Warranty

All Chroma instruments are warranted against defects in material and workmanship for a period of one year after date of shipment. Chroma agrees to repair or replace any assembly or component found to be defective, under normal use during this period. Chroma's obligation under this warranty is limited solely to repairing any such instrument which in Chroma's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Chroma.

This warranty does not apply to any products repaired or altered by persons not authorized by Chroma, or not in accordance with instructions furnished by Chroma. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Chroma assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Chroma assumes no liability for secondary charges or consequential damages and in any event, Chroma's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Chroma for use of its products are based upon tests believed to be reliable, but Chroma makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Chroma any liability in connection with the sale of our products other than set forth herein.

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WARNING

To avoid damage to this instrument, pay special attention to the following:

1. Proper system grounding connection
2. Proper signal output connection

(1) System grounding connection

All signal output stages in this system are equipped with electrostatic discharge (ESD) protection circuit. But during application, follow the steps below to protect the generator against electrostatic discharge or power leakage.

(a) The generator case grounding is linked to the Safety Ground of the power socket, and this pin should really be connected to the factory earth ground.

(b) Before connecting the interface signal cable from the monitor to the generator, make sure the ground pin is connected first to discharge any potential difference between the monitor ground and the generator ground.

It is best to use a shielding cable with its shielding layer connected to the metal case of the connector and the monitor chassis ground. The output signal of the generator is also connected in this way. In this case, the user can simply plug the connectors together to discharge any potential difference between the monitor ground and the generator ground by the touch of the metal cases before the signal wires are connected.

(c) The electrostatic discharge speed is not so quick as immediate. Therefore misuse of it may damage the generator. It is best to connect the Safety Ground on the Monitor and the Monitor Case to the factory grounding cable so that the generator GND is the same as the Monitor GND.

(2) Signal Output Connection

Output signals must not contact with each other nor with any DC/AC power inside the monitor to avoid damage to the generator output circuit.

Table of Contents

1. An Overview

1.1 How to Read the Manual

The system is to produce various kinds of output signals for CRT&LCD to display a series of particular patterns in adjustment and inspection. Before using the system, you have to understand the input signals of a monitor and its methods of wiring roughly. In operating the system, if you can connect a VGA or Multi-Sync monitor to the output of the system, you will watch the change of output signals on the screen at the same time, and thus get a better effect.

Suggestions on Reading

(1) First, read the names and definitions of the basic timing graphs on 2.1.
(2) Then, read the arrangements of the front and back panels on 2.2. If the monitor mentioned above is ready, you can connect the R, G, B, H, V output by the analog of the system to the input side of the monitor, and then power on.
(3) Operate by yourself according to the steps described on 2.3, and output the signals to the monitor until the patterns appear according to the explanations on 2.4.
(4) Read Chapter 3 carefully in order to modify any parameter at will and understand its meaning. Do not change arbitrarily the pixel rate (MHz) and H total in Timing Format on 3.1, otherwise the monitor will be damaged because of too high horizontal frequency.
(5) If there is any error message occurring in the operation, you can refer to 2.5. So far you have learned how to operate the system.
(6) The system offers some added functions of control and index in the two keys of CONFIG and SEARCH on 2.6 for the convenience of use.
(7) The detailed specifications of the system are listed on 1.4 for reference.
(8) Chapter 4 is about calibration and maintenance. You do not need to read it closely if the system is all right.
(9) Chapter 5 is about the use of RS232C. You do not need to read it if you do not use RS232C.
(10) Appendixes A, B, C and D are a built-in data base. The data base can be displayed on the monitor bit by bit through the key of Search. Appendix B explains further concerning the built-in Pattern. Reading of it will make you know more about the occasion and purpose of using Pattern.

1.2 Introduction of the Products

The products of the system include Model 2135 (135MHz), Model 2165 (165MHz), Model 2220 (200MHz), and Model 2250 (250MHz). These four models are different in the bandwidth of frequency, but this manual is fit for all of them. Except the highest range of frequency, the four models are the same in operation, action, and data structure; accordingly, the PC data files or memory cards are compatible among them, and thus the data management can be simplified.

1.3 Special Functions

(1) A Wide Range of Video Frequency:
The four models in the system offer the highest pixel rate from 135 MHz to 250 MHz. The horizontal frequency reaches 250 KHz and the vertical one 1KHz. They meet the production, research, test, and inspection of current and future monitors on market.

(2) Two Output Signals for Choice:
There are two kinds of output signals for choice: TTL (digital logic), ANALOG (analog signal), and ECL. They meet the testing requirements of various monitors.

(3) The Simulation of the Setting of Super Frequency:
If the setting of pixel rate exceeds the highest output frequency in the system, the system will divide the frequency automatically, and get an output with changeless horizontal, vertical frequency, size, phase but lowered resolution in order to simulate the monitor of super frequency in test.

(4) Easy and Automated Operation:
The system has a built-in, humanized software for operation. All parameters can be easily set, and input through the keys on the panel or RS-232/485C in order to fully reinforce the automated production.

(5) The Biggest Capacity of Graphic Display:
The system has a super VRAM of 32 Mbits. The graphic size it provides can reach $2048 \times 2048 \times 8$ planes. In other words, each displayed pixel has 256 color for choice on a monitor of 2048×2048.

(6) Flexible Output Control:
Programmable combination of Timing and Pattern can be output manually or automatically. The output of output signals like R, G, B, Reverse and control signal like 16-bit TTL is instant.

(7) Rich Data Base of Timing and Pattern:
In the data base there are rich built-in patterns for standard test like SMPTE, Rate of Change in High Voltage, X-Hatch, Color Delay, 256 Color, Cross Scanning Inspection,

Dynamic Patterns of Display, Windows Picture, etc. The data base is quite helpful for the production testing of monitors.

(8) A Memory Bank with Large Capacity:

1. **FLASH :** 100 Timing/100 Pattern are built in.
2. **NVRAM :** 300 Timing/100 Pattern/100 Program are for setting.
3. **IC Memory Card :** 2600 Timing/600 Pattern/899 Program are for setting.

(9) Four Different Models:

The four models are different in frequency, but share all data files. They can be upgraded at any time.

1.4 Specifications

■ **Pixel Rate**

Accuracy: smaller than 25PPM typical (50PPM maximum)

■ **Graphic Display**

2048 × 2048 × 8 Planes (can be expanded to 4096 × 2048 × 8)

■ **Scan Mode**

Non-interlace

Interlace Video & Sync.

■ **Analog Output**

- Video Output

  Video: R, G, B (load of 75 OHM)

  Sync on Green: On/Off Programmable

  Video Level: 0-1.0V Programmable (resolution: 0.37 mV)

  Sync Level: 0-0.5V Programmable (resolution: 0.156 mV)

  White Level: 0-1.2V Programmable (resolution: 0.66 mV)

  Black Level: 7.5 or 0 IRE

  Rise/Fall Time: 1.6nS typical (2nS maximum)

- Separable TTL Sync

  Hs, Vs, Xs (Hs, Vs, or Composite-Sync can be chosen)

  Rise/Fall Time: 3nS typical (5nS maximum)

■ **TTL / ECL Output**

Video: 6 / 4-bit plane

Sync: Hs, Vs, Xs

Rise/Fall Time: 3 / 1 nS typical (5 / 2 nS maximum)

(Up to 80 MHz)

- **Horizontal Timing**
  - Width of Horizontal Scanning: 128-8192 Pixels
  - Width of Sync Signal: 16-8191 Pixels
  - Location of Sync Signal: leading edge in blanking period
  - Resolution: 1 Pixel
- **Vertical Timing**
  - Width of Vertical Scanning: 8-4096 Lines
  - Width of Sync Signal: 0-4095 Lines
  - Location of Sync Signal: leading edge in blanking period
  - Resolution: 1 Line
- **Composite Sync Signal**

  H+V, H Exclusive or V, or RS343A waveform with equalizational & serration pulse.
- **Data Storage Device**

  FLASH: 100 Timings + 100 Patterns

  NVRAM: 300 Timings + 100 Patterns + 100 Programs

  Memory Card: limitless storage of data

  Disk on PC: limitless storage of data
- **User Interface**

  keypad, RS232/485C, remote keypad, 16 output bits
- **AC Input**

  90-132V/180-264V, automatic switching of 47-63Hz
- **Exterior Size & Weight**

  430mm (W) × 133mm (H) × 380mm (D)

  19″ rack mounting kit is optional.

  Weight is about 12 Kg.

Note : For the specifications of LCD module refer to Appendix E.

1.5 Equipment and Accessories

<A> Standard Equipment

1. a main system

2. a power cord with three conductors
3. a manual

<B> Optional Equipment

1. a signal cord of analog (5 BNC connectors) converting to 15-pin D-type connector VGA monitor
2. a signal cord of 24-pin centronic converting to 9-pin D-type connector EGA monitor
3. a 1.5-meter BNC to BNC cable signal cord with the same axis (75Ω)
4. an RS-232C cable of 9 pins to 9 pins or 9 pins to 25 pins
5. a memory card
6. a remote keypad with 23 kyes
7. a PC-based control software

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Table of Contents

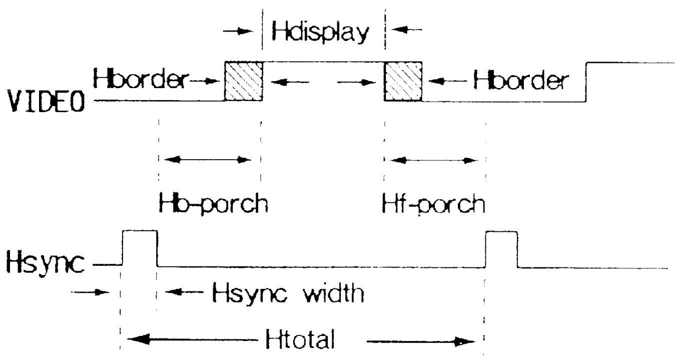
2. Operation on the Panel

Before operation there is a simple explanation about a monitor's Timing Graphs of Video/Sync Signals on 2.1. The names of parameters used in this system are designated on 2.1 too. The locations of important parts on the front and rear panels are introduced on 2.2. The operational procedures of general keys are explained on 2.3. The operation of keys concerning Output Enable and Disable is particularly explained on 2.4. The error messages in operation are listed and explained closely on 2.5. Besides, some special limits on use are listed on 2.5 too. The actions of these two keys, CONFIG and SEARCH are discussed on 2.6.

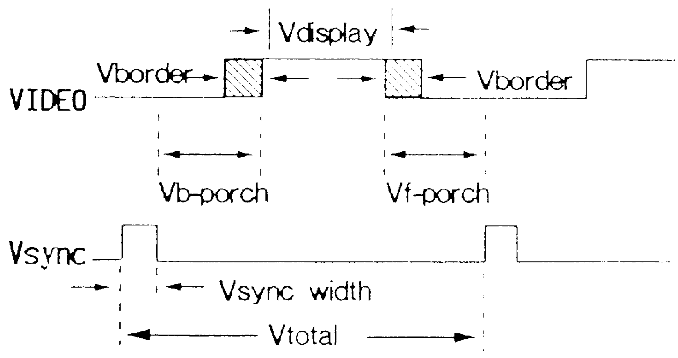
2.1 The Timing Graphs & Parameter Names

There are three kinds of input signals in a monitor: Video, Horizontal Sync, and Vertical Sync. The timing relation among these three signals is generally expressed in the following two graphs.

<A>



<B>



Graph A shows the timing relation of Video and Hsync while graph B that of Video and Vsync. All parameters can be expressed in absolute time (μS or mS) or unit time (pixel). The two units are convertible. In order to increase accuracy and speed of operation, you are recommended to express in pixel.

The definition of parameters:

- Htotal — It represents the time of a scanning horizontal raster line.
- Hdisplay — It represents the time of a picture displayed on a scanning horizontal raster line.
- Hb-porch — H back porch is a period of time from the end of Hsync signal to the start of Hdisplay.
- Hsync Width — It represents the time of the width of Hsync signal.
- Hborder — The part is not included in general standard signals. It is only symmetrically and slightly included in some special display types, before and after the time of display, to show more picture section.
- Hf-porch — H front porch is a period of time from the end of Hdisplay to the start of Hsync.
- Vtotal — It represents the time of a whole vertical field.
- Vdisplay — It represents the time of the display of vertical field.
- Vb-porch — V back porch is a period of time from the end of Vsync signal to the start of Vdisplay.
- Vsync Width — It represents the time of the width of Vsync signal.
- Vborder — The part is not included in general standard signals. It is only symmetrically and slightly included in some special display types, before and after the time of display, to show more picture section.
- Vf-porch — V front porch is a period of time from the end of Vdisplay to the start of Vsync.

The 12 parameters mentioned above, except Hf-porch and Vf-porch, will be used in the system. The values of Hf-porch and Vf-porch can be calculated once the other parameters are existing.

- Hf-porch = Htotal – Hsync width – Hb-porch – Hdisplay
- Vf-porch = Vtotal – Vsync width – Vb-porch – Vdisplay

* The examples of converting absolute time to pixel are shown as follows:

1. The Time of One Pixel :
   If Fp (Pixel Frequency) is 100MHz, the time of one pixel can be expressed as
   tp = 1/Fp = 1/100MHz = 10nS.

