Futaba

B

蛍光表示管製品規格
VACUUM FLUORESCENT DISPLAY SPECIFICATION

双葉電子工業株式会社
電子部品事業部　電子管技術グループ
ENGINEERING GROUP, ELECTRON TUBE
ELECTRONIC COMPONENTS DIVISION
FUTABA CORPORATION

形名 Type No.　16-BT-131INK

用　途:Application　SET TOP BOX
外形寸法:Outer Dimension　118.2 (L) × 20.5 (W) × 5.9 (T) mm
Cadmium Free Phosphor, Lead Free Solder
発光色:Color of Illumination　Green (G. x=0.24,y=0.41)
Red (R. x=0.67,y=0.33)

絶対最大定格:Absolute Maximum Rating

項目 : Item		Symbol	Terminals	Rating	Unit
フィラメント電圧 :Filament Voltage		Ef	F+-F-	4.8	Vdc
ロジック電源電圧 :Logic Supply Voltage	*2	V_{DD}	V_{DD}	−0.3 ～ 6.0	Vdc
ドライバ電源電圧 :Driver Supply Voltage	*3	V_H	V_H	−0.3 ～ 37	Vdc
ロジック信号入力電圧 :Logic Input Voltage		V_{IN}	SI,CLK,LAT,BK	−0.3 ～ V_{DD}+0.3	Vdc
保存温度 :Storage Temperature		T_{stg}	−	-55 ～ +80	℃

絶対最大定格:瞬時たりとも超えてはならない規格であり、此れを超えた場合恒久的な機能障害を発生する可能性があります。
Absolute Maximum Condition : The value shall not be exceeded in any conditions. Permanent damage to VFD may be expected.

推奨動作条件:Recommended Operating Condition

項目 : Item		Symbol	Min.	Typ.	Max.	Unit
フィラメント電圧 :Filament Voltage	*1	Ef	3.60	4.0	4.40	Vdc
ドライバ電源電圧 :Driver Supply Voltage	*3	V_H	28	31	34	Vdc
ロジック電源電圧 :Logic Supply Voltage	*2	V_{DD}	4.5	5.0	5.5	Vdc
Hレベル入力電圧 :H-Level Input Voltage		V_{IH}	V_{DD}×0.8	−	V_{DD}	Vdc
Lレベル入力電圧 :L-Level Input Voltage		V_{IL}	0	−	V_{DD}×0.2	Vdc
カットオフバイアス :Cut-off Bias	*1	Ek	2.0	−	3.0	Vdc
動作温度 :Operating Temperature		T_{opr}	-20	−	+70	℃

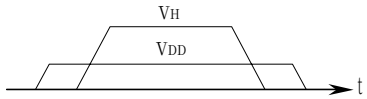
内部クロック動作特性:Characteristics of Internal Clock Circuit

項目 : Item	Symbol	条件:Condition	Typ.	Unit
自己発信周波数 :Internal Clock Frequency	f_{OSC}	V_{DD}=5.0V R_{OSC}=33kΩ	4.8	MHz
表示フレーム周波数 :Display Frame Frequency	f_{FR}		361	Hz

推奨動作条件:信頼性、品質を確保できうる範囲 (寿命はTyp.値が最適値です。)
Recommended Operating Condition:Quality and reliability can be assured in this condition.
(Typ.condition is the most optimized value on the life time.)

*1 フィラメントの極性のマイナス側に印加する。
Ek is applied to the minus polarity of the filament.

*2 電源シーケンス　Power Supply Sequence
V_Hを印加中はV_{DD}を4.5～5.5Vの間でご使用下さい。
V_{DD} should be 4.5 to 5.5V when applying V_H.
電源投入時はV_{DD}とV_Hを同時、またはV_{DD}を投入した後にV_Hを投入下さい。
V_H and V_{DD} should be on at the same,or V_H should be on after V_{DD} is on.
電源遮断時はV_{DD}とV_Hを同時、またはV_Hを遮断した後にV_{DD}を遮断下さい。
V_H and V_{DD} should be off at the same,or V_{DD} should be off after V_H is off.



電源シーケンス
Power Supply Sequence

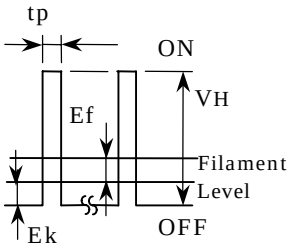
*3 V_Hを印加中は推奨動作条件でご使用下さい。Recommended Operating Condition should be used when applying V_H.

本製品は半導体製品ですので静電気のお取り扱いには十分ご注意お願いします。
The VFD is built with C-MOS Ics.Precautions should be taken to minimize the possibility of static charges.
本規格と異なる使い方をされる場合、品質,信頼性を確保出来ない場合がありますので事前にご相談下さい。
Since deviation from this specification may generate quality or reliability concerns, please consult to FUTABA prior to use.
この仕様書の内容はお断りなく変更することがありますのでご了承下さい。
This specification is subject to change without notice.

電気的特性:Electrical Characteristics

指定がない場合は、推奨動作条例のTyp値、全点灯、f_{CLK}=5MHz、PGND=LGND=0Vとする。

Unless otherwise specified, The test condition should be Typ value of recommended condition and all segments on, f_{CLK}=5MHz,PGND=LGND=0V.

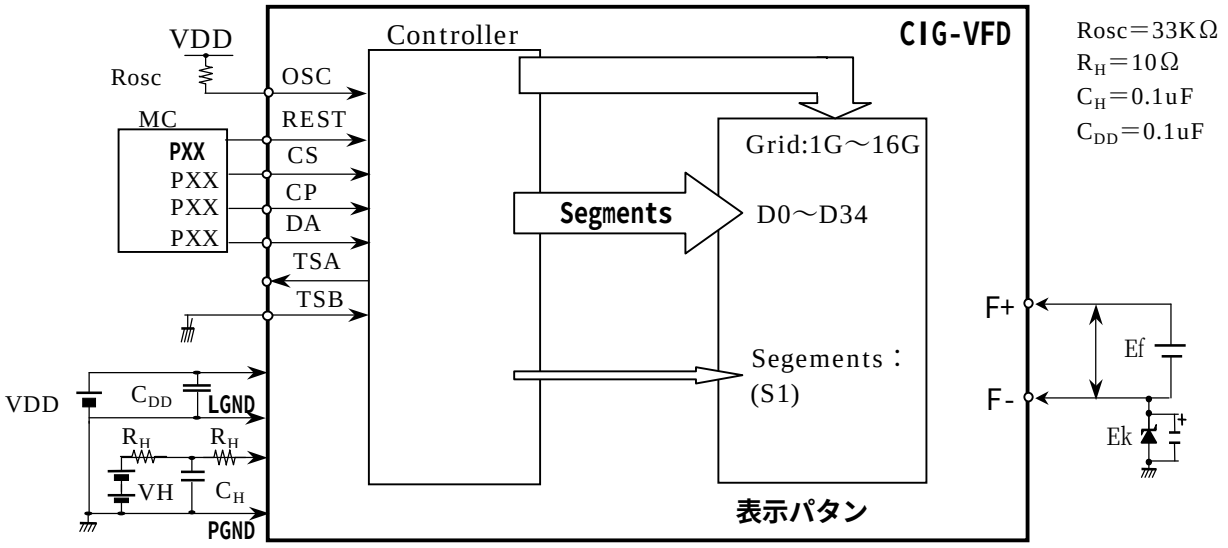
項目 : Item	Test Condition		Symbol	Min.	Typ.	Max.	Unit.
フィラメント電流 Filament Current	Ef = 4.0 Vdc V_H=V_{DD}=0		If	85	94	104	mAdc
ロジック電源電流 Logic Supply Current	f_{CLK} = 5MHz		I_{DD}	—	-	5.0	mA
ドライバ電源電流 Driver Supply Current	全点灯 All Segments on		$I_{H(AVG)}$	—	10	20	mA
			$I_{H(PEAK)}$	—	11	22	mA
Hレベル入力電流 H-Level Input Current	V_{IN}=V_{DD}		I_{IH}	—	—	5	μA
Lレベル入力電流 L-Level Input Current	V_{IN}=0V	SI,CLK LAT	I_{IL}	—	—	−5	μA
		BK		−35	−50	−400	
輝 度 Luminance	Ef = 4.0 Vdc V_{DD} = 5.0 Vdc V_H = 31.0 Vdc Ek = 2.0 Vdc Dimming = 240/255 (Duty=1/17)		L(G.)	350	700	—	cd/m^2
			L(R.)	50	100	—	cd/m^2
			L( )			—	cd/m^2
			L( )			—	cd/m^2
			L( )			—	cd/m^2
			L( )			—	cd/m^2
			L( )			—	cd/m^2
			L( )			—	cd/m^2
輝度比 Luminance Ratio between Digits			$\frac{Lmax}{Lmin}$	—	—	2	

