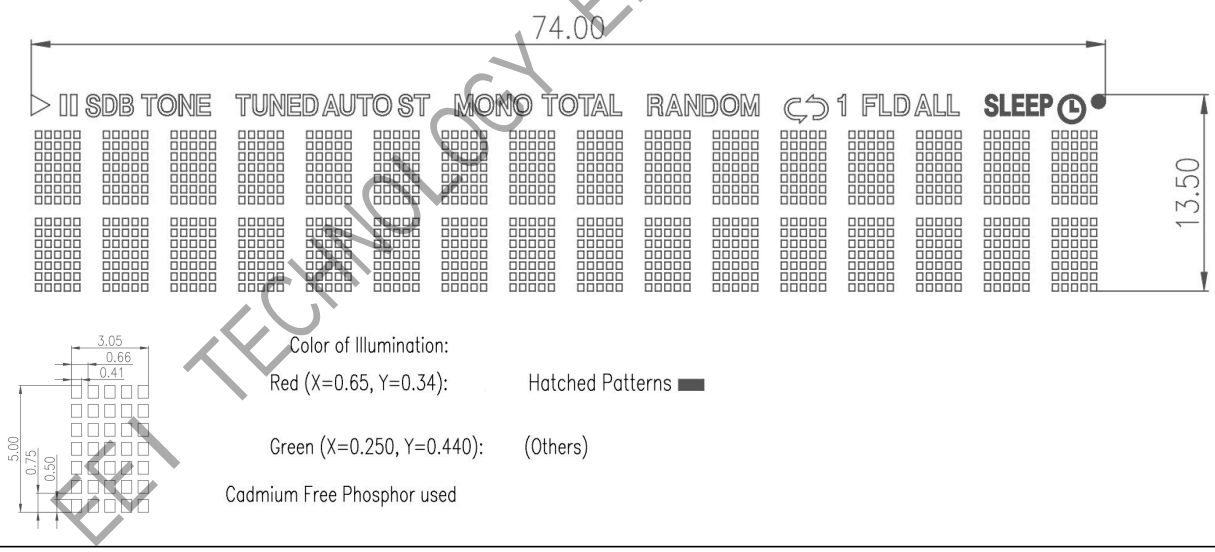
Function configuration(2-2)

IO Port reference configuration

Jumper diagram	Configuration	Function
	J3 OPEN	Select +3V3 reference
	J4 SHORT	
	J3 SHORT	Select external reference
	J4 OPEN	
	Note: (1) Attention to electrostatic protection. (2) Do not move the jumper while working.	

Pattern Details



Overview of software functions

Item	Description
DCRAM Quantity	32(16x2Row).
CGRAM Quantity	
CGROM Font Table	Standard ASCII Font.
ADRAM Quantity	20(4x5Group).
Brightness level control	255Step.
Standby Mode	Filament driver Enable control.