2. Horizontal Parameters :
   Htotal = 10µS means
   (a) H.Freq = 1/10µS = 100 Khz.
   (b) 10µS ÷ tp = 1000 (pixels)
       Therefore, Htotal = 1000 (pixels) is the value of the expression in pixel.

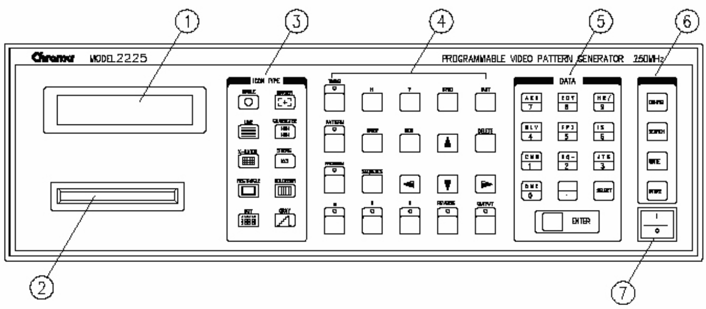
   Hdisplay = 8µS means
   8µS ÷ tp = 800 (pixels)
   Therefore, Hdisplay = 800 (pixels)
   The same conversion can be applied to Hsync width, Hb-porch, Hborder.

3. Vertical Parameters : (suppose Htotal =10µS)
   Vtotal = 16mS means
   (a) V.Freq = 1/16mS = 66.667Hz
   (b) 16mS ÷ 10µS (Htotal) = 1600 Lines
       Therefore, Vtotal = 1600 (pixels)
   Note : One pixel in vertical direction represents the time of a
   horizontal raster scanning line.

   Vdisplay = 12mS means
   12mS ÷ 10µS = 1200 Lines
   Therefore, Vdisplay = 1200 (pixels)
   The same conversion can be applied to Vsync width, Vb-porch, Vborder.

2.2 Front & Rear Panels

The Front Panel



(1) LCD Display Screen of 20×2

(2) Memory Card Slot (optional)

(3) Keys for ICON

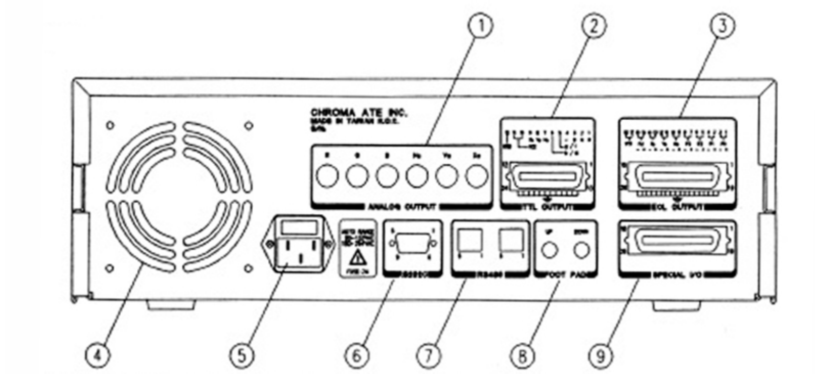
(4) Basic Function Keys

(5) Numerical Keys

(6) Special Function Keys

(7) Power Switch

The Rear Panel



(1) Output of Analog Video/Sync (BNC)

(2) Output of TTL Video/Sync (24 pins)

(3) Output of ECL Video/Sync (36 PIN)

(4) Fan

(5) Power Socket

(6) RS-232C Socket (9 pins)

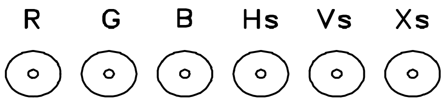
(7) RS485C Socket (2 pin X 2)

(8) Foot Pad Up/Down connector

(9) 16 Bit O/P, Remote Keypad connector (36 pin)

About the Connectors

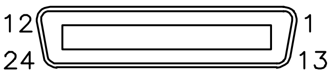
(1) Analog Video/Sync Socket (BNC, refer to subsection 4.1)



R, G, B are analog signals, so they must be connected with a load of 75 Ω.
Hs, Vs, Xs are separable Hsync, Vsync, Xsync signals in TTL. They are for the monitor of separable Sync signals.

(2) TTL Video/Sync Connector (24 pins, refer to subsection 4.1)

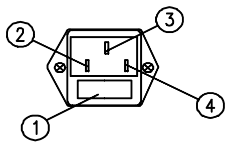
12	11	10	9	8	7	6	5	4	3	2	1
ECL /Fd	ECL Fd	+5V	Xs	Vs	Hs	b/M	g/I	r	B	G	R



Pin 1 to pin 6 are video signals for EGA's R, G, B, r, g, b. If the monitor is CGA, pin 1, pin 2, pin 3, pin 5 are used for R, G, B, I ; if it is mono, only pin 6 is used for video. Pin 13 to pin 24 are connected to GND. ECL Fd, /Fd are for self-test, and a terminator must be added.

(3) Power Socket

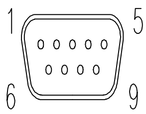
1. Fuse holder (spare fuse included)
2. Line
3. GND
4. Neutral



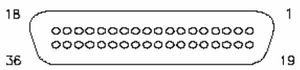
(4) RS-232C Connector (DB-9 pins, for details refer to Chapter 5)

Data Terminal Pin Out:

1. NC
2. RxD (connects the PC's TxD)
3. TxD (connects the PC's RxD)
4. DTR (connects the PC's DSR)
5. GND (connects the PC's GND)
6. DSR (connects the PC's DTR)
7. RTS (connects the PC's CTS)
8. CTS (connects the PC's RTS)
9. NC



(5) Special I/O Connector (36 pins)

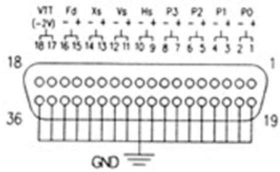


1 BIT# 0	10 GND	19 BIT# 1	28 GND
2 BIT# 2	11 S7	20 BIT# 3	29 RL0
3 BIT# 4	12 S6	21 BIT# 5	30 RL1
4 BIT# 6	13 S5	22 BIT# 7	31 RL2
5 BIT# 8	14 S4	23 BIT# 9	32 RL3
6 BIT# 10	15 S3	24 BIT# 11	33 RL4
7 BIT# 12	16 S2	25 BIT# 13	34 RL5
8 BIT# 14	17 S1	26 BIT# 15	35 +5V
9 GND	18 S0	27 GND	36 +5V

(6)RS485 Connector

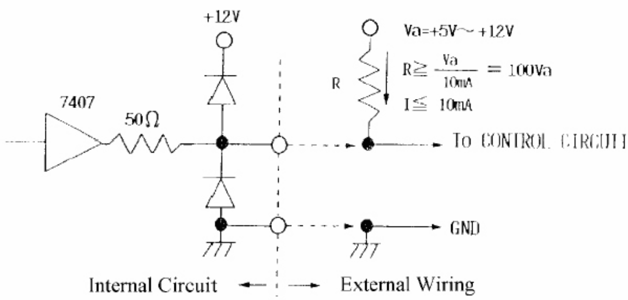
PIN: 1 = N.C
2 = N.C
3 = DATA+
4 = DATA-
5 = N.C
6 = N.C

(7)ECL Video & Sync



P0 = R
P1 = G
P2 = B
P3 = I

Bit # 0 to 15 is the 16-bit digital output. It can be used to control external circuit; for example, relay. Its value is set in Timing Format. Its output is open collector type. The circuit of each bit is as follows:



S0 to S7, and RL0 to RL5 are the wiring of remote keypad. When short happens between a line S and a line RL, it means that a key is pressed. The location of each key is shown as follows.

	S0	S1	S2	S3	S4	S5	S6	S7
RL0	CONFIG	SEARCH	WRITE	STORE	9	6	3	SELECT
RL1	8	5	2	"."	7	4	1	0
RL2	QUIT	DELETE	→	OUTPUT	SYNC	↑	↓	REVERSE
RL3	V	ICON	←	B	H	DRAW	SEQ	G
RL4	TIMING	PATTERN	PROGRAM	R	MARKER	CHARACTER	STRING	COLORBAR
RL5	CIRCLE	LINE	X-HATCH	RECTANGLE	DOT	GRAY	ENTER	

Note : For the definition of LCD module refer to Appendix E.

2.3 Operation of General keys

2.3.1 Introduction

Before operating the panel, let's see what we want to input to the system through the panel. First, we like to produce a certain pattern on the monitor through the output of the system. Because of the wish, we must set correct values for the timing parameters mentioned on 2.1. Then, we have to set needed patterns to form the video waveforms. Thus doing, we will get correct patterns on the monitor. All the timing parameters are called a Timing Format. All the parameters for defining a pattern are called a Pattern Format.

After the parameters have been set, various kinds of Timing Formats can be stored at different positions in the system. You can use them according to their numbers of positions (Timing No. 1~3000) in the future. Similarly, Pattern Formats can be also stored at Pattern No. 1~800.

In the test of a monitor, a variety of timing relation and patterns are often needed to be tested. We can store the numbers of Timing Formats and Pattern Formats in advance according to their order. Then, we may retrieve all of them simply by a number, and execute the output one by one. This is called a Program Format. The range of its numbers is Program No. 1~999.

The settings of Timing, Pattern, Program, and the setting of Icons which is essential in the setting of Pattern will be described in Chapter 3. Judging from the classification of keys on the front panel, basic function keys and keys for Icon are required in this chapter. As for the special function keys like CONFIG, SEARCH, WRITE, STORE, they are used in the setting of RS-232C.

2.3.2 The Status of Power-On

Let's do the basic operation on the panel. First, power on and you can see the following message on LCD.

```
---- SELF TEST ----
-- PLEASE WAIT --
```

After several seconds, if the self-test is all right, the following message will appear. And after two seconds, the status of output will be as follows according to the condition of last power-off. If the self-test is wrong, please refer to subsection 2.5.

```
＊＊＊ SYSTEM READY ＊＊＊
C2135   V1.6   2048X10 24
```

It means that the model is 2225, software version 1.0, and VRAM capacity 2048×2048.

(1) If you power off in the condition of OUTPUT DISABLE last time, it will be the same condition this time.

(2) If you power off in the condition of OUTPUT ENABLE last time, it will be the same condition this time, and the output will be the same Timing, Pattern or Program Format.

LCD shows the currently output Timing No. or Program's Sequence No. Once **QUIT** is pressed, the status will become OUTPUT DISABLE, and LCD will show as follows.

```
＊＊＊ SYSTEM READY ＊＊＊
C2135   V1.6   2048X1024
```

2.3.3 Examples of Operation

According to Appendix A, the Timing Format of VGA 640×480 is stored at # 13. Retrieve it by pressing the following keys one by one.

TIMING , **1** , **3** , **ENTER**

LCD shows the name of the Timing Format automatically as follows.

```
TIMING      （KEY＝0 - 9）
NAME＝VGA     640× 480
```

If you do not want to change the name, press **▼** , and LCD will turn to next parameter as follows.

```
PIXEL = 25.175 MHz
3.126 - 480.000
```

3.126 - 480.000 is the suggested range of input. If you press **3** , **.** , **0** , **ENTER** , you will hear a sound of beep, and LCD will show the error message of a too large or too small input value. It will also suggest the range of input value as follows.

```
DATA   RANGE   ERROR
RANGE＝3.126 - 480
```

Now, if you press any key, LCD will return to the original display as follows.

```
PIXEL＝25.175MHz
3.126 - 480.000
```

You can see that the just input 3.0MHz is not accepted. The pixel is still 25.175 MHz. If there is any mistaken input or wrongly pressed key, the system will produce a sound of beep to reject.

By the use of [◄] , [►] you can modify any digit of a parameter value. By the use of [DELETE] you can erase the value at which the cursor stays, and move all values behind to left one digit.

So far you will see that the use of [▲] , [▼] , [◄] , [►] , [DELETE] , [ENTER] [0] ~ [9] is quite easy. It is similar to the use of a PC's keyboard. As long as you do not press ENTER, all modified values will not enter into the system. In addition, if there is a value beyond the range, and you press ENTER to save it, it will not be accepted, for an error message will appear.

2.3.4 The Action of [SELECT]

Continue to press [▼] to the next parameter, and LCD will show as follows.

```
INTERLACE MODE？   YES
0＝No，1＝Yes
```

Now press [0] , and data will change from YES to NO automatically. Press [1] again, and data will change back to YES. Also, you can press [SELECT] to change data. Here Yes/No will progress alternately. But if data are various, pressing [SELECT] will change them one by one. When you have selected correct data, you must press [ENTER] , otherwise the input is incomplete. Pressing [SELECT] upon the input of a pure value will make the digit at which the cursor stays become a value plus one (+1).
Now, press [▲] several times to return to the display of Timing Name as follows.

```
TIMING    （KEY＝0 - 9）
NAME＝VGA    640x 480
```

Here data is alpha-numeric. Pressing [SELECT] will change the definitions of the datakeys from 0~9. For example, LCD shows KEY = 0~9, so pressing [7] is to select "7". But one more pressing of [SELECT] will make LCD show as follows.

```
TIMING    （KEY＝A - J）
NAME＝7
```

Now, pressing [7] will become the input of "A" as follows.

```
TIMING    （KEY＝A - J）
NAME＝7A
```

One more pressing of SELECT will become "KEY = K–T". One more pressing will be "U - %", and one more will be "0 - 9". It is easy for the input of English letters. The English letter represented by each numerical key is printed above each key on the front panel.