形名 Type No 16-BT-131INK

機能表:Function Table

機能 Function	記号 Symbol	入力／出力 Input／Output	内容 Description
シフトクロック入力端子 Shift Clock Input	CP	入力 Input	CPの立ち上がりでシリアルデータがシフトしまス。 Serial data is shifted on the rising edge of CP
シリアルデータ入力 Serial Data Input	DA	入力 Input	LSB側より入力します。 Input from LSB
テスト端子A Test Pin A	TSA	-	オープンにして下さい。 Leave this open.This is for factory use.
テスト端子B Test Pin B	TSB	-	L-GNDに接続して下さい。 Connect it with L-GND
チップセレクト入力端子 Chip Select Input	$\overline{CS}$	入力 Input	$\overline{CS}$をハイレベルにするとデータのシリアル転送が禁止されます。 Serial data transfer is disabled when $\overline{CS}$ pin is "H" level.
リセット入力端子 Reset Input	$\overline{RESET}$	入力 Input	$\overline{RESET}$ をローレベルにすると全ての機能を初期化します。 ``Low``initializes all the functions. 初期状態リセット機能を参照下さい。 For an initial status ,see Reset Function.
自己発振用端子 Pin for self-oscillation.	OSC	入力/出力 Input/Output	自己発振用端子です。 (外部からクロックを与えて使用しないで下さい。) Pin for self -oscillation. (Do not apply external clocks to these pins) 抵抗を接続します。 Connect this pin to resisitor. VDD / Rosc / OSC / Rosc＝33KΩ
ロジック電源端子 Logic Supply Pin	VDD	入力 Iutput	ロジック回路のための電源端子 Power Supply pin for Logic Circuit.
ドライバ電源端子 Driver Supply Pin	VH	入力 Input	ドライバの回路のための電源端子 Power Supply pin for Driver Output.
ロジックグランド端子 Logic GND Pin	LGND	入力 Input	ロジックのグランド GND for Logic Circuit.
パワーグランド端子 Power GND Pin	PGND	入力 Input	VHのグランド GND for VH Circuit
フィラメント端子 Filament Pin	F-,F+	入力 Input	フィラメント電圧入力端子 Filament Voltage input
ノーピン No Pin	NP	—	NP部にはピンはありません。 There is no pin.

接続回路(例)



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● Timing condition

The timing condition for serial transfer is shown below.

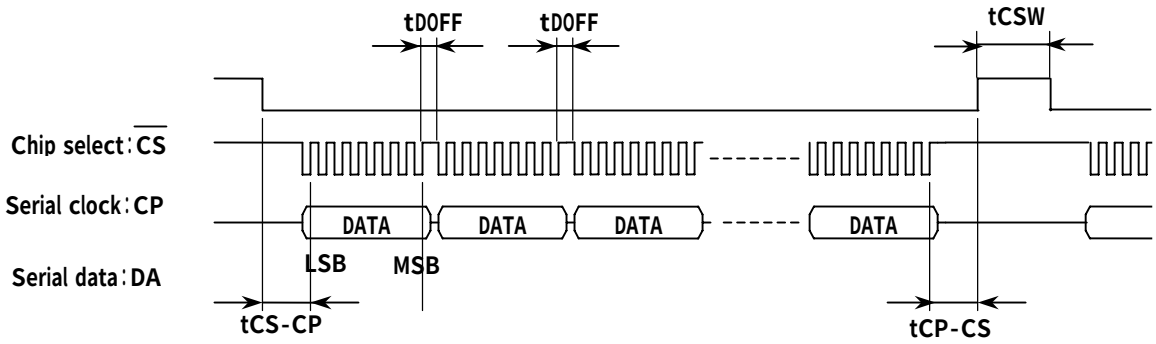


Fig. 2-2-1 Timing Condition of Serial Data Transfer

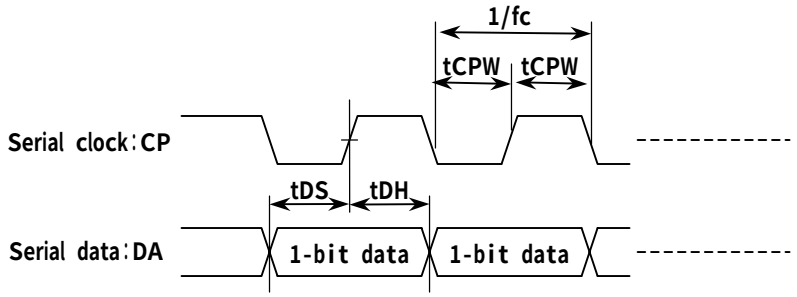


Fig. 2-2-2 Timing Condition of Serial Clock

Table 2-1 Timing Condition

Item	Symbol	Condition	Min	Typ	Max	Unit
CP frequency	fc	—	—	—	0.5	MHz
CP pulse width	tCPW	—	(700)	—	—	ns
Time needed between CS and CP	tCS-CP	—	(1000)	—	—	ns
Time needed between CP and CS	tCP-CS	—	(1000)	—	—	ns
Time to wait CS	tCSW	oscillating	(1000)	—	—	ns
Time to process data	tDOFF	oscillating	(2000)	—	—	ns
Time to set up data	tDS	—	(300)	—	—	ns
Time to hold data	tDH	—	(300)	—	—	ns

形名

16-BT-131INK

● Commands

1 List of commands

Table 3-1 shows the list of commands.

Table 3-1 Commands

Command	MSB			1st Byte				LSB	MSB		2nd Byte					LSB	
	B7	B6	B5	B4	B3	B2	B1	B0	B7	B6	B5	B4	B3	B2	B1	B0	
DCRAM_A DATA WRITE	0	0	1	X4	X3	X2	X1	X0	C7	C6	C5	C4	C3	C2	C1	C0	
DISPLAY MODE	0	0	0	0	0	0	0	0	*	*	S6	S5	S4	S3	S2	S1	
CGRAM DATA WRITE	0	1	0	*	*	Y2	Y1	Y0	*	D30	D25	D20	D15	D10	D5	D0	2nd Byte
									*	D31	D 26	D21	D16	D11	D6	D1	3rd Byte
									*	D32	D 27	D22	D17	D12	D7	D2	4th Byte
									*	D33	D28	D23	D18	D13	D8	D3	5th Byte
									*	D34	D29	D24	D19	D14	D9	D4	6th Byte
ADRAM DATA WRITE	0	1	1	X4	X3	X2	X1	X0	*	*	E5	E4	E3	E2	E1	E0	
DIGIT SET OF DISPLAY TIMING	1	1	1	0	0	0	*	*	0	*	*	*	1	1	1	1	
DIMMING SET	1	1	1	0	0	1	*	*	H7	H6	H5	H4	H3	H2	H1	H0	
GRAY LEVEL DATA	1	0	1	*	*	J2	J1	J0	I7	I6	I5	I4	I3	I2	I1	I0	
GRAY LEVEL ON/OFFSET	1	1	0	X4	X3	X2	X1	X0	K7	K6	K5	K4	K3	K2	*	K0	
DISPLAY LIGHT ON/OFF	1	1	1	0	1	0	LS	HS	Command not needed								
STAND-BY MODE SET	1	1	1	0	1	1	*	ST	Command not needed								