EEI TECHNOLOGY ELECTRONIC STUDIO

Command List

NO.	Command	Byte	MSB							LSB	Hex	Description
			B7	B6	B5	B4	B3	B2	B1	B0		
1	DISPCLR	1st	0	1	0	1	0	1	0	1	0x55	Clear Display.
2	PWRCTR	1st	1	0	1	1	0	0	0	1	0xB1	Display Power control Command.
		2nd	0	0	0	0	0	0	0	EN	--	EN = 0 Power OFF, EN = 1 Power ON.
3	DIMMCTR	1st	1	0	1	0	0	0	0	0	0xA0	Set display brightness Command.
		2nd	L7	L6	L5	L4	L3	L2	L1	L0	--	Brightness level.
4	CURCFG	1st	1	0	1	0	0	0	0	1	0xA1	Cursor configuration Command.
		2nd	--	--	--	--	E1	E0	B1	B0	--	En = Row0/Row1 Cursor Enable. Bn = Row0/Row1 Cursor Blink Enable.
5	CURPOS	1st	1	0	1	0	0	0	1	0	0xA2	Set cursor position Command.
		2nd	0	0	0	0	0	0	0	SR	--	SR = 0, select Row0. SR = 1, select Row1.
		3rd	0	0	0	0	P3	P2	P1	P0	--	Cursor position.
6	ADRAMWR	1st	1	1	0	0	1	1	0	0	0xCC	Write auxiliary drive RAM Command.
		2nd	0	0	0	0	0	A2	A1	A0	--	Select auxiliary drive start Address.
		3rd	--	--	--	--	D3	D2	D1	D0	--	Write auxiliary drive Data.
		--	--	--	--	--	--	--	--	--	--	Note: This command supports
		n.Byte	--	--	--	--	D3	D2	D1	D0	--	continuous write
7	CGRAMWR	1st	1	1	0	0	1	1	0	1	0xCD	Write custom memory Command.
		2nd	0	0	0	0	0	0	0	SR	--	SR = 0, select Row0. SR = 1, select Row1.
		3rd	0	0	0	0	A3	A2	A1	A0	--	Select custom memory Address.
		4th	--	D6	D5	D4	D3	D2	D1	D0	--	Write 5X7 matrix COM1 Data.
		5th	--	D14	D13	D12	D11	D10	D9	D8	--	Write 5X7 matrix COM2 Data.
		6th	--	D22	D21	D20	D19	D18	D17	D16	--	Write 5X7 matrix COM3 Data.
		7th	--	D30	D29	D28	D27	D26	D25	D24	--	Write 5X7 matrix COM4 Data.
		8th	--	D38	D37	D36	D35	D34	D33	D32	--	Write 5X7 matrix COM5 Data.
8	DCRAM0WR	1st	1	1	0	0	1	0	1	0	0xCA	Write Row0 DCRAM Command.
		2nd	0	0	0	0	A3	A2	A1	A0	--	Select Row0 DCRAM start Address.
		3rd	D7	D6	D5	D4	D3	D2	D1	D0	--	Write DCRAM Data.
		--	--	--	--	--	--	--	--	--	--	Note: This command supports
		n.Byte	D7	D6	D5	D4	D3	D2	D1	D0	--	continuous write
8	DCRAM1WR	1st	1	1	0	0	1	0	1	1	0xCB	Write Row1 DCRAM Command.
		2nd	0	0	0	0	A3	A2	A1	A0	--	Select DCRAM start Address.
		3rd	D7	D6	D5	D4	D3	D2	D1	D0	--	Write DCRAM Data.
		--	--	--	--	--	--	--	--	--	--	Note: This command supports
		n.Byte	D7	D6	D5	D4	D3	D2	D1	D0	--	continuous write

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Command Summary

0x55	DISPCLR(Clear Display)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
DISPCLR	0	1	0	1	0	1	0	1	0x55
Parameter	--								--
Description	"-" Don't care (1) This command is used to clear the screen display. (2) DCRAM ADRAM will be cleared.								

0xB1	PWRCTR(Display Power Control)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
PWRCTR	1	0	1	1	0	0	0	1	0xB1
Parameter 1st	0	0	0	0	0	0	0	EN	--
Description	(1) This command is used to control the display drive power. (2) Power-on default state EN = 0. (3) EN = 0, Power OFF, EN = 1, Power ON.								

0xA0	DIMMCTR(Display brightness level Control)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
DIMMCTR	1	0	1	0	0	0	0	0	0xA0
Parameter 1st	L7	L6	L5	L4	L3	L2	L1	L0	--
Description	(1) This command is used to adjust the brightness of the display. (2) Power-on default state L[7:0] = 0xFF.								

0xA1	CURCFG(Cursor Configuration)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
CURCFG	1	0	1	0	0	0	0	1	0xA1
Parameter 1st	--	--	--	--	E1	E0	B1	B0	--
Description	(1) This command is used to configure the cursor. (2) Power-on default state E[1:0], B[1:0] = 0x00. (3) E1/E0 : Row1/Row0 Cursor Enable control. (4) B1/B0 : Row1/Row0 Cursor Blink Enable control.								

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0xA2	CURPOS(Set Cursor Position)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
CURPOS	1	0	1	0	0	0	1	0	0xA2
Parameter 1st	0	0	0	0	0	0	0	SR	--
Data 1st	0	0	0	0	P3	P2	P1	P0	--
Description	(1) This command is used to set the cursor position. (2) Power-on default state SR, P[3:0] = 0x00. (3) SR : Select Row0/Row1, SR = 0 Row0, SR = 1, Row1. (4) P[3:0] Set cursor position.								

0xCC	ADRAMWR(Write auxiliary drive Register)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
ADRAMWR	1	1	0	0	1	1	0	0	0xCC
Parameter 1st	0	0	0	0	0	A2	A1	A0	--
Data 1st	--	--	--	--	D3	D2	D1	D0	--
--	--	--	--	--	--	--	--	--	--
Data n	--	--	--	--	D3	D2	D1	D0	--

Description

(1) This command is used to write the auxiliary driver register.
(2) The auxiliary driver is connected with the icon at the top of the screen.
(3) Power-on default state A[2:0], D[3:0] = 0x00.
(4) A[3:0] : Start address, D[3:0] Data.
(5) This command supports continuous write,When writing continuously, the address will increase automatically, and there is no need to reset the address.
(6) (Format : Start - COMM - PARAM - DATA0 - DATAn - End).
(7) The relationship between the icon and the data is shown in the figure below.