2.3.5 Input of Timing Format

TIMING , H , V , SYNC are used to input Timing Format. Basically, after pressing the key of Timing, you can use ▲, ▼ to see all parameters. In order to move quickly to the positions of another group of parameters, H , V , SYNC are invented as three different entrances for the whole Format parameters. Once you enter, you can still use ▲ , ▼ to search the positions of correct parameters. For detailed explanations of parameters please refer to Chapter 3.

The system will check if the interrelation among all parameters is correct when you press TIMING , or retrieve a new Timing Format. If there is something wrong, "RELATION ERROR" will appear. For the messages please refer to 2.5. If there is no relation error, the system will check if the Timing Format stored in NVRAM or a memory card has checksum error, or data are stored in a memory card which is not inserted, or the Timing Format is an empty format which has never been used. LCD will probably show as follows.

TIMING（CHECKSUM　ERR） # ＝XXXX

TIMING（CARD） # ＝XXXX

TIMING（EMPTY） # ＝XXXX

2.3.6 Input of Pattern Format

PATTERN , DRAW , ICON , and ten keys for ICON are the input keys in relation to Pattern. The input of Pattern is similar to that of Timing. For details please refer to Chapter 3.

2.3.7 Input of Program Format

PROGRAM , SEQ are the input keys in relation to Program. The input of Program is similar to that of Pattern. In one Program 40 sequences can be set. Each sequence includes a Timing Format No., a Pattern Format No., and its duration (seconds). According to its Timing/Pattern, each sequence will produce the output. When time is up, the next sequence will automatically produce the output according to its Timing/Pattern. For details please refer to Chapter 3.

2.3.8 Special Function Keys

Special function keys includ CONFIG SEARCH WRITE STORE . Each of them will be described as follows.

CONFIG : In this key some system status can be set such as Data-Lockout, Baud Rate of RS-232C, etc. Besides, the key can be used to execute the program of self-diagnosis too. For details please refer to 2.6.

SEARCH : This key lets you inquire a data file such as the catalog of Timing Format. You do not need to peruse the manual. For details please refer to 2.6.

WRITE : This key lets you establish different characters, strings or color pens for Pattern. For details please refer to 3.5 ~ 3.7.

STORE : This key lets you store the four data files of Timing, Pattern, Program, and Icon into the system's memory for later use. For details please refer to 3.1 ~ 3.4.

2.3.9 Keys for Controlling Output

The six keys, R , G , B , REVERSE , OUTPUT , QUIT , in relation to the control of hardware output enable/disable are going to be explained in details on 2.4.

2.4 Output Enable/Disable

The keys concerning output include QUIT , OUTPUT , R , G , B , and REVERSE . They will be explained one by one from 2.4.1 to 2.4.3.

2.4.1 The Key of QUIT

Any time if you want to stop output, you can press this key, and LCD will show as follows.

```
＊＊＊SYSTEM READY＊＊＊
 C2135 V1.6   2048× 1024
```

Five LEDs of R, G, B, REVERSE, and OUTPUT will be all turned off.

2.4.2 The Key of OUTPUT

When the LEDs of Timing, Pattern, Program are all turned off, pressing OUTPUT will produce no action but a sound of beep. At this moment, you must press any one of the above three keys and make it lighted, then press OUTPUT to produce output as follows.

(1) When the LED of Timing or Pattern is lighted, pressing OUTPUT means to do Output Enable. The output is called single output when it is produced according to Timing and Pattern Format. At this moment Output LED will be lighted.

(2) When the LED of Program is lighted, pressing OUTPUT means to produce output according to the Timing/Pattern Format designated by the first sequence in Program. This way is called sequential output. At this moment Output LED will be lighted too.

In sequential output LCD will show the currently output data of sequence for reference.
If the time (second) in the sequence is not 0, when the time of output is up, the next sequence will be automatically output until the last one. Then, the first sequence will be output once more. If Timing or Pattern Format in the sequence is "0", the sequence is nothing, and will be skipped without execution.

In sequential output, if you press a key which is neither QUIT nor within the range of 0 to 9, the output will stay at the current sequence, and move forward no longer until the next key is pressed. If the key is neither within the range of 0 to 9 nor ▼, the output will move to the next sequence. If the key is ▲, the output will return to the previous sequence, then move downward. WAIT will be shown at the left lower corner on LCD when output halts temporarily.

In the progress of sequence, pressing 0 to 9 , if the largest defined sequence No. is No. 9, the sequence which is pressed will be executed at once. When time is up, the progress will be forward automatically. But if the largest sequence No. is beyond 9, pressing 5 to 9 will also directly output the sequence which is pressed. However, if you press 0 to 4 , the output will halt temporarily until the second numerical key is pressed, and the system knows which sequence is ready to be executed; for example, 01, 13, etc.

In the setting of a sequence, if the time (second) is 0, after the sequence is output, the progress will halt until ▲, ▼, or 0 ~ 9 is pressed. WAIT will be shown at the left lower corner on LCD when output halts. For the setting of a sequence please refer to 3.3.

2.4.3 The Other keys

When the three colorful signals: TTL-RGBI, RGBrgb, Analog Color are output, the LEDs of R, G, B will be lighted, but the LED of REVERSE will be extinguished. At this moment, pressing the four keys once means OFF, and once more ON. For example, pressing R once means R LED OFF. R is no longer existing in the output signal. In the case of RGBrgb, R and r are all LOW. Pressing R once more, the status will return to R LED = ON. In other words, if there is R existing originally in Pattern, there will be the output of R's Video. The same action can be applied to G and B.

Pressing REVERSE will make the current Pattern become Complement Pattern, and one more pressing will make the status recover. Complement Pattern means that all pixels on the picture have become the complementary color of the original picture.

2.5 Error Messages and Special Limits

Error messages will be shown on LCD if there is something wrong in self-test, or some key is wrongly pressed, or relation error is existing in Timing. The meaning of each error message is given below.

2.5.1 Error Messages of Power-On

```
CHECKSUM ERROR
FLASH MEMORY IS BAD
```

It means that there is a checksum error in the flash which stores program. The system halts, and the flash need changing.

```
------- SELF TEST -------
SYSTEM RAM ERROR
```

It means that SRAM read/write is abnormal. The system halts, and SRAM needs changing.

```
ERROR：PRESS  "CONFIG"
C2135  V1.5  2048× 1024
```

It means that there are some problems existing in self-test after the machine is powered on. Pressing **CONFIG** will make you get the following display. If you choose YES, you can see the error list tested during power-on.

```
LIST  PWR  ON  ERR？
0＝No，1＝Yes
```

After **YES** , **ENTER** have been pressed, a possible message will appear as follows.

```
TIMING  XXXX
CHECKSUM  ERROR
```

Only after checking, modifying and storing the data anew can the error be removed.

```
PATTERN  XXX
CHECKSUM  ERROR
```

```
PROGRAM  XXX
CHECKSUM  ERROR
```

```
PLL  IS  DEAD
PRESS  "↓"
```

The PLL circuit works abnormally. It ought to be repaired.

```
PLL  IS  INACCURATE
PRESS  "↓"
```

```
NVRAM  R/W  ERROR
PRESS  "↓"
```

NVRAM READ/WRITE is abnormal. It ought to be changed.

```
MEMORY CARD ERROR：
BATTERY  IS  TOO  LOW
```

The battery on the memory card ought to be changed.

```
MEMORY CARD ERROR：
BATTERY  IS  DEAD
```

The battery ought to be changed too. The stored data have been damaged, so they need to be updated.

In addition, the relation error messages described on 2.5.3 will probably appear too. They mean the errors in Timing Format.

2.5.2 Error Messages in Operation

```
DATA   RANGE   ERROR
RANGE＝XXX ~ XXX
```

The parameter value which can be input is displayed on the second row for reference. Pressing any key will let you obtain the original picture on LCD again.

```
UNFORMAT MEMORY CARD
```

It means that when a natural picture is stored onto memory card, the card is found not formatted.

```
ALLOCATE SPACE ERROR
```

It means that when a natural picture is stored onto memory card, the allocation of space fails.

```
ERASE ERROR
```

It means that the erasion of a natural picture from the memory card fails.

```
THIS FILE DATA ERROR
```

It means that when a natural picture of memory card is stored onto flash memory, or uploaded to the host (PC), the picture is found wrong.

```
THIS FILE OVER 320KB
```

It means that when a natural picture of memory card is stored onto flash memory, the picture should not exceed 320 kbytes.

```
MEM SPACE NOT ENOUGH
```

It means that when the natural picture of flash memory is copied to memory card, the space of the card is found not enough.

```
FORMAT ERROR
```

It means that when the memory card is formatted into a natural picture, there is a mistake.

```
MEMORY CARD ERROR：
HEADER NOT FOUND
```

It means that when the software version is updated, the memory card's header ID is found not the same as F/W.

```
INVALID F/W C23XX
CAN NOT UPDATE
```

It means that when the software is updated from memory card (F/W data are stored here) to flash memory, the F/W data are found unfit for the system.

```
UART：NO RESPONSE
PRESS ANY KEY
```

It means that the connection between the host (PC) and the system fails.

```
MEMORY CARD ERROR:
CHECKSUM ERROR
```

It means that when the software version is updated, the checksum value of the F/W program stored on the memory card is found wrong.

```
CANNOT ERASE MEMORY!
 FLASH MEMORY IS BAD.
```

It means that when the software version is updated, the erasion of flash memory's contents is found wrong.

```
CANNOT PROGRAMMING!
FLASH MEMORY IS BAD.
```

It means that when the software version is updated, the F/W code written into flash memory is found wrong.

```
INSERT MEMORY CARD
WITH F/W CODE
```

It means that the flash memory is found wrong when the instrument is powered on, so the software version needs to be updated. Please insert a memory card with F/W data, power on the instrument again, and the system will update the software version automatically.
A sound of beep means that pressing of the key is invalid.

2.5.3 The Meaning of Relation Errors

In Timing Format there must be some relation existing among the values. When the relation is broken, the system cannot work. Pressing **OUTPUT** or **TIMING** will let you know the situation, and urge you to correct the parameters. The errors can be classified as follows.

(1)

```
TIMING   XXX   ERROR：
Htotal   too   small
```

(a) It means that Hdelay = Htotal − Hb-porch − Hsync width − Hdisplay < 0, so Htotal should be enlarged, or Hb-porch, Hsync width, Hdisplay should be reduced in order to make Hdelay ≥ 0.

(b) It means that the time of blanking is too short, so Htotal should be enlarged. Blanking should take at least 16 pixels, and more than 1.1µS.

(2)

```
TIMING   XXX   ERROR：
Hborder   too   big
```

(a) It means that Hborder > Hdelay.

(b) It means that Hdisplay + 2 Hborder > 2048, so Hborder or Hdisplay should be reduced, or Hdelay enlarged.

(3)

```
TIMING   XXX   ERROR：
Hb-porch   too   small
```

It means that the time from the start of Hsync to that of Video is too short (Hsync width+Hb-porch), the system cannot output, so Hsync or Hb-porch should be enlarged.

(4)

```
TIMING   XXX   ERROR：
Hsync   width   too   big
```

It means that Hsync width ≥ Htotal − 48, so Hsync width should be reduced, or Htotal enlarged.

(5)

```
TIMING   XXX   ERROR：
Vtotal   too   small
```

It means that Vdelay = Vtotal − Vsync width − Vb-porch − Vdisplay < 0, so Vtotal should be enlarged, or Vsync width, Vb-porch, Vdisplay reduced.

** NOTE : In Interlace Mode, if Vdelay = 0, the interior of the system will change it to 1 automatically (reduce 1 from Vb-porch) to execute.

(6)

```
TIMING   XXX   ERROR：
Vborder   too   big
```

(a) It means that Vborder > Vdelay.

(b) It means that Vdisplay + 2 Vborder > 2048 @ NON-INTERLACE

(c) It means that Vdisplay + 2 Vborder > 1024 @ INTERLACE

** NOTE : In Interlace Mode, the values of Vdelay, Vborder, Vtotal, Vdisplay are those in every Field; that is, the halves of Frame values.

(7)

```
TIMING   XXX   ERROR：
Vb-porch   too   small
```

(a) The time from the start of Vsync to that of Video is smaller than or equal to 0, so Vb-porch or Vsync width should be enlarged.

(b) In Interlace Mode, the following two conditions cannot exist.

Vb-porch ≤ 2 @ Vsync width = 0 or

Vb-porch ≤ Vsync width @ Vsync width ≠ 0

** NOTE : If Vdelay is 0, the above Vb-porch should be reduced 1, and taken as real Vb-porch for the comparison of the expression.

(8)

```
TIMING   XXX   ERROR：
Vsync   width   too   big
```

It means that Vsync width ≥ Vtotal, so Vtotal should be enlarged, or Vsync width reduced.

(9)

```
TIMING   XXX   ERROR：
V   Total   too   big
```

(a) Vtotal > 4096 @ NON – INTERLACE or

(b) Vtotal > 2047 @ INTERLACE

(10)

TIMING XXX ERROR：
White level too small

It means White level < Video level should equal or larger than Video level.

(11)

TIMING XXX ERROR：
White level too big

It means White level > 1.2V.