＊: arbitrary
Xn: To set the address for display timing, n= 0 to 4
Cn: To set the character code of CGRAM/CGROM, n= 0 to 7
Sn: Sn=1: is used as the Grid pin, Sn=0: is used as the Segment pin
Yn: To set the CGRAM address, n= 0 to 2
Dn: To set the CGRAM character code, n= 0 to 34
En: To set ON/OFFof S1～S 6outputs, n= 0 to 5
Un: To set the URAM address, n= 0 to 2
Fn: To set display timing, n= 0 to 6
Hn: To set the value for dimming, n= 0 to 7
Jn: To set the address of the gray scale register, n= 0 to 2
In: To set the data for the gray scale level, n= 0 to 7
Kn: To set Enable/Disable of the gray scale level, n= 0 and 2 to 7
HS: ~~To set to all lights ON, HS=1: all lights ON (all segments at H) HS=0: normal lighting mode~~
*The type isn`t used in all lights ON.
LS: To set to all lights OFF, LS=1: all lights OFF (all segments at L) LS=0: normal lighting mode
ST: To set the stand-by mode, ST=1: stand-by mode HS=0: normal operating mode

In case of continuous data write-in to RAM (DCRAM, CGRAM, ADRAM, etc.), it is not necessary to specify the first byte of the second and later bytes, because the addresses are automatically incremented internally.

Note: There is no guarantee for any operation resulted from the setting using other commands listed above.

2 Description of commands

2.1 DCRAM data write command

The DCRAM (data control RAM) has a 5-bit address to store the character codes of the CGROM and the CGRAM. The character codes specified by the DCRAM are converted into the character pattern of 5x7 dot matrix via the CGROM or the CGRAM.. To write-in the DCRAM, specify the DCRAM address and write-in the character codes of the CGROM and the CGRAM. For the setting relationship of the DCRAM address to the display timing, refer to section 2.4, Display timing set command. The command format is shown below.

【Command Format】

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	
1st bvte (1st)	0	0	1	X4	X3	X2	X1	X0	The DCRAM data write mode is selected and the DCRAM address is specified. (Ex. The DCRAM address 0H is specified.)
2nd byte (2nd)	C7	C6	C5	C4	C3	C2	C1	C0	The CGROM and CGRAM character codes are specified. (The specified character codes are written into the DCRAM address 00H.)

●To continuously specify the CGROM and CGRAM character codes, specify character codes only as shown below. As the DCRAM addresses are automatically incremented, it is not necessary to specify the first byte. Addresses are specified from 00H to 17H incrementing 1 by 1. It is possible to continuously transfer up to 24 addresses.

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	
3rd byte (3rd)	C7	C6	C5	C4	C3	C2	C1	C0	The CGROM and CGRAM character codes are specified. (The data are written into the DCRAM address 01H.)
4th byte (4th)	C7	C6	C5	C4	C3	C2	C1	C0	The CGROM and CGRAM character codes are specified. (The data are written into the DCRAM address 02H.)
⋮									
25th byte (25th)	C7	C6	C5	C4	C3	C2	C1	C0	The CGROM and CGRAM character codes are specified. (The data are written into the DCRAM address 17H.)

X0 (LSB) ～X4 (MSB)： DCRAM address (5 bits：24 characters)
C0 (LSB) ～C7 (MSB)： CGROM and CGRAM codes (8 bits：256 characters)

2.2 DISPLAY MODE SETTING COMMAND

The Display Mode Setting Command is used to set S1/G22, S2/G21,S3/G20, S4/G19, S5/G18, and S6/G17 as the Grid pin or the segment pin. The Display Mode Setting Command Format is shown below.

【Command Format】

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0
1st bvte (1st)	0	0	0	0	0	0	0	0
2nd byte (2nd)	0	0	0	0	0	0	0	0

2.3 CGRAM data write command

The CGRAM (character generator RAM) has a 3-bit address to store character Patterns of 5x7 dot matrix. Character patterns stored in the CGRAM can be outputted by specifying the character code (address) of DCRAM. The CGRAM addresses are assigned from 00H to 07H. (The other addresses are all for CGROM.) The CGRAM can store 8 types of character pattern. The CGRAM can be written-in by specifying its address. The command format is shown below.

【Command Format】

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	
1st byte (1st)	0	1	0	*	*	Y2	Y1	Y0	The CGRAM data write command and the CGRAM address are specified. (Ex: The CGRAM address 00H is specified.)
2nd byte (2nd)	*	D30	D25	D20	D15	D10	D5	D0	The data in the first row is specified. (The data is written into the CGRAM address 00H.)
3rd byte (3rd)	*	D31	D26	D21	D16	D11	D6	D1	The data in the second row is specified. (The data is written into the CGRAM address 00H.)
4th byte (4th)	*	D32	D27	D22	D17	D12	D7	D2	The data in the third row is specified. (The data is written into the CGRAM address 00H.)
5th byte (5th)	*	D33	D28	D23	D18	D13	D8	D3	The data in the fourth row is specified. (The data is written into the CGRAM address 00H.)
6th byte (6th)	*	D34	D29	D24	D19	D14	D9	D4	The data in the fifth row is specified. (The data is written into the CGRAM address 00H.)

●To continuously specify character pattern data, specify the character pattern data only as shown below. As the DCRAM addresses are automatically incremented, it is not necessary to specify the first byte. The character pattern data of the 2nd to the 6th byte are considered as one data. The time between bytes t_{DOFF} is 2us(min).

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	
2nd byte (7th)	*	D30	D25	D20	D15	D10	D5	D0	The data in the first row is specified. (Written into the CGRAM address 01H.)
⋮									
6th byte (11th)	*	D34	D29	D24	D19	D14	D9	D4	The data in the fifth row is specified. (Written into the CGRAM address 01H.)

Y0(LSB)～Y2(MSB) : CGRAM address (3 bits: for 8 characters)
D0(LSB)～D34(MSB): character pattern data (35 bits: 35 outputs for a digit)
*: Don't Care

【Setting relationship of CGRAM Addresses】

HEX	Y2	Y1	Y0	Specified CGRAM
0	0	0	0	RAM00 (00H)
1	0	0	1	RAM01 (01H)
2	0	1	0	RAM02 (02H)
3	0	1	1	RAM03 (03H)
4	1	0	0	RAM04 (04H)
5	1	0	1	RAM05 (05H)
6	1	1	0	RAM06 (06H)
7	1	1	1	RAM07 (07H)

【Setting relationship CGRAM Outputs】

D0	D1	D2	D3	D4
D5	D6	D7	D8	D9
D10	D11	D12	D13	D14
D15	D16	D17	D18	D19
D20	D21	D22	D23	D24
D25	D26	D27	D28	D29
D30	D31	D32	D33	D34

- The setting relationship of CGRAM outputs may vary depending of the VFD product.
- Refer to the individual specification.

2.4 ADRAM data write command

The ADRAM (Additional Data RAM) has a 5-bit address to store data.
The signal data specified by the ADRAM is directly outputted.
To write the ADRAM data, specify the ADRAM address before writing-in data.
For the setting relationship between the ADRAM address to set and display timing, refer to the section 2.5 Setting of display timing. The command format is shown below.