A[2:0] = 0x04	A[2:0] = 0x03	A[2:0] = 0x02	A[2:0] = 0x01	A[2:0] = 0x00	Data
○	ALL	RANDOM	ST	TONE	D0
	FLD	TOTAL	AUTO	SDB	D1
SLEEP	1	MONO	TUNED		D2
--		--	--		D3

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0xCD	CGRAMWR(Write custom memory)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
CGRAMWR	1	1	0	0	1	1	0	1	0xCD
Parameter 1st	0	0	0	0	0	0	0	SR	--
Parameter 2nd	0	0	0	0	A3	A2	A1	A0	--
Data 1st	--	D6	D5	D4	D3	D2	D1	D0	--
Data 2nd	--	D14	D13	D12	D11	D10	D9	D8	--
Data 3rd	--	D22	D21	D20	D19	D18	D17	D16	--
Data 4th	--	D30	D29	D28	D27	D26	D25	D24	--
Data 5th	--	D38	D37	D36	D35	D34	D33	D32	--

Description

(1) This command is used to write custom memory.

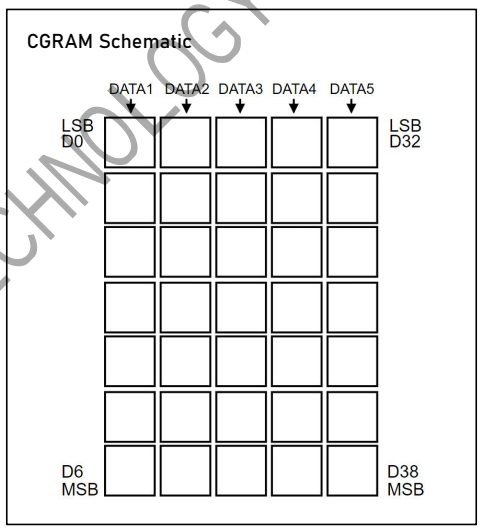
(2) The address of CGRAM (0x00-0x0F) will be mapped to the address of CGROM (0x00-0x0F). If DCRAM writes data within this range, the dot matrix corresponding to the address will point to CGRAM, that is, CGROM address = CGRAM address = A[3:0].

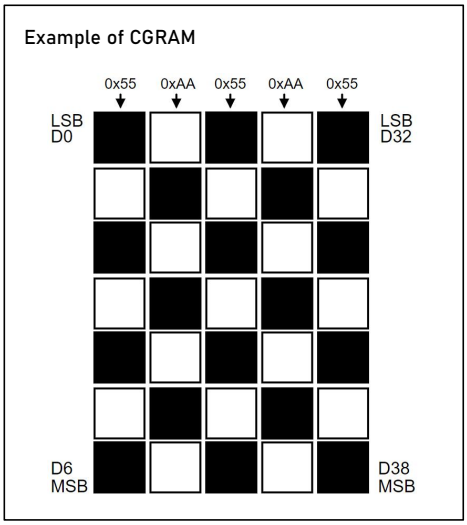
(3) Power-on default state SR, A[3:0] = 0x00.

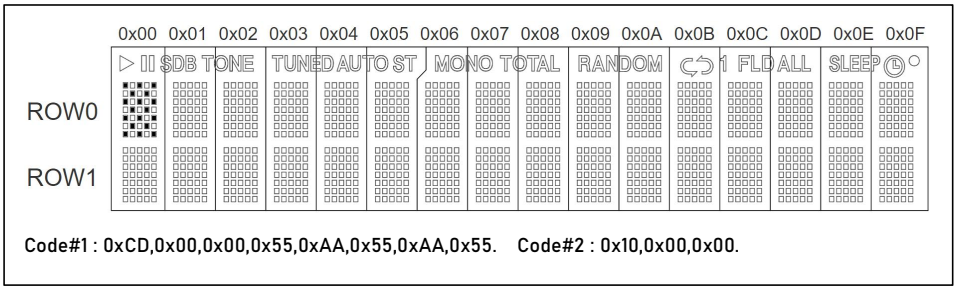
(4) A[3:0] : CGRAM Address, SR : Select Row0/Row1, SR = 0 Row0, SR = 1, Row1.