(12)

TIMING XXX ERROR：
Pixel rate = 40 – 136 MHz

It means when LVDS and CLOCK mode choose LCD – 1/2FD, Pixel rate is bigger than 136 MHz or smaller than 40 MHz.

(13)

TIMING XXX ERROR：
Pixel rate = 20 – 68 MHz

It means when LVDS and CLOCK mode choose LCD–FD, Pixel rate is bigger than 68 MHz or smaller than 20 MHz.

(14)

TIMING XXX ERROR：
Pixel rate = 25 – 112 MHz

It means Panel Link, and Pixel rate is bigger than 112 MHz or smaller than 25 MHz.

2.5.4 The Error Messages of Simulation

(1)

TIMING XXX SIMULATE
Hsync width too big

In simulation of Fp ÷ N, it is possible that the error of Hsync width ≥ Htotal will happen, and output will not work because of round-off. Hsync width should be reduced, or Htotal enlarged.

(2)

TIMING XXX SIMULATE
BLANKING too small

In simulaiton of Fp ÷ N, it is possible that the time of horizontal blanking is smaller than 16 pixels or 500ns because of round-off. Htotal should be enlarged, or Hdisplay reduced.

2.5.5 Others

```
. . . . . . . . . . . . . . . . . . . . . .
NVRAM   WRITE   ERROR
```

It means that NVRAM cannot make write work. Please use another position, or get a new NVRAM.

```
TIMING   0115   TRANSFER
XXXXX   Too   Big
```

```
TIMING   1000   TRANSFER
XXXXX   Too   Small
```

If the converted value exceeds the permitted range during pixel's unit conversion of μS/mS, the above two transfer errors will appear. You must correct the mistake, otherwise you cannot convert.

2.5.6 Special Limits

Some actions of the system under certain circumstances are not what you expect. They are listed here despite that they are barely used.

(1) In Interlace Mode, only Hdelay ≥ 1 can the system work. If Hdelay = 0 after the calculation of the value in Timing, it will change to Hdelay = 1 automatically, and reduce 1 from Hb-porch.

(2) In Interlace Mode, if Vb-porch is not larger than Vsync width above one line, the system cannot work, and relation error (7) will happen.

(3) In Interlace Mode, if Xs = SERR, equalization pulse must exist in all time of Vf-porch (one pulse every 1/2 line, and the width Hsync width ÷ 2). Equalization pulse also exists from the start of Vb-porch to the time equivalent to Vsync width. In Non-interlace Mode, if Xs = SERR, there is no equalization pulse but serration pulse. Each line has a pulse, and the width of the pulse is equal to that of Hsync.

(4) It is correct only when the width of all equalization and serration pulses is the values of resolution in Htotal, Hsync width and Hb-porch. When the above values are not those of resolution, minimum error is possible, but the position of rising edge is still correct. The so-called value of resolution means that its pixel figure is the integer

multiple of N. According to the range of each Fp given below, the value of N can be 16, 8, 4, 2, 1.

Value of N	C2135	C2165	C2250	C2250
16	80-135MHz	82.5-165MHz	100-200MHz	125-250MHz
8	40-79.999	41.25-82.499	50-99.999	62.5-124.999
4	20-39.999	20.63-41.249	25-49.999	31.25-62.499
2	10-19.999	10.32-20.629	12.5-24.999	15.625-31.249
1	<10	<10.32	<12.5	<15.625

(5) In Blink Pattern, twofold VRAM of Hdisplay × Vdisplay is required. If VRAM is not enough, automatic simulation will divide pixel frequency, Htotal, Hdisplay, Hb-porch, Hsync width, and Hborder by two, four, eight, etc. until output can be produced according to the Timing of the simulation.

(6) In Analog Output, if Sync is on green, the system will add Xs to G signal. If the setting is Xs = OFF - LOW or OFF - HIGH , the outputs of Xs, Hs, and Vs will all become OFF - LOW without regard of the original settings of Hs and Vs.

(7) Generally speaking, when Video is selected as TTL,ECL or Analog in Timing, only the selected signal (Video or separable Sync) will be output.The others will be disabled. For example, if Analog is selected, Analog R, G, B and Analog Hs, Vs, Xs will be output, but TTL RGBrgb and TTL Hs, Vs, Xs will all be disabled as LOW.

(8) In Timing Format, if a parameter is input by μS/mS, the largest value is invariably 65.535. But the largest values of Hborder and Vborder are 0.5, and must be even number.

2.6 The Actions of CONFIG and SEARCH

In the following statements, if they are about the operation of memory card, please pay attention to the position of Write Protect on the card. If you want to write, please set the switch at the position where you are able to write. If you simply want to read, you can set the switch at the position of Write Protect. Before retrieving the memory card, power-on or power-off, you have to set the switch at the position of Write Protect so as to protect the data from being damaged.

2.6.1 The Actions of CONFIG

The key can control or display some operations of the system such as the discovery of errors during power-on, the execution of self-diagnosis program, the control of data lock, the setting of RS-232C, and cancellation of some internally stored files. Details are given below.

After pressing **CONFIG** and inputting adequately, or pressing ▼ , the following messages will appear one by one.

```
LIST  PWR  ON  ERR？
0＝NO，1＝YES
```

If you press YES, the results of self-diagnosis will be displayed as described on 2.5.1.

```
RUN  DIAGNOSIS？
```

If you press YES, you will enter into the self-diagnosis program. Details will be given on 4.2.

```
DATA  ENTRY  LOCK？
```

If you set YES, you can merely retrieve the internally stored files, but cannot modify the contents of the files. It prevents you from changing any established data.

```
STOP  PROG  RUN？  NO
（IF NO CARD TO READ）
```

If YES is set, but in the execution of Program Run, the data of any sequence is put on a memory card which is not inserted, the execution must be stopped. If NO is set, the execution of Program Run can continue in spite of the above sequence.

```
RS232C  SETUP ?
```

If YES is input, the transfer protocol of RS232C can be set. Details will be given in Chapter 5.

```
ERASE  TIMING  NO.
= XXXX TO XXXX
```

The following four displays can let you cancel the data files stored in NVRAM or a memory card. In other words, the files will become empty.

```
ERASE  PATTERN  NO.
＝XXX TO XXX
```

The starting file number input from left must be smaller than or equal to the ending number at right, otherwise the error message of Start > End will appear.

```
ERASE   PROGRAM   NO.
＝XXX TO XXX
```

```
ERASE   ICON：CIRCLE
＝XX TO XX
```

2.6.2 The Actions of SEARCH

Since there are lots of stored data, the key is invented to bring convenience to your searching for some of the data. One method is that the data are output to a monitor for reference while another displayed on LCD. Explanations are given below.

Press **SEARCH**, and the following choice will appear.

```
DISPLAY PORT = XXXXXXX
```

You may choose the display on LCD or on a monitor screen. These two methods are going to be explained as A and B in details.

< A > The Display on LCD

It can be used only to inquire the numbers and names of the data files of Timing, Pattern, Program, and Icon.

```
DATA   TYPE = XXXXXXXX
```

Here you can choose Timing, Pattern, Program, or Icon.

```
SEARCH   BY = XXXXXX
```

Here you can choose number or name. If you choose number, it means that you intend to inquire name through number, and vice versa.

```
TIMING
# = 0001 : MDA/HGC
```

Here the example is obtained through the choice of Timing and Search By Number at the previous two displays. Timing name can be read at right the instant you input the number. By pressing **SELECT** you can move the digit forward.

```
SOURCE = MDA
# = 0001 : MDA/HGC
```

It is the example of Search by Name. Input the name of MDA at the upper corner, press **ENTER**, search for the name with the same prefix MDA, and display it. If there are more than one file with the prefix, the next number will be displayed automatically every two seconds. At last the first number will come back, and the repetition will continue. If there is no set corresponding to the condition, "No Such Name !" will appear on the second row.

< B > The Display on a Monitor Screen

Timing parameter in Buffer RAM will be output to the monitor by pressing of **TIMING**.
Since the inquired data will be displayed, the monitor which is fit for the Timing must be connected to the output of the system.

```
DATA   TYPE = XXXXXXX
```

There are 13 kinds of data for choice.

- ☐ TIMING NAME
- ☐ TIMING PARAMETER
- ☐ PATTERN NAME
- ☐ PATTERN PARAMETER
- ☐ PROGRAM NAME
- ☐ PROGRAM PARAMETER
- ☐ ICON NAME
- ☐ ICON PARAMETER
- ☐ CHARACTER FONT

- ☐ CHARACTER BIT MAP
- ☐ DISPLAY PATTERN
- ☐ DISPLAY STRING
- ☐ DISPLAY COLOR PEN

TIMING ＃＝0001：MDA/HGC

A number is input at any of the previous ten items first, then some data will be displayed on the monitor. If you want to inquire a name, the names of some data files will be displayed from the number on. If you want to inquire the name of another number, you just input a new number. If your previous inquiry is about a parameter, all parameters in the number's data file will be displayed on the monitor. Character Font means to display characters on the monitor while Bit Map enlarge characters and display their structure by adding the grills. Display Pattern, the item 11, is to search downward according to the input number. When it has found the first Pattern that is not empty, it will display it. The next Pattern can be found and displayed automatically by pressing **SELECT** . Thus doing, you will easily see the Patten which you like to search or has been established.

Display String can display the code of string and the real font for reference. Display Color Pen can display Norm-Color, Norm-Mono, Gray and User 1, 2, 3 Form for reference. The real color will be displayed for understanding too.

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Table of Contents

3. The Setting of Data Files

According to the nature of data, the methods of establishing a data base are described on the following subsections.

3.1 is about the setting of Timing Format.
3.2 is about the setting of Pattern Format.
3.3 is about the setting of Program Format.
3.4 is about the setting of Icon Format.
3.5 is about the setting of Character.
3.6 is about the setting of String.
3.7 is about the setting of Color Pen.
3.8 is about the functions of **WRITE** .

3.1 The Setting of Timing Format

The data described in this chapter are all controlled by the four command keys on the front panel: **TIMING** , **H** , **V** , and **SYNC** . The purpose is to input some basic characteristics of a monitor to the system so as to make the system produce correct signals for the monitor. Input items include the frequency of Video, the scan mode (Interlace or Non-interlace), the timing relation among all Videos and Sync. , etc. All items for setting can be moved from the first one to the last one by pressing ▲ and ▼. Nevertheless, the invention of the above four keys is for convenience. They let you directly enter into a certain item to set.

Now we are going to divide into five subsections to discuss.

3.1.1 is about the establishment of general information.
3.1.2 is about the information of Horizontal Timing.
3.1.3 is about the information of Vertical Timing.
3.1.4 is about the setting of Sync signals.
3.1.5 is about the ways of storing a Timing Format.

3.1.1 Establishment of General Information

The establishment of general information includes pixel rate, scan mode, Analog, TTL, output level, and the range of the set values. Please input the related information about the monitor you want to test into the system.

First, press **TIMING** , and LCD will show as follows.

```
TIMING
No.＝XXX：........
```

Under the screen, input the number of Timing format stored in the system with numerical keys, and retrieve the format. The system will put the format into buffer for modification or output of signals. The quantity and number of a format vary according to different media of storage.

- FLASH (Read Only) : storing 100 sets from 001 ~ 100. For the number and corresponding contents please refer to Appendix A.
- NVRAM (Read / Write) : storing 300 sets from 101 ~ 400. You can store by your own setting.
- Memory Card (Read / Write) : storing 2600 sets from 401 ~ 3000. You can store by your own setting.

Attention : After a value has been set, you must remember to press **ENTER** , otherwise the system will reject it. LCD will show the name of the format in which the value is stored for reference.

```
TIMING （KEY＝0 - 9）
NAME＝XXXXXXXXXXXX
```

You can give the format a name for future identity. For the way of setting please refer to 2.3.4. about the actions of **SELECT** . Here the biggest letters that can be set are 12. The name is a piece of data in buffer. It is not quite the same with the stored name mentioned above.

```
Pixel＝nnn.nnnMHz
3.126 - 480.000
```

Key in the value of pixel rate with the numerical key. The maximum range for the set value in the system is 480 MHz. It is entirely larger than any model's maximum value of output in the series. For example, 135 MHz in 2213, and 250 MHz in 2225. The reason is that the system has the function of over range pixel rate simulation. Its features are described below.

■ Over Range Pixel Rate Simulation

The design of the function is that when the set value of pixel rate exceeds the specifications or equipment of the system, the system will automatically change Fp (pixel rate) into Fp ÷ N so as to do the output of simulation (N = 1, 2, 4 or 8, so Fp will become the output value permitted by the system). This function makes the system operate possibly in a monitor with any displayed frequency. Even a monitor's pixel rate reaches 480 MHz, and its horizontal as well as vertical frequencies are changeless, the function can make it stay in Sync.

For the special limits and attention in setting please refer to 2.5.4.

```
INTERLACE  MODE？ NO
0＝NO，1＝YES
```

Here Scan can be set either as 0 = Non-interlace or as 1 = Interlace Sync & Video.

```
VIDEO＝ANALOG - COLOR
PRESS 1 - 9，SEL
```

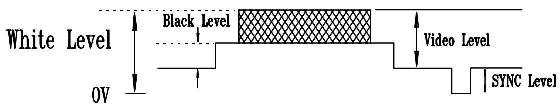
Here you can choose the signal type of Video output. The choice will determine the production of output color in the future Pattern. Accordingly, you must make a good choice.