【Command Format】

	B7	B6	B5	B4	B3	B2	B1	B0	
1st byte (1st)	0	1	1	X4	X3	X2	X1	X0	To select the ADRAM data write and to specify the ADRAM address. (Ex: To specify the ADRAM address 00H.)
2nd byte (2nd)	*	*	*	*	*	*	*	E0	To specify the signal data. (Ex: To write-in the data to the ADRAM address 00H.)

●To continuously specify the signal data, specify the character codes only as shown below. Since the ADRAM addresses are automatically incremented, it is not necessary to specify the 1st byte. Addresses are specified from 00H to 17H incrementing 1 by 1. Up to 24 addresses can be continuously transferred.

	B7	B6	B5	B4	B3	B2	B1	B0	
3rd byte (3rd)	*	*	*	*	*	*	*	E0	To specify the signal data. (The data is written into the ADRAM address 01H.)
4th byte (4th)	*	*	*	*	*	*	*	E0	To specify the signal data. (The data is written into the ADRAM address 02H.)
25th byte (25th)	*	*	*	*	*	*	*	E0	To specify the signal data. (The data is written into the ADRAM address 17H.)

X0 (LSB) ～X4 (MSB)： ADRAM address (5-bit)
E0:S1 "0": output OFF "1": output ON
*： Don't Care

☆Please refer to the table below for segment(E0) position and ADRAM(X0～X4) Duty Timing (Digit) Address setting relationship.

Duty Timing(Digit) Address	S1/G22 (E0)
T1(01100000B)	NOTE
T2(01100001B)	NOTE
T3(01100010B)	NOTE
T4(01100011B)	NOTE
T5(01100100B)	NOTE
T6(01100101B)	NOTE
T7(01100110B)	NOTE
T8(01100111B)	NOTE
T9(01101000B)	NOTE
T10(01101001B)	NOTE
T11(01101010B)	NOTE
T12(01101011B)	NOTE
T13(01101100B)	NOTE
T14(01101101B)	NOTE
T15(01101110B)	NOTE
T16(01101111B)	NOTE

NOTE Set the standard pattern by P8

2.5 Display timing set command

The display timing command sets the display timing including the universal timing using 8-bit data. When the power is supplied or the RESET signal is inputted, the value is set to the initial value (1G to 16G). Be sure to execute this command before turning on the display light. Then, set the fixed value for each VFD. For the set value, refer to the individual VFD specification. The command format is shown below.

[Command Format]

	B7	B6	B5	B4	B3	B2	B1	B0	
1st byte (1st)	1	1	1	0	0	0	*	*	To select the display timing set.
2nd byte (2nd)	0	*	*	*	1	1	1	1	To select the display timing set and the universal timing enable/disable.

2.6 Dimming data write command

Brightness can be controlled in 240 levels using 8-bit data by setting the dimming data write command. When the power is supplied or the RESET signal is inputted, the register value is set to 0. Be sure to execute this command before turning on the display light. Then set the desired value.

[Command Format]

	B7	B6	B5	B4	B3	B2	B1	B0	
1st byte (1st)	1	1	1	0	0	1	*	*	To select the dimming data set.
2nd byte (2nd)	H7	H6	H5	H4	H3	H2	H1	H0	To select the dimming data set.

H0(LSB)～H7(MSB) : dimming data (8 bits: for 240 levels)
* : Don't Care

[Relationship between the dimming data and the dimming status]

H7	H6	H5	H4	H3	H2	H1	H0	Dimming data	Remarks
0	0	0	0	0	0	0	0	0/255	Initial value (*)
0	0	0	0	0	0	0	1	1/255	
0	0	0	0	0	0	1	0	2/255	
:	:	:	:	:	:	:	:	:	
1	1	1	0	1	1	1	1	239/255	
1	1	1	1	0	0	0	0	240/255	
1	1	1	1	0	0	0	1		
:	:	:	:	:	:	:	:		
1	1	1	1	1	1	1	1		

* The status when the power is supplied or the RESET signal is inputted.

2.7 Gray-level data write command

The Gray-level data command is used to control display brightness in 240 levels with the 8-bit data for each anode driver output (D0～D34/S1).
When the power is supplied or the RESET signal is inputted, the register value is set to 0.
Be sure to execute this command before turning on the display light. Then set the desired value.

[Command Format]

1st byte (1st)

B7	B6	B5	B4	B3	B2	B1	B0
1	0	1	*	*	J2	J1	J0

To select the gray-level data write command and specify the address to write-in.
(Ex: The gray-level register address 00H is specified.)

2nd byte (2nd)

B7	B6	B5	B4	B3	B2	B1	B0
I7	I6	I5	I4	I3	I2	I1	I0

To write-in the gray-level data.
(Ex: The data is written into the gray-level register address 00H.)

●To continuously specify the address, specify the gray-level data only as shown below. As addresses are automatically incremented, it is not necessary to specify the first byte. The specified addresses are specified from 0H to7H incrementing 1 by 1. The time between bytes (t_{DOFF}) is 2us(min).

3rd byte (3nd)

B7	B6	B5	B4	B3	B2	B1	B0
I7	I6	I5	I4	I3	I2	I1	I0

To write-in the gray-level data.
(The data is written into the address 01H of the gray-level register.)

4th byte (4 th)

B7	B6	B5	B4	B3	B2	B1	B0
I7	I6	I5	I4	I3	I2	I1	I0

To write-in the gray-level data.
(The data is written into the address 02H of the gray-level register.)

J0 (LSB) ～J2 (MSB) : to specify the address of the gray-revel register (3 bits)
I0(LSB)～I7(MSB) : gray-level data (8 bits: for 240 gray-level)
* : Don't Care

●Address of the gray-level register

Address			Specified register
J2	J1	J0	
0	0	0	Gray-level register for outputting D0～D34
0	0	1	Gray-level register for outputting S1
0	1	0	Don't Care
0	1	1	Don't Care
1	0	0	Don't Care
1	0	1	Don't Care
1	1	0	Don't Care
1	1	1	Don't Care

●Relationship between the data and gray-level

I7	I6	I5	I4	I3	I2	I1	I0	Gray-level data	Remarks
0	0	0	0	0	0	0	0	0/255	Initial value(*)
0	0	0	0	0	0	0	1	1/255	
0	0	0	0	0	0	1	0	2/255	
:	:	:	:	:	:	:	:	:	
1	1	1	0	1	1	1	1	239/255	
1	1	1	1	0	0	0	0	240/255	
1	1	1	1	0	0	0	1		
:	:	:	:	:	:	:	:		
1	1	1	1	1	1	1	1		

* The status when the power is supplied or the RESET signal is inputted.

2.8 Gray-level ON/OFF set command

The Gray-level ON/OFF set command has a 5-bit address which is used to specify the gray-level ON/OFF of the anode driver output (D0～D34/S1) for each timing. When the gray-level ON is specified, the data is outputted in the corresponding pulse width to the value set by the gray-level data write command. When the power is supplied or the RESET signal is inputted, the register value is set to 0. Be sure to execute this command before turning on the display light. Then, set the desired value.
For the setting relationship between the address and the display timing, refer to the section 2.5, Display timing set command. The command format is shown below.

【Command Format】

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	
1st byte (1st)	1	1	0	X4	X3	X2	X1	X0	To select the gray-level ON/OFF set and specify address. (Ex: The address 0H is specified.)
2nd byte (2nd)	*	*	*	*	*	K2	*	K0	To set the gray-level ON/OFF for each output. (The data is written into the address 00H.)