(5) This command does not support continuous writing. After the writing is completed, the address will not increase automatically. need to execute this command again.

(6) D[38:0] : CGRAM Matrix Data,The relationship between the data and the dot matrix is shown in the figure below.







Code#1 : 0xCD,0x00,0x00,0x55,0xAA,0x55,0xAA,0x55. Code#2 : 0x10,0x00,0x00.

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0xCA/0xCB	CGRAMWR(Write custom memory)								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
DCRAMWR	1	1	0	0	1	0	1	(CA/CB)	0xCA/0xCB
Parameter 1st	0	0	0	0	A3	A2	A1	A0	--
Data 1st	D7	D6	D5	D4	D3	D2	D1	D0	--
--	--	--	--	--	--	--	--	--	--
Data n	D7	D6	D5	D4	D3	D2	D1	D0	--

Description

(1) This command is used to write character generator.

(2) D[7:0] character mapping data, send the standard ASCII code to the module to display the corresponding character at the specified position.

(3) DCRAMWR = 0xCA : Write Row0 DCRAM Data.

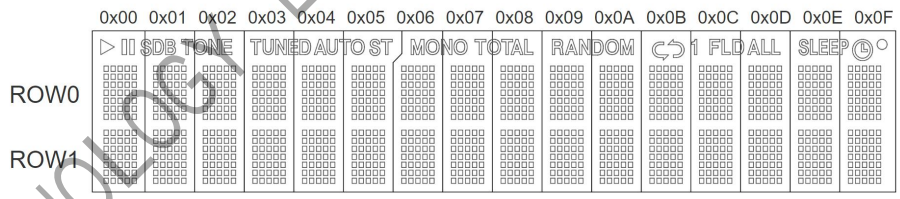
(4) DCRAMWR = 0xCB : Write Row1 DCRAM Data.

(5) A[3:0] : Starting position Address,The relationship between the address and the starting position is shown in the figure below.

(6) This command supports continuous write,When writing continuously, the address will increase automatically, and there is no need to reset the address.

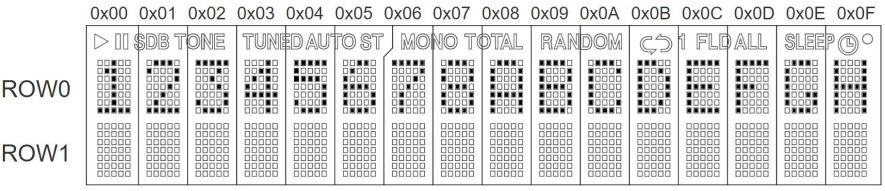
(7) Format : Start - COMM - PARAM - DATA0 - DATAn - End.