1. ANALOG-COLOR
2. ANALOG-MONO
3. TTL-RGBrgb
4. TTL-RGBI
5. TTL-MONO + I
6. TTL-MONO+1
7. ECL

For output, if Video signal is chosen as TTL or ECL and Analog, only the chosen signals (Video and separable Sync) can be output. Others will be disabled.

Attention : The choice here will influence the change of the next display. If you choose Analog, the display will be as follows, but if you choose TTL or LCD, the display will skip over the following five displays, and directly reach the sixth one.

In the following setting, all parameters have the relative relation. Please take the following waveform for the reference of setting.



Xs SYNC ON GREEN？ NO
0＝NO，1＝YES

Here you may decide whether the setting of Analog Green signal is with Sync or not. If you want the setting with Sync, the system will synthesize Xs into Green signal. Therefore, the choice of Xs, the last item in Timing Format, must be done correctly.

SYNC LEVEL＝XXX mV
0 - 500mV

If "YES" is set on the previous display, the display for setting the level of Sync signal will appear.

VIDEO LEVEL＝XXX mV
0 - 1000mV

Set the level of Video signal.

WHITE LEVEL＝XXXmV
0 - 1200mV

Set the level of White Level (DC OFFSET). If it is set as 0, all signals will be negative voltage. If it is set as same as Video Level, Video signal will be positive voltage and Sync signal negative one.

BLACK LEVEL＝XXXX
0＝0IRE，1＝7.5IRE

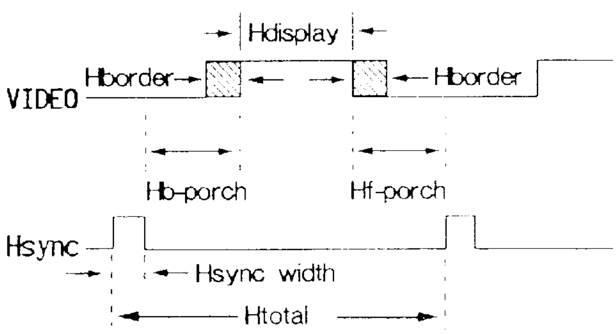
Set the level of Black Level. 0 = 0 IRE, 1 = 7.5 IRE.

NOTE : Based on Video Level = 100 IRE, the amplitude of 7.5 IRE in mV can be got.

3.1.2 Information of Horizontal Timing

The set values described here belong to the horizontal timing in Timing Format. The contents include H Total, H Display, H Back Porch, H Sync Width, H Border, H Size (mm), etc. You can key in the data according to the timing graph of the monitor under test.

Attention : You are recommended to take the pixel setting as basis, for it will bring the most accurate output of signals. The time value (μS) produced at the lower side of each display is got through the conversion of input pixel value.



See how to establish the information of horizontal timing. The system will display as follows when it is powered on and is pressed, or the general information stated on

H

3.1.1. has been established.

```
H   TOTAL  =XXXX
```

Set all pixels of a horizontal scan line. The range for input is from 128 to 8192 pixels. After input, press **ENTER** to enter into the next display.

```
H   DISPLAY  =XXXX
```

Set the horizontal display pixels. The range for input is from 0 to 2048 pixels. If there is a VRAM extended board, the range is from 0 to 4096 pixels. After input, press **ENTER** to enter into the next display.

```
H   B-PORCH=XXXX
```

Set the pixels of horizontal back porch. It is defined as the distance from the back edge of H Sync to the front edge of H Display. The range for input is from 0 to 8191 pixels. After input, press **ENTER** to enter into the next display.

```
Hs   WIDTH=XXXX
```

Set the width of horizontal Sync signal. The range for input is from 16 to 8191 pixels. After input, press **ENTER** to enter into the next display.

```
H   BORDER=XXX
```

Set the pixels of the width of horizontal border. The range for input is from 0 to 255 pixels. After input, press **ENTER** to enter into the next display.

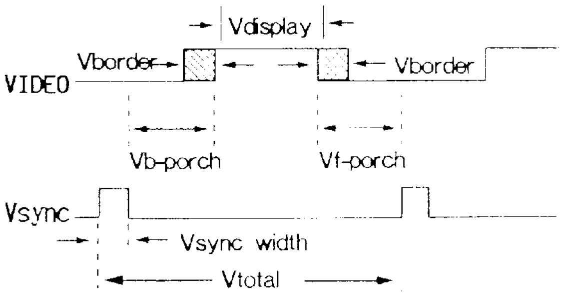
```
H   SIZE=XXX . XXXmm
```

In the application of setting the size of horizontal display width by mm, it is not necessary to input real size. The chief purpose is that the system will calculate the set value and the setting of vertical part by H Size/V Size to get a real aspect ratio. Thus doing, on the picture display you will obtain a perfect circle and a perfect square about Circle and X'HATCH for favorable exercise on test. For example, in a display monitor of 4 : 3, you may input 4.000mm to H Size, and 3.000mm to V Size. Thus doing, the system will calculate the ratio automatically. Of course, it is much better if the correct size can be input, because the numerals shown on the picture through the setting of pattern is useful for you to adjust the size of the picture.

3.1.3 Information of Vertical Timing

The set values described here belong to the vertical timing in Timing Format. The contents include V Total, V Display, V Back Porch, V Sync Width, V Border, V Size (mm), etc. You can key in the data according to the timing graph of the monitor under test.

Attention : You are recommended to take the setting of line as basis, for it will bring the most accurate output of signals. The time value (mS) produced at the lower side of each display is obtained through the conversion of input pixel value.



Now let's see how to establish the information of vertical timing. The system will automatically display as follows when it is powered on and V is pressed, or the information of horizontal timing described on 3.1.2 has been established.

V TOTAL=XXXX

Set the lines of a vertical field. The range for input is from 6 to 4096 lines.

V DISPLAY=XXXX

Set the display lines of a vertical field. The range for input is from 0 to 2048 lines.

V B-PORCH=XXXX

Set the lines of vertical back porch. It is defined as the distance from the back edge of V Sync to the front edge of V Display. The range for input is from 0 to 4095 lines.

Vs WIDTH=XXXX

Set the width of vertical Sync signal. The range for input is from 1 to 4095 lines.

```
V BORDER＝XXX
```

Set the lines of the width of border. The range for input is from 0 to 255 lines.

```
V SIZE＝XXXXXXmm
```

Set the size of vertical display width by mm. For the related explanations please refer to 3.1.2.

3.1.4 The Setting of Sync Signals

The set values described here belong to the horizontal and vertical Sync signals in Timing Format. The contents include the output polarity of H Sync, V Sync, X Sync, and the selection of X Sync.

```
Hs OUTPUT＝ON（＋）
PRESS 1 - 4，SEL
```

Set the output status of separable horizontal Sync signal. You can do the cyclical search and setting with the numerical keys of 1 to 4 or the key of **SELECT** . The contents of setting are given below.

1 = ON （＋） is for the output of positive polarity.

2 = ON （－） is for the output of negative polarity.

3 = OFF-LOW is for Disable, and the output is Low.

4 = OFF-HIGH is for Disable, and the output is High.

```
Vs OUTPUT＝ON（＋）
PRESS 1 - 4，SEL
```

Set the output status of separable vertical Sync signal. There are four choices as the previous one.

```
Xs OUTPUT＝ON（＋）
PRESS 1 - 4，SEL
```

Set the output status of Xs Sync signal. There are four choices as the previous one. The output status of Xs Sync signal can be defined as five types of Sync signals through the next display.

```
Xs SELECT＝H＋V
PRESS 1 - 5，SEL
```

Set the output status of Xs. You can do the cyclical search with the numerical keys of 1 to 5 or the key of **SELECT** . The contents are given below.

(1) H + V (compound Sync signal)

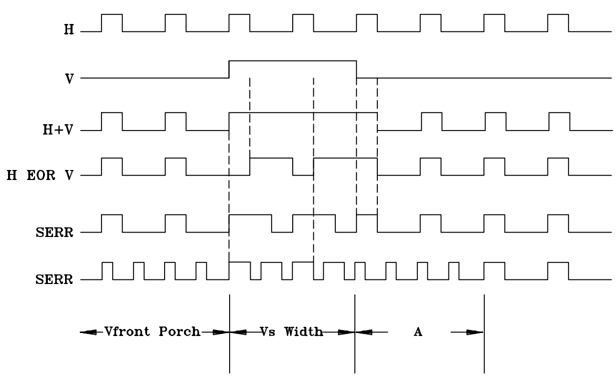
(2) H EOR V (H exclusive or V)

(3) SERR (Serration Pulse)

(4) H (separable horizontal Sync signal)

(5) V (separable vertical Sync signal)

For the waveforms of H + V, H EOR V, SERR, and the detailed explanations of SERR Equalization under Interlace as well as Non-interlace please refer to the following graph.



Under Interlace, SERR signals all have Equalization pulses in V front porch. Each line has two pulses. The width is the half of H sync width. The same condition is applied to Serration pulse in the middle of Vs width, and Equalization pulse within time A. The width of time A is as same as Vs width.

```
PEN SIZE SCALE＝1.0
0.1 – 12.7
```

Icon has the parameter of Pen Size in pattern; that is, the width of drawing lines, but it should be multiplied by Pen Size Scale to get the actual width. By the use of the parameter, the width of drawing lines on a picture will not change even though the timing is changed. It is easy for the automatic alignment system to detect the positions of lines.

3.1.5 Storage of Timing Format

The system will automatically display the following message when you press **STORE** in the setting of Timing Format, or have set all parameters of Timing Format.

STORE　TIMING？
0＝NO，1＝YES

You have to decide whether to store the present data or not. If you do not, please key in 0 (NO). Be careful that if you have not stored the data, the system will abandon them automatically when it is powered off, or when you recall a Timing Format. If you choose YES, the following message will appear.

STORE　TIMING＃＝XXX
EMPTY＃＝XXX，XXX

Please input the number of the format you want to store. The system will store the format into NVRAM or Memory Card according to the designated number. After the format has been stored, it will not be lost even though the system is powered off. The second row on the display indicates that you are staying at the first unused empty number in NVRAM or Memory Card. It is for your storing reference.

The number on the first row is the position where the originally recalled format occupies. It is shown for reference too.

Attention :

(1) No. 001 ~ 100 are for the formats in FLASH. They are defaults. You can change them, but cannot store them.

(2) No. 101 ~ 400 are for the formats in NVRAM. You can store them as you like.

(3) No. 401 ~ 3000 are for the formats in Memory Card. You can store them as you like.

3.2 The Setting of Pattern Format

The output pattern of the system is defined by pattern format. The setting is chiefly to select 20 icons at most, and draw them in overlap on the monitor screen (for the establishment of icon see 3.4). Thus we can understand that pattern is composed of some icons, and an icon is some basic drawings such as circles or grids of different size, or color bars of different colors. These drawings can be used in different patterns, but a pattern can be composed of different simple drawings, and becomes a more complicated pattern. The advantage of the way is that you can set up some standard simple icons to organize a new pattern quickly in the future. Now see the subtitles of LCD after pressing **PATTERN** . As for **DRAW** , it is another middle entrance in the series of problems of pattern. It makes you enter into any of the 20 icons you set.

```
PATTERN
NO.=XXX：. . . . . . . . . . . . .
```

Here the No. and name of the present pattern format in buffer is displayed. If you like to recall another format, you can simply key in the new number, press **ENTER** , and the display of LCD will go to the next row. If you do not recall the format, you can press ▼ directly, and go to the next row. The system contains the following pattern formats.

FLASH (READ ONLY) : # 001 ~ 100, 100 sets in total.
NVRAM (READ / WRITE) : # 101 ~ 200, 100 sets in total.
Memory Card (READ / WRITE) : # 201 ~ 800, 600 sets in total.

```
PATTERN    （KEY＝0 - 9）
NAME＝XXXXXXXXXXXX
```

Here you can set a name for the pattern format in buffer for future identity. For the way of setting please refer to 2.3.4. The letters for setting can reach 12 at most.

```
   COLOR  FORM＝NORM
   PRESS 1 - 5，SEL
```

When Analog is output, 256 kinds of color can be displayed on a picture. But since the output amplitude of R, G, B in the system can all be expressed by 0/1023 to 1023/1023, 1024 values in total, there are 1024×1024×1024=1,073,741,824 kinds of combinations in R, G, B. Now, which 256 among the 1,073,741,824 kinds of combinations are to be displayed on a picture?

The system has designed three kinds of 256-color pen combinations. Each kind of combination is called a color form. The three kinds of combinations are given below.

1. Norm (Analog-Color)
2. Norm (Analog-Mono)
3. Gray

For detailed information please refer to Appendix D.