●To continuously specify the gray-level ON/OFF set, specify the setting data only as shown below. As addresses are automatically incremented, it is not necessary to specify the first byte. Addresses are specified from 00H to 17H incrementing 1 by 1. The time between bytes (t_{DOFF}) is 2us(min).

	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	
3rd byte (3rd)	*	*	*	*	*	K2	*	K0	To set the gray-level ON/OFF for each output. (Written into the address 01H.)
4th byte (4th)	*	*	*	*	*	K2	*	K0	To set the gray-level ON/OFF for each output. (Written into the address 02H.)
⋮									
25th byte (25th)	*	*	*	*	*	K2	*	K0	To set the gray-level ON/OFF for each output. (Written into the address 17H.)

X0 (LSB) ～X4 (MSB)： address (5 bits)
K0 (LSB) ,K2 (MSB)： gray-level ON/OFF (6 bits) 0: gray-level OFF 1: gray-level ON
* : Don't Care

●Corresponding driver output to the gray-level ON/OFF setting

Data	Driver output
K0	Gray-level ON/OFF setting for the output of D0～D34 0: gray-level OFF, 1: gray-level ON
*	-
K2	Gray-level ON/OFF setting for the output of S1 0: gray-level OFF, 1: gray-level ON

2.9 Display light ON/OFF set command

The display light ON/OFF set command are used to turn on all the display lights or turn them off. The all display lights OFF mode is mainly used for blinking or protecting the display from any misoperation to be aused when the power is supplied. The command format is shown below.

[Command Format]

	B7	B6	B5	B4	B3	B2	B1	B0
1st byte	1	1	1	0	1	0	LS	HS

To select the all display light ON/OFF and specify operation.

LS,HS: display operation data
* : Don't Care

●Set value and display status

LS	HS	Display status	Remarks
0	0	Normal operation	
1	0	All display lights OFF	* The status when the power is supplied or the RESET signal is inputted.

2.10 Stand-by mode command

The setting of the Stand-by mode command saves the power while the display is in the standing-by mode The command format is shown below.

[Command format]

	B7	B6	B5	B4	B3	B2	B1	B0
1st byte	1	1	1	0	1	1	*	ST

To select the stand-by mode and specify operation.

ST: Stand-by setting bit 0: normal operation mode, 1: stand-by mode
*: Don't Care

2.11 CGROM codes

Table 2 shows the standard CGROM (the general-purpose code). For the custom-designed code, please consult with the engineer in charge. (Please keep the address 20H off.)

Table 2 CGROM Codes (General-purpose code:02)

MSB / LSB	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	RAM0															
0001	RAM1															
0010	RAM2															
0011	RAM3															
0100	RAM4															
0101	RAM5															
0110	RAM6															
0111	RAM7															
1000																
1001																
1010																
1011																
1100																
1101																
1110																
1111																

＊The addresses 00H to 07H are for the CGRAM address

2.12 Initial value at the time reset

The initial value when the RESET signal is input is shown in Table 3.

Table 3 The initial value when the RESET signal is input

No.	Set to	Initial value
1	DCRAM	DCRAM Address=00H ALL DCRAM Data=20H
2	CGRAM	CGRAM Address=00H ALL CGRAM Data=00H
3	ADRAM	ADRAM Address=00H ALL ADRAM Data=00H Segment OFF (S1 OFF)
4	Number of Digit Set	”00001111”
5	Dimming Set	0/255
6	Gray Level Set	J2～J0=”000” 0/255
7	Gray Level On/Off Set	GLRAM Address =00H K0,K2=”0” (Gray Level Disable)
8	Display Light Set	L S=”1” H S=”0”(Display all off)
9	Stan-by Mode	ST=”0”(Normal Mode)

[Remark]

Grey level data should be always set except “0” when if grey function is not used.

● Flowchart of Commands

1 Basic flowchart of commands

The flowchart below shows the basic flow of commands from the time when power is turned on to the time when the display lights up. After the power is turned on, the values in 2 and 3 are set to the fixed value for each VFD used. Refer to the individual specification for the fixed value.

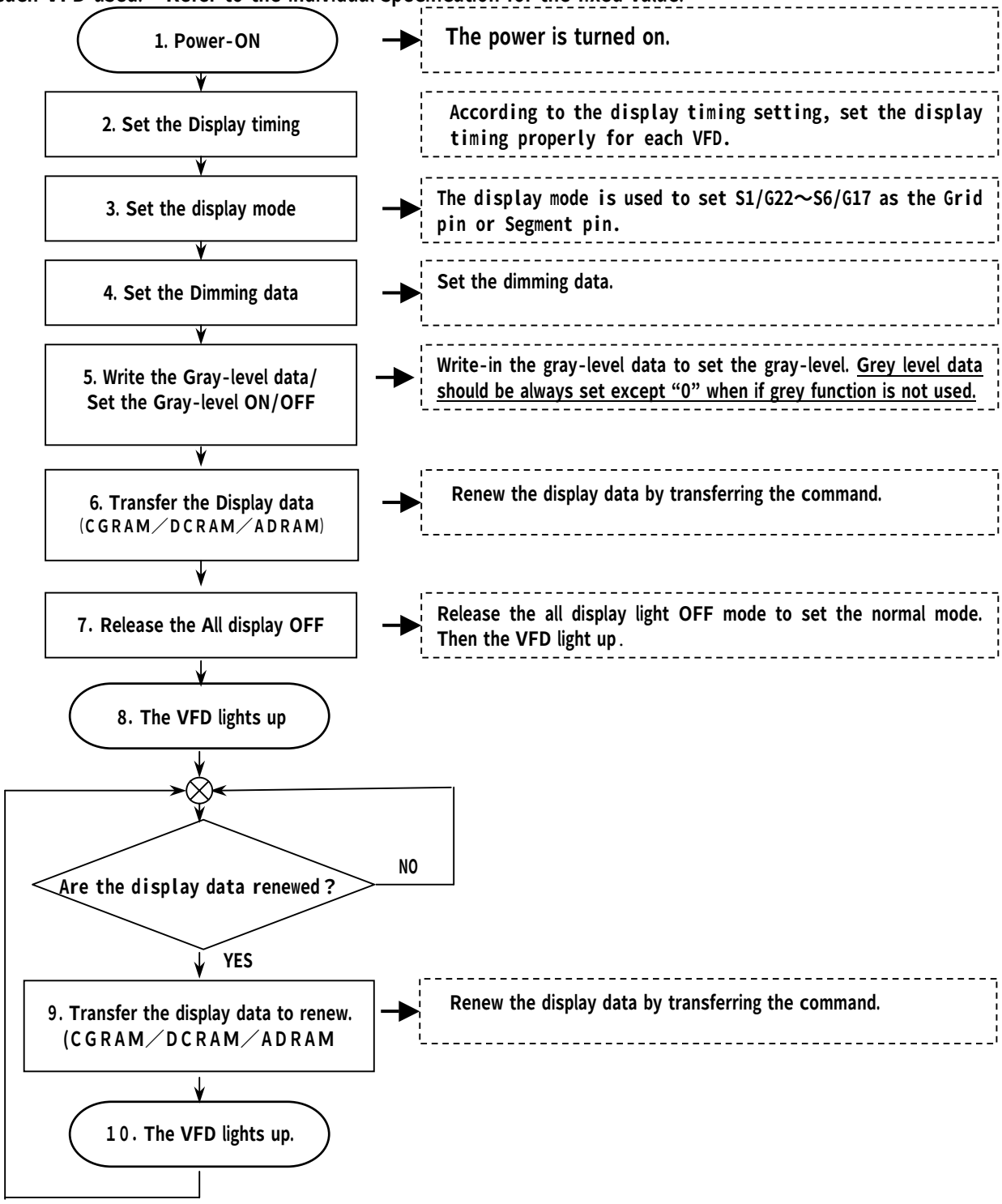


Fig. 4-1-1 Basic Command Flowchart

● Power-ON reset control

1 Power-ON reset circuit

For the power-on resetting, connect the resistor Rrst between the terminal to the logic power supply and the terminal to the system reset signal input, and the capacitor Crst between the RST terminal and the GND terminal. An example of the circuit connection is shown below.