DCRAM Address



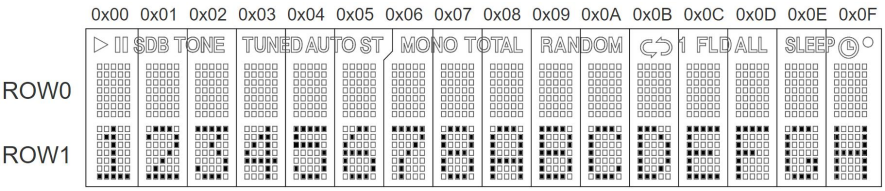
Example of DCRAM

Write Row0 16 characters



Code : 0xCA,0x00,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48

Write Row1 16 characters



Code : 0xCB,0x00,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48

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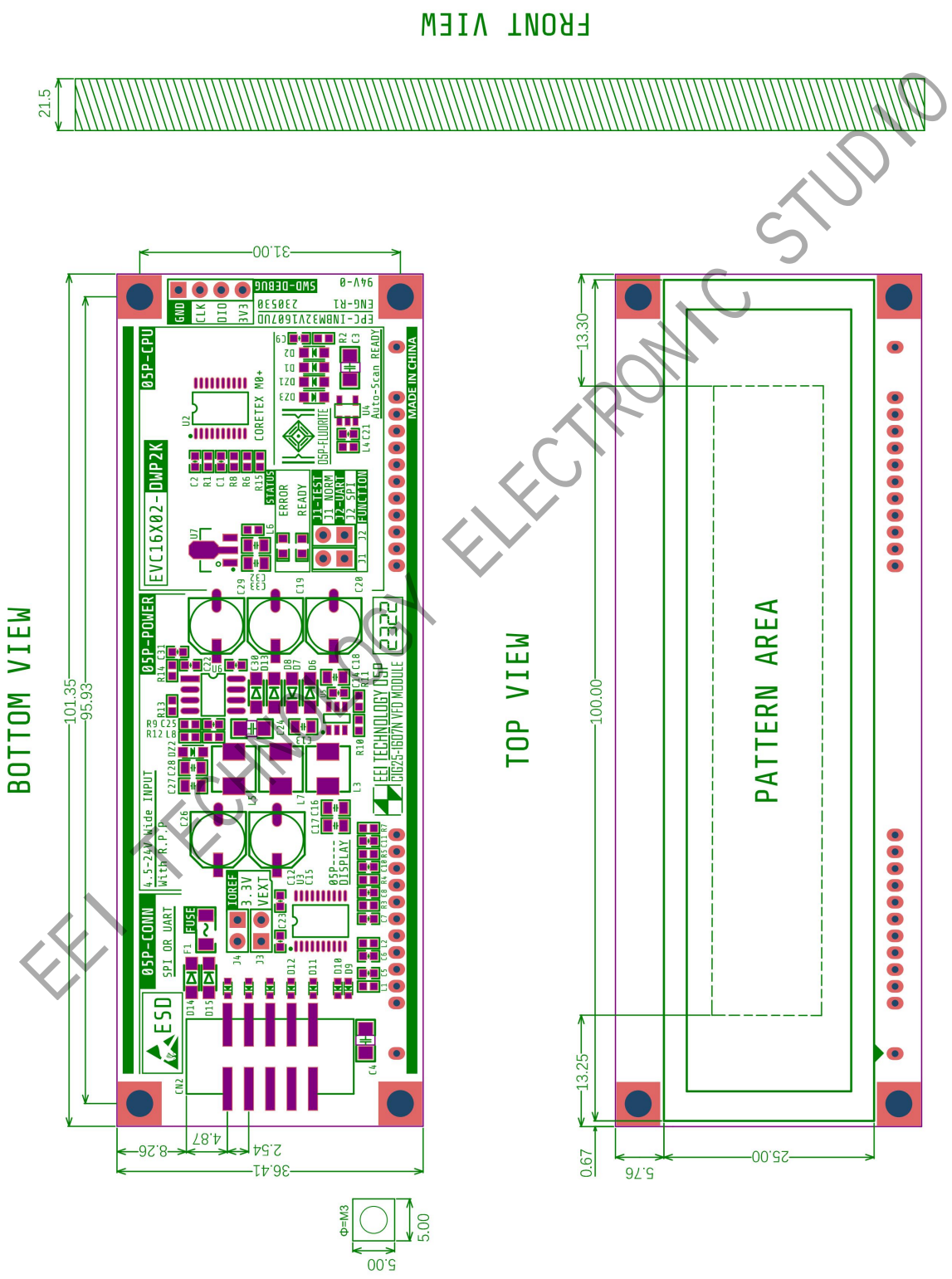
Module Outline DIAGRAM



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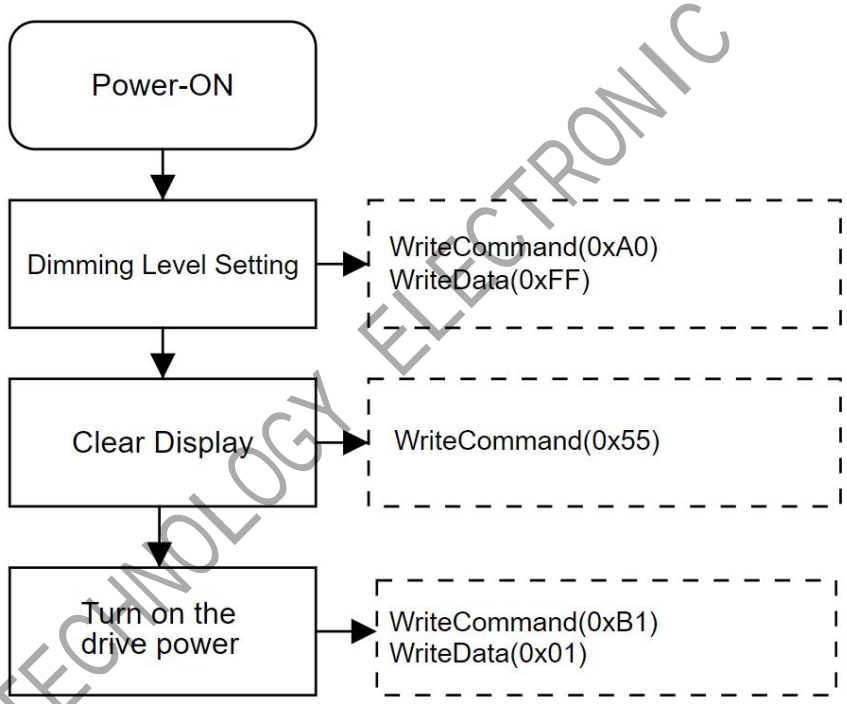
Example of Display initialization