Two kinds of norm forms are all set as norm here, because the system will choose a correct norm form automatically depending on whether Video Output in Timing is Analog Color or Analog Mono. Besides, there are three kinds of norms: User 1, User 2, User 3. Each has 256 pens, but pen 0 and pen 255 are defined as R, G, B = 0, 0, 0 and 1023, 1023, 1023 by the system. You can define others' amplitude combination of R, G, B, and input them into the system by the use of **WRITE** . User 1 Form exists in NVRAM while User 2

Form and User 3 Form exist in Memory Card. Be careful that if you define the output as TTL in Timing, the system will provide a set of color form to the signals of TTL. For details please refer to Appendix D.

```
BACKGROUND  COLOR＝0
0 - 255；0＝BLACK
```

Here you can set the background color of a picture. The confirmation of color involves the number of color pen you set. In the meantime the system, according to the color form you set at the previous step, will take the numbered color pen. Each color pen has different amplitude output of R, G, B signals to produce different colors. As for TTL, the color form set by the system will take out of it the relatively numbered color pen. For the setting of color, whether it is in TTL or Norm Form, its color and the relation of strong/weak luminance are the same as long as you choose pen 0 ~ 15. In other words, it is the color of 16-color bar; accordingly, you are recommended to use the 16 colors (refer to Appendix D).

```
FOREGROUND COLOR ＝15
0 - 255；15＝WHITE
```

Here you can set the color of drawing on a picture. After the color has been confirmed, it will be automatically adopted in the drawing of icon under the circumstance of no specific color in icon. The setting of color is the same as that of background color.

```
POSITIVE  PATTERN？YES
0＝NO；1＝YES
```

Here you can choose positive pattern or negative (reverse) pattern. If you choose negative, all colors, including background color and foreground color, will change into the output of their complements. Analog Gray Level will become the complementary level of 1023 too; that is, level = 100 will become 1023 – 100 = 923. The effect is the same as pressing the key of **REVERSE** .

```
BLINK  PATTERN？  NO
0＝NO；1＝YES
```

Here you can decide whether to display a blink pattern or not. If you do not, you will skip over the next two questions. The so-called blink pattern means that there are some drawings appearing momentarily and then disappearing on a picture. Pattern No. 62 is a built-in blink pattern. You may watch it by outputting it onto the monitor.

```
BLINK  SPEED（FIELDS）
ON＝1；OFF＝1
```

This is to determine the time of appearance and disappearance of a specified drawing on a picture as mentioned above. ON means the time of appearance while OFF that of disappearance. The calculating unit of the time is based on the number of field. The output of the picture is an alternation of ON and OFF.

```
BLINK DRAW＝0，0，0
0 - 20；0＝DUMMY
```

Here you can see that the drawing specified for blink is in which three of the following 20 draws. 0 is dummy (no draw is specified for blink). The specified draw will blink according to the blink speed set above.

```
CLEAR　DRAW？
0＝NO；1＝YES
```

Here you can choose whether to clear the following 20 draws or not. If you choose "YES", the data of the 20 draws will become "DUMMY". If you do not clear, press **0** or **▼** to go to the next display.

```
DRAW1＝XXXXX　#＝1
NAME＝XXXXXXXXXX
```

Here you can decide which icon to be drawn for the draw 1. The operation is that when the cursor is at the left of the upper row, you choose an icon type among the command keys of icon type on the front panel, press it and **ENTER** , then the cursor will move to the right of the upper row. Now key in the number of the icon you want to choose, and press **ENTER** to complete the setting of the first draw. The name displayed on the second row is for reference. There are ten kinds of icon types such as circle, line, dot, etc. Each type has # 1 ~ 99 sets of formats. Among them, # 1 ~ 20 are the data built in FLASH by the system, # 21 ~ 40 those built and stored in NVRAM by yourself, and # 41 ~ 99 those stored in Memory Card.

After draw 1 has been set, the system will go into the setting of draw 2 till that of draw 20 automatically. Their settings are similar to the setting of draw 1. When the icon type of a draw is set as dummy (pressing **0**) , it means that no drawing needs to be drawn in the draw.

```
STORE　PATTERN？
0＝NO；1＝YES
```

The picture is displayed when you progress from the previous setting, or press **ENTER** in the setting of pattern. Here you can decide whether to store the above set values as a pattern format. If you choose NO, the setting of pattern will come to an end. But be careful that if you power off or recall another pattern format, the data currently stored in buffer will be abandoned automatically. If you choose YES, you will go into the next display.

```
STORE   PATTERN＃＝XXX
EMPTY＃＝XXX；XXX
```

Here you are asked to input the number of the format you want to store. Since # 001 ~ # 100 are the preset numbers stored in FLASH, you can use those of # 101 ~ # 200 stored in NVRAM or those of # 201 ~ 800 in Memory Card. “EMPTY # = XXX ; XXX”, shown at the second row of the display, is the first unused number in both NVRAM and Memory Card. The number at the first row is the number of the originally recalled format. It is for your reference. After inputting the number of the format you want to store, and pressing **STORE** , you have accomplished the setting of pattern.

In addition, there are some special patterns directly done by firmware, so you do not need to set the icon. The positions of these patterns in FLASH are shown as follows.

Pattern #5	SMPTE RP-133
Pattern #12	RASTER
Pattern #13	BORDER
Pattern #34	RGB X-HATCH

When you need to modify any of them, you can retrieve it, change its pattern name, foreground color, background color, etc. Then save it into another position. You definitely cannot change other parameters.

3.3 The Setting of Program Format

Every time when the output is changed, a timing format or pattern format needs to be retrieved anew, then the key of Output Enable can be pressed. The step takes too much time, and is easy to make a mistake for the operators on the production line of monitors. Accordingly, it is expected to preset a series of combinations of timing and pattern. After the key of Output Enable has been pressed, each time of key pressing will automatically change the output into the next combination of timing and pattern. The output will return to the first combination when you press the key again at the last combination. Thus doing, the problems of wasting time and making a mistake will be solved. Moreover, it is expected to change the output automatically in order without pressing any key. It will be more flexible if the output duration of each combination of timing and pattern can be set respectively.

In view of the demand, the system has designed program formats for automatic test. From sequence 1 to 40 in each program format, you can set at most 40 combinations of timing and pattern in order. The output duration of each combination can be set individually, including the time unit: second, minute, hour, day. Pressing **OUTPUT** after the setting has been done, the combination of timing and pattern in sequence 1 will be output first, and when time is up, that of timing and pattern in sequence 2 will be output. Till after the combination of timing and pattern in sequence 40 is output, the output will return to that of timing and pattern in sequence 1. This way of output is called sequential output.

After pressing **PROGRAM** on the front panel, you will hear a sound of beep. It means that single output is being done, so you cannot press **PROGRAM** . If you want to press the key of **PROGRAM** , you must press **QUIT** at first, and stop single output.

```
PROGRAM
NO.＝XXX：. . . . . . . . . . . .
```

Input any number and name of the format you desire to recall. In the system the formats that can be stored are as follows.

001 ~ # 100 stored in NVRAM
101 ~ # 999 stored in Memory Card

```
PROGRAM （KEY＝0 - 9）
NAME＝XXXXXXXXXXXX
```

Here you can set the name of a format for future identity. For the methods of setting please refer to 2.3.4.

```
CLEAR PROGRAM？
0＝NO，1＝YES
```

You can clear the timing /pattern No. and output time of sequence 1 to sequence 40 as "0"; that is, dummy sequence.

```
SEQ 1： / TMG / PTN / SEC./U
         XXXX / XXX / XX.X/X
```

The second row on the above display is for you to set four parameters in sequence 1: Timing No., Pattern No., Output Time (0 ~ 25.5) and time unit (second, minute, hour, day).

```
SEQ 40：/ TMG / PTN / SEC./U
         XXXX / XXX / XX.X/X
```

Here you can set 40 sequences. Among them, Timing No. or Pattern No. is “0”, and that is called dummy sequence. In sequential output, dummy sequence will be skipped and not be output.

STORE PROGRAM？ 0＝NO，1＝YES

The display will appear after sequence 40 has been input, or **STORE** is directly pressed. Here if you choose “YES”, you can store the program into NVRAM or Memory Card. As for the position of storage, you can decide it in the next question. The way of storing a program is similar to that of storing a timing or pattern.

If the sequences of a program are all dummy, you cannot press the key of OUTPUT ENABLE, otherwise you will hear a sound of beep for warning.

If there is an error existing in the timing / pattern format of any sequence, the error message will be shown by pressing OUTPUT ENABLE. Only after the error has been corrected and stored back into NVRAM or Memory Card can you press OUTPUT ENABLE again to produce output.

If there is a timing / pattern format of any sequence existing in Memory Card, but the card has not been inserted into the system, you can manage it by either of the following two ways.

1. Stop the program run.
2. Execute the program run, but regard the sequence as dummy sequence and skip over it. The first way is to set STOP PROGRAM RUN = YES in **CONFIG** while the second way is to set NO. For the ways of setting in CONFIG please refer to 2.6.1.

In sequential output, when time is up, the next sequence will be output (if it is dummy, it will be skipped over). After the output of sequence 40 is completed, the output will return to sequence 1. But if the time of a certain sequence is set as 0 S, the output will stop when the execution comes to the sequence. The next output will not begin until ▲ , ▼ or the numeral keys of **0** ~ **9** is pressed. ▲ means to return to the previous sequence. ▼ means to go to the next sequence. **0** ~ **9** means to directly skip to the numbered sequence. Even though the time of a sequence is not 0 S, the output will stop too if you press other key than **0** ~ **9** and **QUIT** before time is up. The output will begin again once a new sequence is designated by pressing **0** ~ **9**. During output, by pressing **0** ~ **9** directly you will skip to the numbered sequence, and begin again. Sometimes, you have to press two keys such as **1** ~ **4** . One more numeral key must be pressed to work normally if there are data which are not dummy existing in sequence 10 ~ 40.

For example, pressing **1** perhaps means any sequence in 10 ~ 19, so the second numeral key must be pressed. In other words, if you really want sequence 1, you must press **0** , **1** . The condition is applied to sequence 2, 3, 4 too. If the input numeral is a dummy sequence, the system will skip over it, and search the next sequence which has meaning. After the system has searched sequence 40, it will search sequence 1 over again.

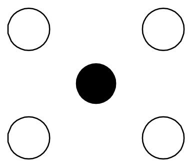
3.4 The Setting of Icon Format

3.4.1 The Types of Icons

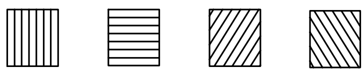
From the explanation of pattern format in 3.2 we have known that a pattern is composed of 20 icons at most. After some basic icons needed for test are established, and stored onto NVRAM or Memory Card, you may take some of them arbitrarily, and combine them into a new pattern for specific testing function. Each icon can be repeatedly used in different patterns. This kind of applicability makes the establishment of a new pattern easier.

On account of the need of different tests and easy setting, icons are divided into ten types for you to draw various kinds of drawings. Examples are give below.

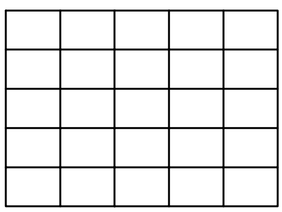
<1> Circle : for drawing all kinds of hollow and solid circles.



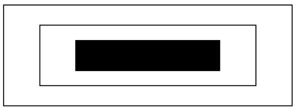
<2> Line : for drawing all kinds of straight, horizontal and oblique lines.



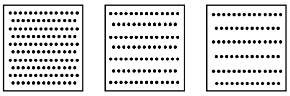
<3> X-hatch : for drawing all kinds of x-hatches.



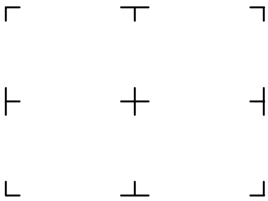
<4> Rectangle : for drawing all kinds of hollow and solid rectangles.



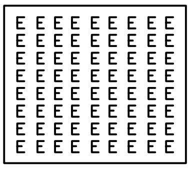
<5> Dot : for drawing the arrangements of all kinds of dots.



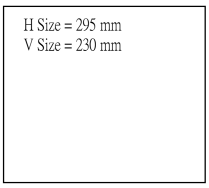
<6> Marker : for drawing the markers of four corners and central positions.



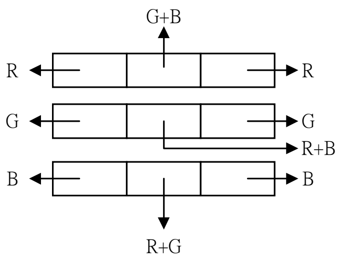
<7> Character : for writing all kinds of English and Chinese words.



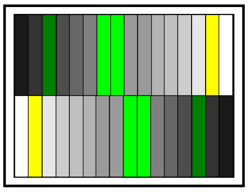
<8> String : for noting some words of special meaning on the pictures.



<9> Color bar : For drawing all kinds of color combinations.



<10> Gray Scale : for drawing all kinds of gray scale combinations with different light.



The above classification makes the setting of each kind of specific icon easier, but each kind of icon still needs different modification. For example, we need the icon of "circle" to draw a large circle in one pattern, and that of "circle" to draw five small circles in another pattern. To satisfy these different requirements, the system, accordingly, lets each kind of icon store as many as 99 formats. This is called icon format. The places for storage are as follows.

# 1 ~ 20	preset by Chroma and stored in FLASH for producing pattern # 1 ~ 100
# 21 ~ 40	set and stored in NVRAM by yourself
# 41 ~ 99	set and stored in Memory Card by yourself

Hence, ten kinds of icon types have 99 × 10 = 990 icon formats in total. The 20 draws in each pattern can all be any of the 990 icon formats.