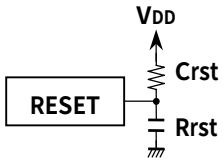


Fig.1 Power-ON reset circuit

2 Timing chart of resetting

Input the reset signal according to the figure shown below. Be sure not to transfer commands immediately after the reset signal is inputted. Because the command transferred before the definition of the internal status of the circuit may cause malfunction. Besides that, the value of tRST varies depending on the externally built parts. It is recommended to transfer the command after allowing sufficient time for the IC to be defined. For the initial value after resetting, refer to the section 2.13

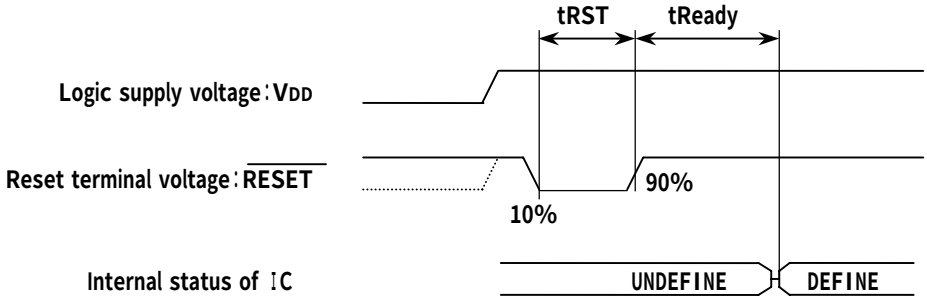


Fig. 2 Timing chart for resetting

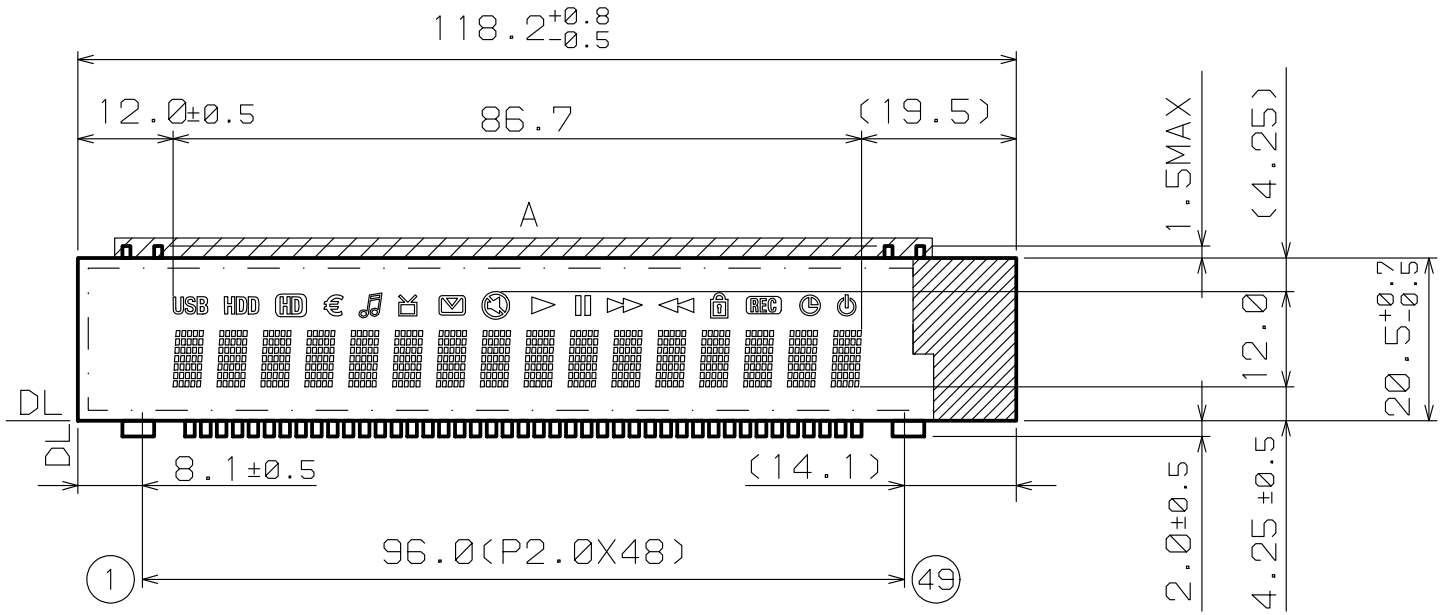
Table 4 Time for Power-ON reset

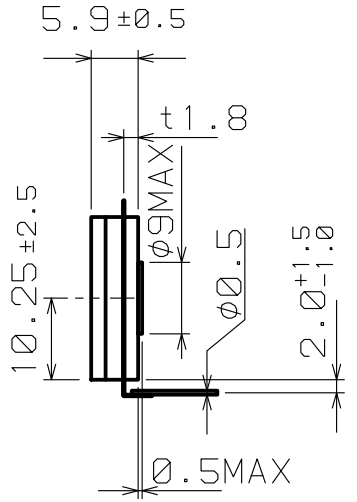
Item	Symbol	Min	Typ	Max	Unit
Reset pulse width	tRST	15	—	—	μs
Reset after Ready Time	t Raedy	2	—	—	ms

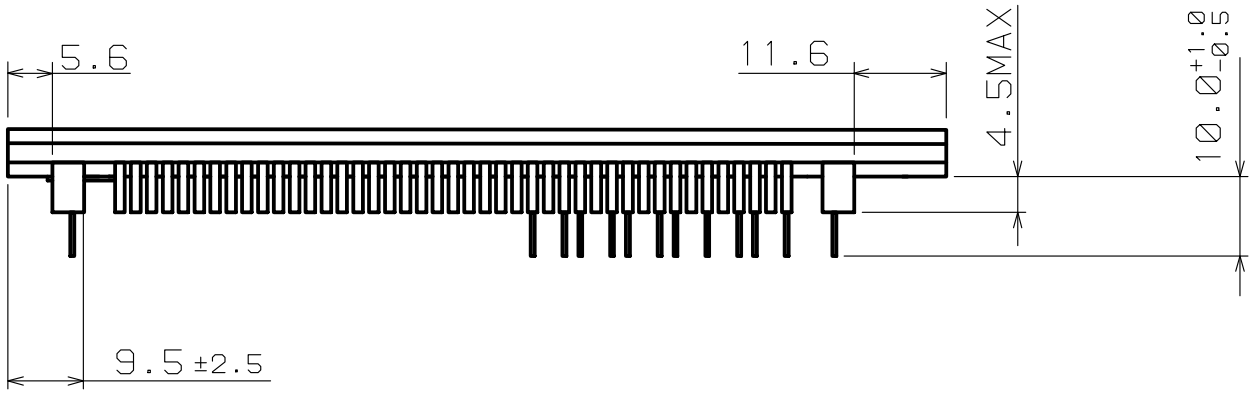
3.タイミングチャート:Timing Chart

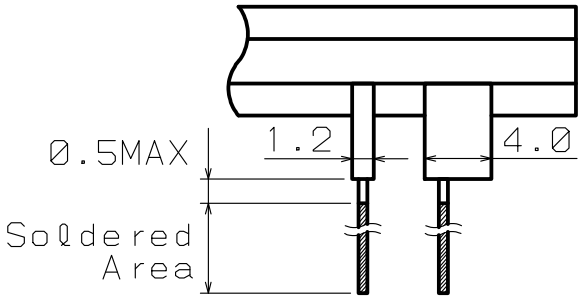
スキャンタイミング Grid Scan Timing	DCRAM/ADRAM/ GSRAM address	グリッドのオン／オフタイミング　ON/OFF timing of Grid																Codes selection	
		1G	2G	3G	4G	5G	6G	7G	8G	9G	10G	11G	12G	13G	14G	15G	16G	DCRAM	ADRAM
T1	00H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T2	01H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T3	02H	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T4	03H	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T5	04H	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T6	05H	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T7	06H	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T8	07H	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	NOTE1	NOTE2
T9	08H	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	NOTE1	NOTE2
T10	09H	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	NOTE1	NOTE2
T11	0AH	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	NOTE1	NOTE2
T12	0BH	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	NOTE1	NOTE2
T13	0CH	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	NOTE1	NOTE2
T14	0DH	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	NOTE1	NOTE2
T15	0EH	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	NOTE1	NOTE2
T16	0FH	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	NOTE1	NOTE2