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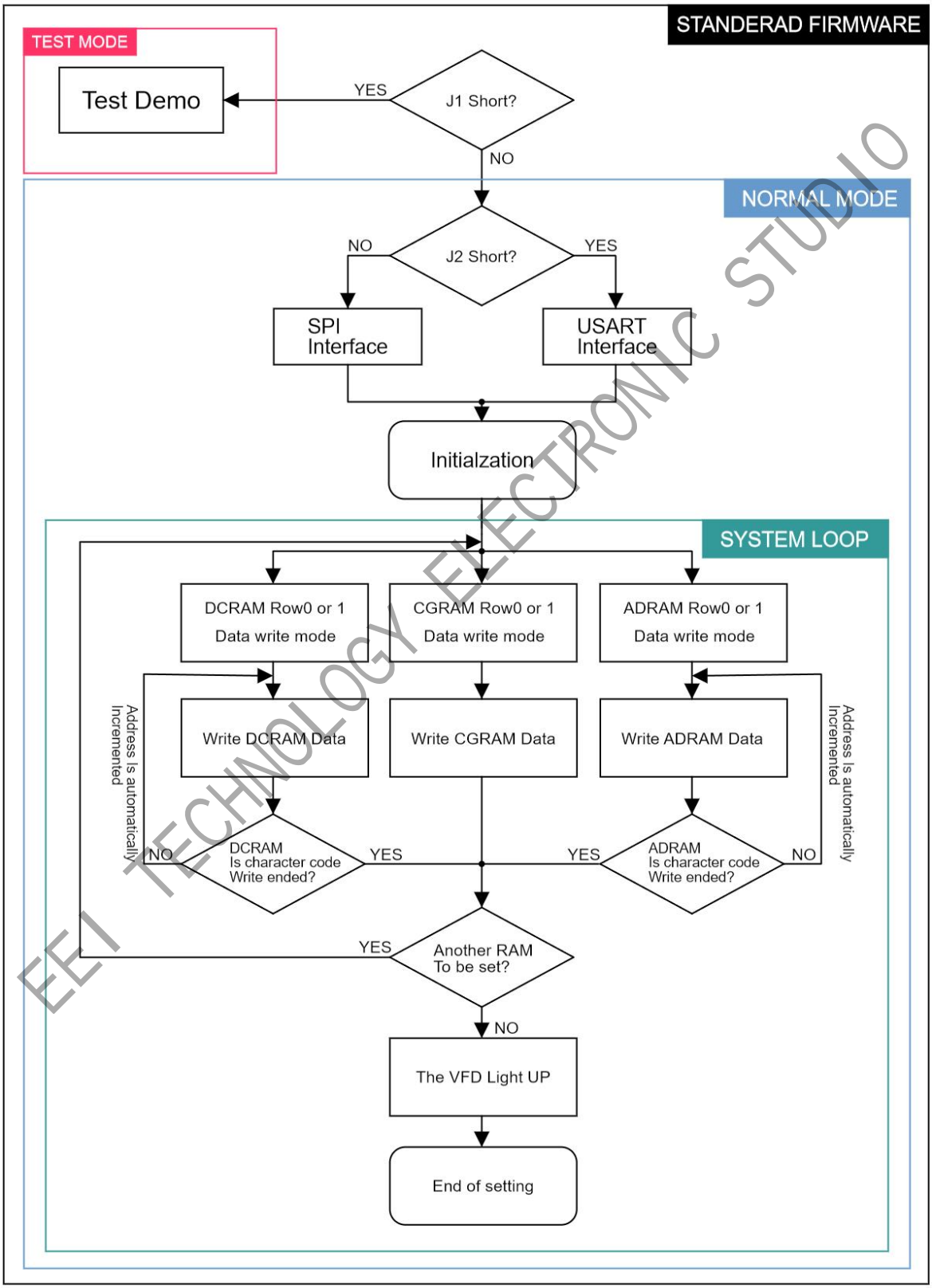
Module software logic



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