3.4.2 How to Set an Icon Format

LCD displays in any of the following draws during the setting of pattern as stated on 3.2.

```
DRAW 3：CIRCLE  ＃＝1
NAME＝XXXXXXXX
```

If you want to read or modify the contents of CIRCLE # 1, press **ICON** , and LCD will display as follows.

```
TYPE：CIRCLE  ＃＝1
NAME＝XXXXXXX
```

Here you can recall another icon type or another format number (# 1 ~ 99). The selection of an icon type can be done by pressing any of the ten keys of **ICON** on the front panel, or using **SELECT** to search the desired type and pressing **ENTER** . The second row on LCD displays the name for reference. If you key in "0" in the selection of an icon type, it will be a dummy icon, and does not draw.

```
CIRCLE   （KEY＝0 - 9）
NAME＝6   CIRCLES
```

Here you can set the name for future identity. The way of inputting a pattern name is as same as that of inputting a timing name.

⋮

```
STORE   ICON
0＝NO，1＝YES
```

The contents in the middle will be explained from 3.4.3 to 3.4.13. At first, press ▼ till you see the display of STORE as above. At this moment, if you choose "YES", you will get the following display.

```
STORE   ICON  #＝XXX
EMPTY  #＝XXX，XXX
```

The second row suggests the first empty number of a format on NVRAM and Memory Card. Input the number you want to store and press **ENTER** to establish a new format.

3.4.3 The Common Contents of Icon Formats

The commonly specified parameters for all icon formats in drawing some drawings on the monitor are explained below. Some other special parameters for each icon will be explained individually from 3.4.4 to 3.4.13.

```
SPECIAL   COLOR？
0＝NO，1＝YES
```

```
SPECIAL COLOR＝XX
0 - 255，15＝WHITE
```

If the color of the drawing is not specified here, the foreground color set in pattern format will be used. Therefore, the foreground in pattern is the default colors of 20 draws.

```
PEN   SIZE＝XXX
1 - 2048
```

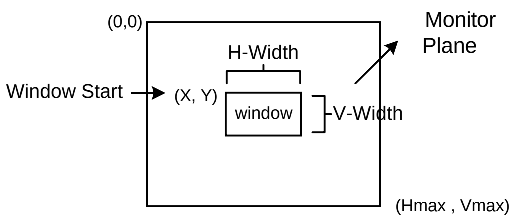
In setting the thickness and thinness of a drawing, for example, when drawing a straight line, pen size = 5 represents that the width of the line is 5 pixels. The general range is from 1 to 2048 pixels. However, for these two kinds of icons, circle and rectangle, pen size = 0 can be set, because here pen size = 0 represents a solid circle, or a solid rectangle; that is, the action of filling.

```
WINDOW DEFINE＝XXXXX
1＝PIXEL，2＝RATIO
```

WINDOW START：(RATIO)
H＝0 / 1，V＝0 / 1

WINDOW SIZE：(RATIO)
H＝1 / 2，V＝1 / 2

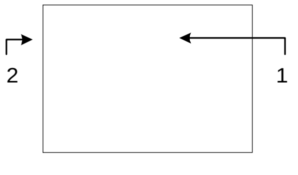
Then, there are three settings used to determine a place on the monitor plane where the drawing can be drawn. The way of setting is to determine the position and size of a window from the window start and window size.



The coordinates at the farthest left upper corner on the monitor plane is regarded as (0, 0). The window start (X, Y) means that the distance from horizontal direction to the point (0, 0) is X pixel, and the distance from vertical direction to the point (0, 0) is Y pixel. The length and width of the window are H width and V width separately. These parameters can be directly set by the unit of pixel. Besides, they can be expressed by the ratio of the window to the whole plane too. Therefore, the primary thing is to determine whether to set window start and size by pixel or ratio. After having determined to adopt ratio, we can see that the real pixel value of horizontal direction is the product of Hdisplay pixel value (for example, 640) in timing format multiplying H ratio value (for example, 1/2); that is, $640 \times 1/2 = 320$ pixels. Vertical direction can be also got through the multiplying of Vdisplay pixel value by V ratio value.

The advantage of ratio expression is that we can see a drawing of the same position and size on monitors of different timing. Accordingly, the icon format established by such a way can be applied to a variety of timing formats.

The purpose of a window is to define the largest scope of a drawing. For example, the icon for drawing a straight line can only do the work inside a window, never outside a window.



1. The real drawn icon (a straight line)
2. Window (the frame is not drawn)

In addition, there is a kind of setting too :

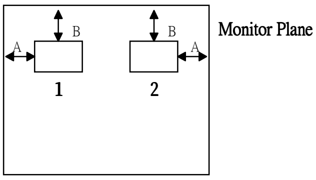
REPEAT＝XXXXXX
PRESS 0 - 5，SEL

Sometimes, a drawing needs to be drawn at more than one place on the picture. At this moment, the function of Repeat can be used to set. Repeat means to copy a window into another place, and draw the same drawing inside the window.

There are six kinds for choice :

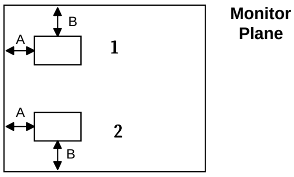
0 = None : not repeat.
1 = Mirror H : copy at horizontal direction.
2 = Mirror V : copy at vertical direction.
3 = Mirror H&V : copy at horizontal and vertical directions
4 = Mirror H&V&C : copy at horizontal, vertical directions and central point.
5 = Full Page : copy fully.

The position of a copied drawing in Mirror H is as follows.



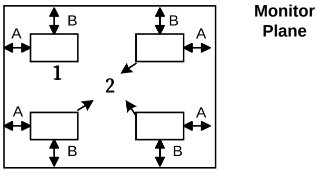
1. original drawing
2. copied drawing

The Mirror V is as follows.



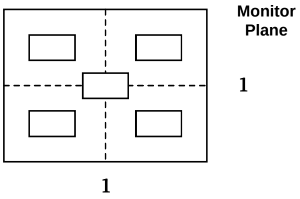
1. original drawing
2. copied drawing

The Mirror H&V is as follows.



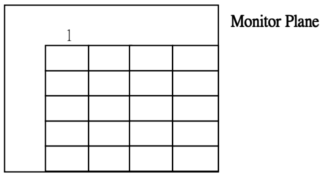
1. original drawing
2. copied drawing

The Mirror H&V&C is as follows.



1. central line

The Full Page (Repeat is done from right and down one by one) is as follows.



1. original drawing

3.4.4 The Special Parameters of Circle

<1> The window size of the icon is changed into diameter, and just the setting of vertical diameter is acceptable.　For example :

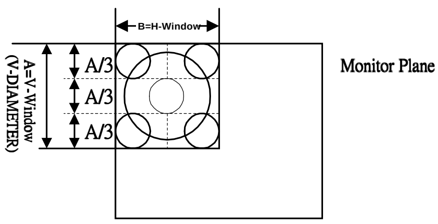
```
DIAMETER（RATIO）
V＝1 / 2
```

<2>

```
TYPE＝6 CIRCLES
PRESS 1 - 2，SEL
```

There are two ways for drawing a circle here: drawing six circles (type = 6 circles); drawing a circle (type = 1 circle).

TYPE = 6 CIRCLES

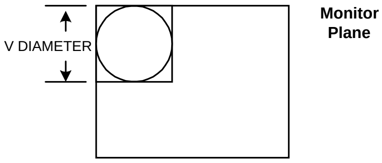


The pixels of every circle at horizontal direction are calculated according to H display (pixel), V display (pixel), H size (mm) and V size (mm) by the system.　You do not need to calculate, but simply input correct H size (mm) and V size (mm) in timing format.

Besides, the size of a window, at both horizontal and vertical directions, is calculated by the value of Diameter Vratio.

V - WINDOW = V display（PIXEL) × Vratio
H - WINDOW = H display（PIXEL）× Vratio

TYPE = 1 CIRCLE



According to V diameter, the system will calculate H diameter automatically, and draw a right circle.

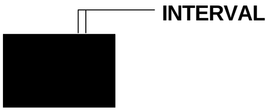
3.4.5 The Special Parameters of Line

```
TYPE＝ ` | ` LINES
PRESS 1 - 6，SEL
```

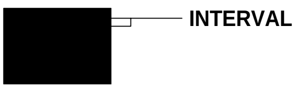
```
INTERVAL＝XXX
0 - 2048，0＝1 LINE
```

These two parameters determine the drawing way of a line, and the interval between lines. There are six ways for drawing a line as follows.

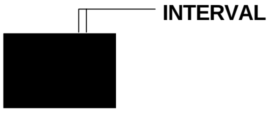
1 = “ | ” Lines : drawing a straight line
When interval = 0, there is only one line in the left.



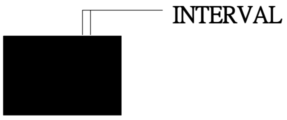
2 = “ — ” Lines : drawing a horizontal line
When interval = 0, there is one line on the above.



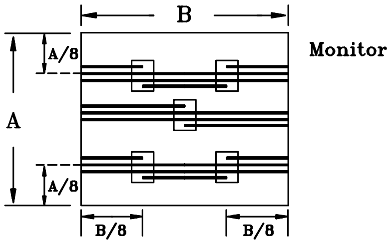
3 = “ / ” Lines : drawing an oblique line (from right to left)
When interval = 0, there is only one diagonal line.



4 = " \ " Lines : drawing an oblique line (from left to right)
When interval = 0, there is only one diagonal line.

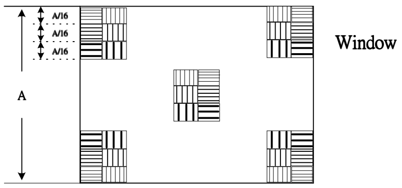


5 = Paring : lines become pairs (for inspecting interlace)

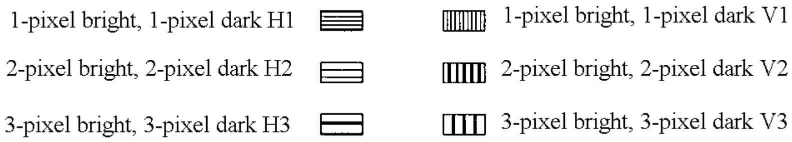


The drawing has neither the function of interval nor that of repeat.

6 = Resolution (testing lines of resolution)



H1, H2, H3, V1, V2, and V3 are all squares of the same size.



The drawing has neither the function of interval nor that of repeat.

3.4.6 X-Hatch

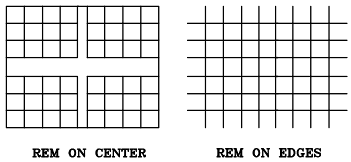
VERTICAL BLOCK ＃＝XXX
1 - 256

TYPE ＝ XXXXXX
PRESS 1 - 3 ，SEL

Set the vertical grids first. The system will calculate the horizontal grids using Hdisplay, Vdisplay, Hsize (mm) as well as Vsize (mm) in timing format, and make all the grids become squares.

There are three types of drawing an x-hatch: the first one is remainder on center; the second one remainder on edges; the third one remainder on center and capable of setting user H block number. The first two types mean that the remaining pixel not enough for a block is put on center or edges.

The advantage of remainder on center is that the nature of lines at the central position of a monitor is the best, and needs no inspection. Nevertheless, the nature of lines at the edges is the worst, and needs inspection urgently. When using the x-hatch to test the nature of lines, the best thing is that there are squares at the borders for inspection (At the moment, vertical block must be an even number, so there will be a symmetry between up and down).

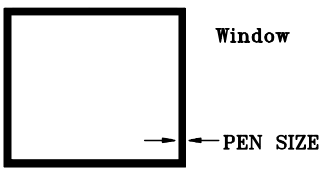


The third type is remainder on center and capable of setting user H block number.

HORIZONT BLOCK ＃＝XXX
1 - 256

Set the number of horizontal block from 1 to 256.

3.4.7 Rectangle



Draw a rectangle along the four sides of a window. When pen size = 0, the rectangle becomes a solid one (all "fill" inside).

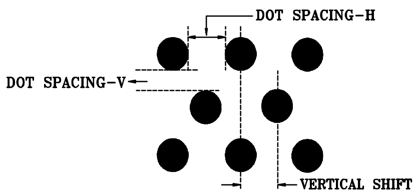
3.4.8 Dot

DOT SPACING：
H＝XXX，V＝XXX

Set the interval between the adjoining points of H and V directions.

VERTICAL SHIFT＝XXX
0 - 255

Set the relative deflection of each point between the upper and lower lines.
The drawing of dots is shown as below.

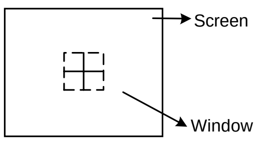


3.4.9 Marker

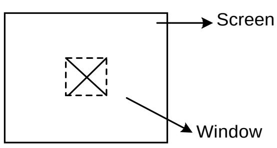
TYPE＝XXXXX
PRESS 1 - 5，SEL

There are five kinds of markers for choice.

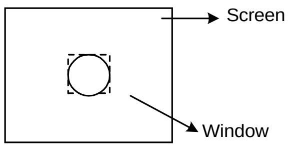
(1) = Center "＋" (the central cross on the picture plane)



(2) = Center " X " (the central X on the picture plane)

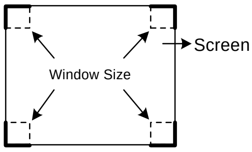


(3) = Center " ○ " (the central circle on the picture plane)

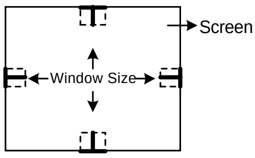


A circle is drawn automatically on the central point by vertical width of a window as diameter.