Note1　Set random code by CGROM codes
Note2　Set the standard　pattern by P8









OTHER F-LEAD
LEAD DETAILS

LEAD FREE SOLDER

(unit in mm)

16-BT-131INK
OUTER DIMENSION

PIN CONNECTION

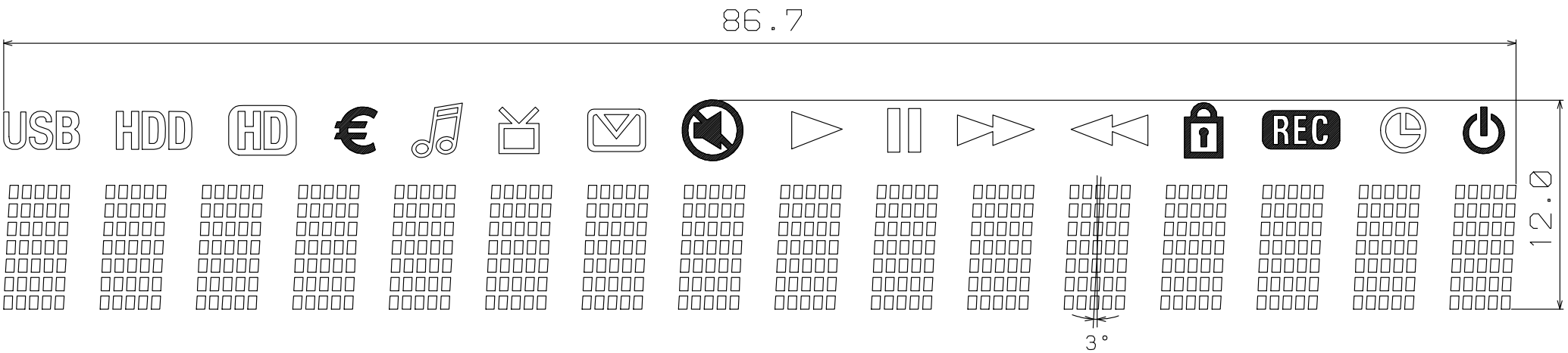
PIN NO.	1	2	3	4	~	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
CONNECTION	F−	NP	NP		NX		TSB	NX	TSA	DA	NX	CP	−CS	NX	−RESET	OSC	NX	VDD	NX	VH	PGND	NX	LGND	NP	NP	F+

NOTE
1) F−,F+ --- Filament
2) NP ------ No pin
3) NX ------ No extend pin
4) DL ------ Datum Line
5) LGND ---- Logic GND pin
6) PGND ---- Power GND pin
7) VH ------ High Voltage Supply pin
8) VDD ----- Logic Voltage Supply pin
9) CP ------ Shift Register Clock
10) DA ------ Serial Data Input
11) TSA,B --- Test pin
12) $\overline{CS}$ ------ Chip Select Input pin
13) $\overline{RESET}$ --- Reset Input
14) OSC ----- Pin for self-oscillation
15) Solder composition is Sn-3Ag-0.5Cu.
16) Cut lead is inside A.

(unit in mm)

16-BT-131INK
OUTER DIMENSION

PATTERN DETAIL



COLOR OF ILLUMINATION

Red (R.x=0.67,y=0.33) - - - - Filled up part.

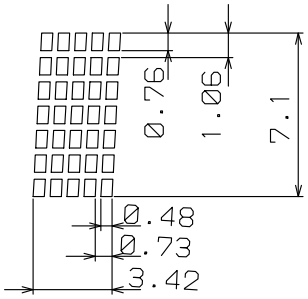
The expected lifetime of R. phosphor is 30,000 hours at room temperature.

(The definition of the life end is minimum value specified of the luminance.)

Cadmium Free Phosphor used.

Green (G. x=0.24,y=0.41) - - - - - All other graphics.

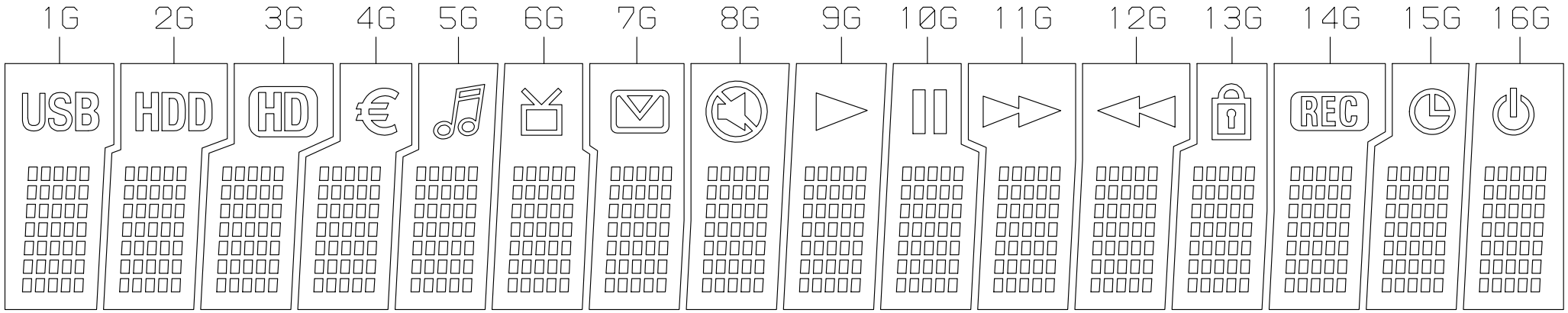
Negative pattern 

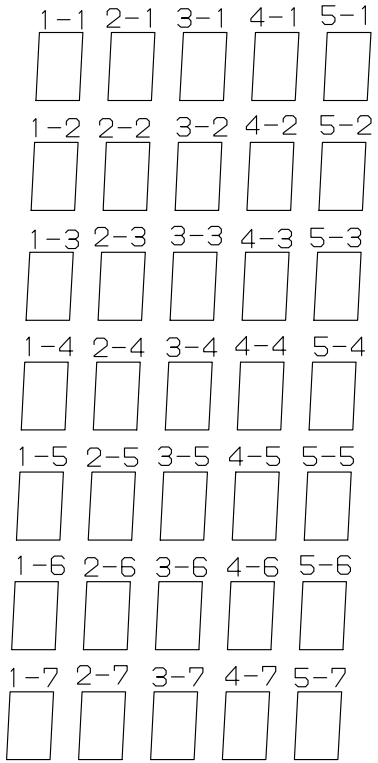


(unit in mm)

16-BT-131INK
PATTERN DETAIL
COLOR OF ILLUMINATION

GRID ASSIGNMENT





(1G~16G)

16-BT-131INK
GRID ASSIGNMENT

ANODE CONNECTION

	1G	2G	3G	4G	5G	6G	7G	8G	9G	10G	11G	12G	13G	14G	15G	16G
D0	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1
D1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1
D2	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1
D3	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1
D4	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1
D5	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2
D6	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
D7	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2
D8	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2
D9	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2
D10	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3
D11	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
D12	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3
D13	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3
D14	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3
D15	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4
D16	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4
D17	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4
D18	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4
D19	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4
D20	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5
D21	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5
D22	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5
D23	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5
D24	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5
D25	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6
D26	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6
D27	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6
D28	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6
D29	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6
D30	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7
D31	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7
D32	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7
D33	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7
D34	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7
S1	USB	HDD	HD	€	♫				▷	⏸	▷▷	◁◁		REC		

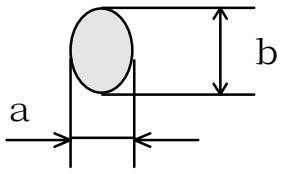
16-BT-131INK
ANODE CONNECTION

Vacuum Fluorescent Display Quality Inspection Standard
蛍光表示管品質判定基準

General 一般

This standard should be adapted to the VFD quality inspection.
本仕様書は蛍光表示管の品質検査規格に適用される。

Inspection Condition 検査条件

Item	Condition
①VFD Operating Condition. VFD 駆動条件	Typ. Recommended Condition 推奨TYP. 駆動条件
②Inspection Aide 検査付帯条件	The inspection is to be performed with Futaba standard filter or a applicable customer's filter and unaided eyes from 30cm distance under brightness of 90－110 lx. Futaba 標準または顧客指定フィルターを通して30cmの距離から、90－110 lx の周囲照度にて、目視判定する。
③Defect Point Definition 不良点の測定方法	 $\phi S = \frac{a+b}{2}$

Limit sample should be provided upon mutual agreement by both parties when necessary.
限度見本は必要に応じ、両者協議の上設定するものとする。

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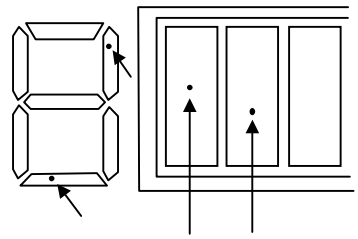
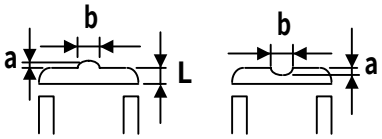
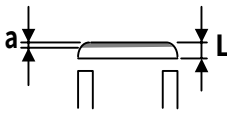
Individual Quality Standard　個別品質基準

Item 項目	Phenomena 現象	Criterion 判定基準
①Foreign Particles･ Black Spot･ Printing Error 異物･黒点･ 印刷不良	Spots(Black spot)on the lighted segment due to dirt or dust. セグメントの斑点状の発光ムラ(黒点)。 	1.A black spot of over Φ0.3mm is counted as defected point. s=Φ0.3mmを超える物は不良とする。 2.In case of spot size is over Φ0.2mm,less than 0.3mm,one spot on the same segment, or maximum 3 spots in a display is to be allowed. Φ0.2mm以上Φ0.3mm以下は、セグメントに1箇まで、全セグメントに3箇所までを良品とする。 3.A spot of less than Φ0.2mm should not be counted as defect point. Φ0.2mm未満の物は個数に拘わらず良品とする。
②Irregularity of segment shape by printing error. ｾｸﾞﾒﾝﾄ凹凸･ 印刷不良	Partial irregularity on a segment. セグメント形状の部分的凹凸 	1.Acceptable size of irregularities with respect to the segment width(L). セグメント幅(L)に対する凹凸の許容寸法。 a=0.3mm max., b=0.3mm max.,acceptable. a=0.3mm 以下、b=0.3mm を良品とする。 2.In case of the (L) below 0.5mm wide,the acceptable irregularities is a=1/2max. of the segment width(L). 尚、セグメント幅(L)が0.5mm以下の場合は、a≦1/2Lを良品とする。
③Uneven luminance 輝度ムラ	Partial dark area on the lighted segment. 発光面の部分的な輝度差	No significant irregularity of luminance is acceptable. 著しい物は無き事。
④Shaded Segment 字カケ	Shaded area appeared on the edge of segments セグメント端部の半影 	1.Shaded Segments up to 1/3 of the segment width are accepted. セグメント幅(L)の1/3までを良品とする。 2.In case of a segment below 0.5mm wide, the acceptable shaded segment should be up to 1/2 of the segment width. 但し、L=≦0.5mmの場合は、1/2迄を良品とする。
⑤Extra lighting モレ発光	Undesirable lighting area or points, a star dust or a bright spot due like to extra phosphor particle. 発光パタン以外への蛍光体付着による星屑状、輝点状の不要発光	Extra lighting which can be clearly observed through the specified filter should be judged as a defect. 指定フィルターを通して不要発光のはっきり判る物を不良とする。
⑥Scratch/Stain on/in glass ガラス傷･汚れ	A scratch,dent,or foreign particles such as stain,attached on the surface or the inside of the front glass. フロントガラス内面･表面のガラス面の傷、シミ等の異物付着	1.Scratch which can be clearly observed through the specified filter should be judged as defect. 指定ﾌｨﾙﾀｰを通して傷のはっきり判る物を不良とする。 2.The criterion for the dent and foreign particle are the same as the specified in ①. 打痕状の傷、異物等は、①頁と同等判定とする。
⑦Chip on the front glass and base plate ガラス欠け	For chip on the front glass and base plate,refer to the next page. ガラス欠けについては、次頁参照	Refer to the next page. 次頁参照

形名　Type No.
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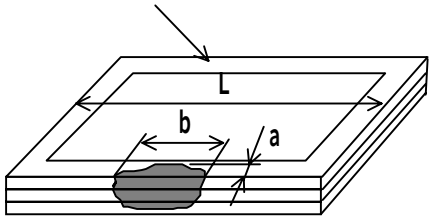
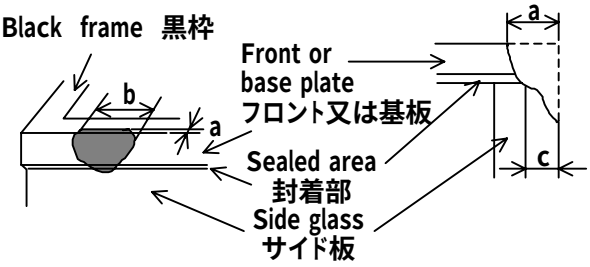
Criterion for the glass chip on the front glass or the base plate.

Definition 定義	Judgment Criterion 判定基準

Black frame 黒枠



Black frame 黒枠



a : depth of chipping
欠けの奥行き寸法
b : length of chipping
欠けの長さ寸法
c : chipping size in relation to thickness of the side glass.
サイド板厚に対する欠け寸法
L : package width (length wide)
パッケージ幅 (長辺方向)

1) Chipping size Spec. 欠けの寸法規格(mm)

	VFD:a	FLVFD:a	b	c
L≦100	within the black frame 黒枠以内	3.0max.	10max.	1/3max.
L＞100	within the black frame 黒枠以内	3.5max.	15max.	1/3max.

VFD : vacuum fluorescent display
蛍光表示管
FLVFD :Front Luminous Vacuum Fluorescent Display
前面発光型蛍光表示管

2) A chip with "a" less than 1mm should not be counted as defect point.
a寸法が1mm未満の場合は欠点としない。

3) A chip area covered with sealing cement should not be counted as defect point.
封着前の欠けは、欠けの中に封着セメントが流入していれば欠点としない。

4) Up to 3 chips within this specification in a same display to be allowed.
表示管全体で規格内の欠け数は3ヶまで良品とする。

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