(4) = Corner Mark (the symbols of four corners on the picture plane)



(5) = Edge "┳" (the symbols of central points of four sides on the picture plane)



3.4.10 Character

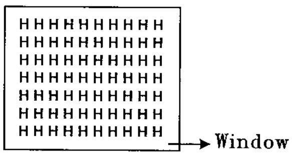
```
CHARACTER  #＝XXX
 1 - 999
```

```
CHARACTER  SPACING；
 H＝XXX，V＝XXX
```

```
DRAW AREA＝XXXXXX
 PRESS 1 - 6，SEL
```

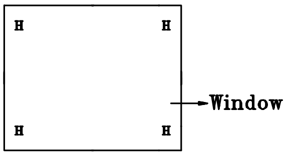
At first, select a character number to display (Character 1 ~ 499 are the built-in fonts of the system. Please refer to Appendix C). Then, set the spacing; that is, the spacing of the arrangement of two neighboring characters at horizontal direction, and the central spacing of that on upper and lower rows. Finally, set the draw area of a window. There are six ways to set as shown below.

(1) = Full Area

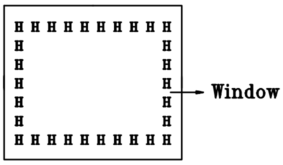


The last right and lower positions at which no character can occupy are left empty.

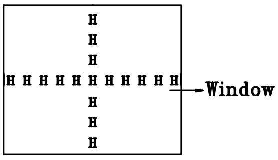
(2) = 4 Corners (one character at each corner)



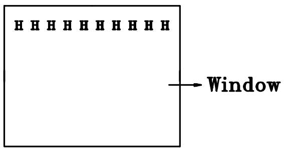
(3) = Edges (four sides)



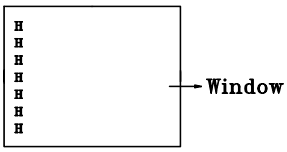
(4) = Middles (the type of central cross)



(5) = 1 Row (a horizontal line at the upper side)



(6) = 1 Colum (a vertical line at left side)



Here pen size means zoom. For example, pen size = 2 means that a whole character is enlarged twofold in horizontal and vertical directions. Spacing is enlarged too.

3.4.11 String

```
TYPE＝XXXXXX
PRESS 1 - 8，SEL
```

There are eight kinds of string types for choice. The font types of the previous seven kinds are arranged by the system.

TYPE 1 = Timing Name : Display the name of timing format inside the window on the picture plane for reference.

TYPE 2 = Pattern Name : Display the name of pattern format inside the window on the picture plane for reference.

TYPE 3 = Timing + Pattern Name : Display timing name and pattern name on two adjoining lines for reference.

TYPE 4 = Size (mm/in) : Display Hsize (mm/in) and Vsize (mm/in) in timing format on two adjoining lines for adjustment of size.

TYPE 5 = H. V. Freq + Pixel : Display Fh, Fv, Hdisplay Pixel and Vdisplay Pixel in timing format for reference such as :
H = 31.500 KHz / 640 pixels
V = 59.941 Hz / 480 pixelz

TYPE 6 = Text (5×7) : Display an article in the type of 5×7 (refer to #32 ~ 127 in Appendix C).

TYPE 7 = Text (7×9) : Display an article in the type of 7×9 (refer to #160 ~ 255 in Appendix C). The type is proportional; that is, the position occupied by horizontal direction is determined by the size of a character. It is not a fixed value.

TYPE 8 = User String : Display the selected string built up by the user (see 3.6). String No. needs selecting as follows.

```
STRING  #＝XXX
1 - 150
```

3.4.12 Color Bar

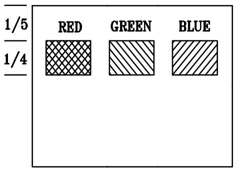
```
TYPE＝XXXXXX
PRESS 1 - 7，SEL
```

There are seven kinds of color arrangements.

TYPE 1 = RGB : Display the three color bars of red, green, blue and characters :

R Color Pen # = 2
G Color Pen # = 4
B Color Pen # = 1

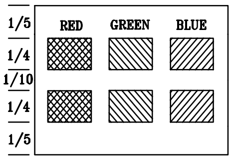
(The size of each bar at horizontal direction is 1/7 of a window.)



TYPE 2 = RGB & Intensity : The three color bars of red, green, blue at the upper row are the same as type 1 whereas those at the lower row are the ones with intensified light. Their color pens are separately as follows :

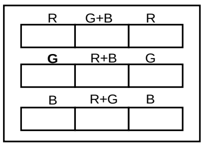
R = Pen 10 G = Pen 12

B = Pen 9



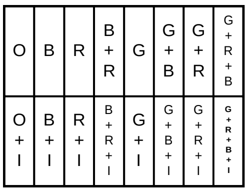
TYPE 3 = RGB Delay : If the phases of the three original colors delay, white will appear on the border of color bars.

R = Pen 10, G + B = Pen 13,
G = Pen 12, R + B = Pen 11,
B = Pen 9, G + R = Pen 14,
(The size of each bar at horizontal direction is 1/5 and at vertical one 1/7.)

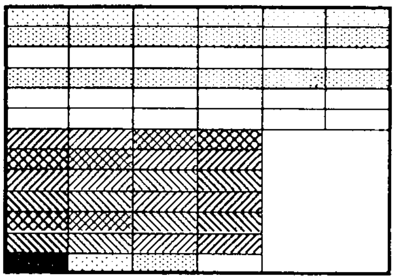


TYPE 4 = 16 Colors : 16-color color bar.

The color pens of the upper row from left to right are 0 ~ 7.
The color pens of the lower row from left to right are 8 ~ 15.



TYPE 5 = 64 Colors : Particularly for the EGA 64-color picture plane (refer to Color Pen in Appenidx D).



- Pen 16 ~ 21 are at the first horizontal row, and in 33 % of color bar luminance (e. g. the middle six colors at the upper row of TYPE 4).
- Pen 1 ~ 6 are at the second horizontal row, and in 66 % of color bar luminance.
- Pen 9 ~ 14 are at the third horizontal row, and in 100 % of color bar luminance.
- Pen 22 ~ 27 are at the fourth horizontal row, and in 66 % of color bar luminance (but 33 % of saturation).
- Pen 28 ~ 33 are at the fifth horizontal row, and in 100 % of color bar luminance (but 33 % of saturation).
- Pen 34 ~ 39 are at the sixth horizontal row, and in 100 % of color bar luminance (but 66 % of saturation).
- Pen 40 ~ 43 are at the seventh horizontal row, and in a variety of brightness and darkness produced by B’s deflection to R.
- Pen 44 ~ 47 are at the eighth horizontal row, and in a variety of brightness and darkness produced by R’s deflection to B.
- Pen 48 ~ 51 are at the ninth horizontal row, and in a variety of brightness and darkness produced by B’s deflection to G.
- Pen 52 ~ 55 are at the tenth horizontal row, and in a variety of brightness and darkness produced by G’s deflection to B.
- Pen 56 ~ 59 are at the eleventh horizontal row, and in a variety of brightness and darkness produced by R’s deflection to G.
- Pen 60 ~ 63 are at the twelfth horizontal row, and in a variety of brightness and darkness produced by G’s deflection to B.
- Pen 0, 8, 7, 15 are at the thirteenth horizontal row, and in 0 %, 33 %, 66 %, 100 % of gray scale respectively.

TYPE 6 = 256 Colors : The arrangement of 256 colors is the matrix of 16 $\times$ 16 bars (refer to Analog Color Form in Appendix D).

- Pen 224 ~ 239 are from left to right at the first horizontal row of the upper side. They are darker 16 gray scales.
- Pen 32 ~ 47 are from left to right at the second horizontal row of the upper side.

They are darker 16 blue scales.

- Pen 64 ~ 79 are from left to right at the third horizontal row of the upper side. They are darker 16 red scales.
- Pen 96 ~ 111 are from left to right at the fourth horizontal row of the upper side. They are darker 16 purple scales.
- Pen 128 ~ 143 are from left to right at the fifth horizontal row of the upper side. They are darker 16 green scales.
- Pen 160 ~ 175 are from left to right at the sixth horizontal row of the upper side. They are darker 16 cyan scales.
- Pen 192 ~ 207 are from left to right at the seventh horizontal row of the upper side. They are darker 16 yellow scales.
- Pen 224 ~ 239 are from left to right at the eighth horizontal row of the upper side. They are darker 16 gray scales.
- The color of row 9 to 16 is as same as that of row 1 to 8, but it is brighter 16 scales (the value of 16 is added to all pen numbers).

TYPE 7 = User Define : Here you can determine the color bar . The arrangement of colors needs to be set either from left to right (H direction) or from up to down (V direction). Besides, at most 8-color pen no. can be set. The input is shown as follows :

```
COLOR   DIRECTION  ＝X
PRESS 1 - 2，SEL
```

```
HOW MANY COLORS？X
1 - 8
```

```
COLOR  ＃1＝XXX
0 - 255
```

:
:
:

```
COLOR  ＃8＝XXX
0 - 255
```

3.4.13 Gray Scale

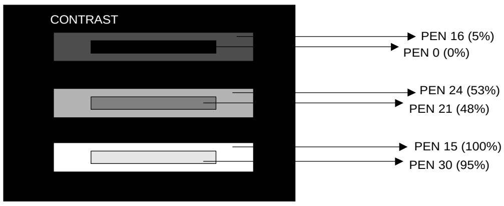
```
TYPE  ＝  XXXXX
PRESS 1 - 7，SEL
```

There are seven kinds of gray scale for choice.

TYPE 1 = 4 Blocks : 4 blocks of gray scale.

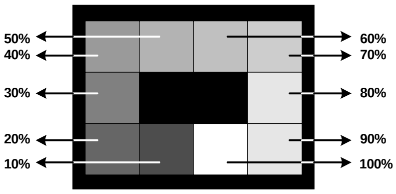
(1) = black, (2) = gray, (3) = gray, (4) = white

TYPE 2 = Contrast : for testing the display of the difference of 5% bright in analog signal (use Norm Pen Form in Appendix D).



The size of each vertical block is 1/7 of a window, and that of horizontal one 3/4. The length and width of the interior + 5% light are all 1/2 of each block.

TYPE 3 = 10 Grays :



Use the pen no. in Norm Pen Form (see Appendix D-1, D-2) as shown below :

- Pen 0 = 0 %
- Pen 17 = 10 %
- Pen 18 = 20 %
- Pen 19 = 30 %
- Pen 20 = 40 %
- Pen 22 = 50 %
- Pen 25 = 60 %
- Pen 26 = 70 %
- Pen 28 = 80 %
- Pen 29 = 90 %
- Pen 15 = 100 %

TYPE 4 = 16 Grays : There are 16 grays from left to right on the first half part like pen 225, 227, 229, ... 255. Levels in norm pen form are 60/1023, 124/1023, ... 1023/11023. The difference between every two levels is 64/1023. The arrangement on the second half part is from right to left.

TYPE 5 = 32 Grays : There are 32 grays from left to right on the first half part. They are pen 224 to 255. Levels in norm pen form are 28/1023. 60/1023, ... 1023/1023. The difference between every two levels is 32/1023. The arrangement on the second half part is from right to left.

TYPE 6 = 256 Grays : Now gray pen form (see Appendix D-3) should be chosen. Pen 0 ~ 255 are from left to right on the first half part. The levels are 0/1023 ~ 1023/1023. The difference between every two levels is 4/1023. The arrangement on the second half part is from right to left.

TYPE 7 = User Define : Here you may determine at most eight grays. The direction of change can be specified as from left to right (H direction), or from up to down (V direction).

```
GRAY  DIRECTION ＝X
PRESS 1 - 2，SEL
```

```
HOW MANY GRAYS？X
1 - 8
```

```
GRAY ＃1＝XXX
0 - 255
```

⋮

```
GRAY ＃8＝XXX
0 - 255
```

TYPE 8 = Multigrays :

It displays the color scales of R, G, B, W. Related parameters are shown as follows:

```
GRAY ＃1＝XX
```

The scales that can be set are given below:

= 0 is 1 scale	= 4 is 16 scales
= 1 is 2 scales	= 5 is 32 scales
= 2 is 4 scales	= 6 is 64 scales
= 3 is 8 scales	= 7 is 128 scales
	= 8 is 256 scales

```
GRAY  #2=XX
```

The colors that can be set are given below:

= 0 is red   = 2 is blue

= 1 is green   = 3 is gray

```
GRAY  #3=XX
```

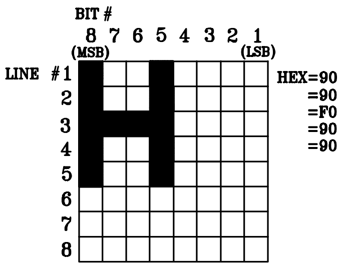
The progressive directions of luminance that can be set are given below:

= 0 is from left to right   = 2 is from up to down

= 1 is from right to left   = 3 is from down to up

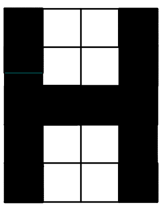
3.5 The Setting of Character

The built-in character numbers are # 1 ~ 499. Other character numbers which you can build are # 500 ~ 611 in NVRAM, and # 700 ~ 999 in Memory Card.

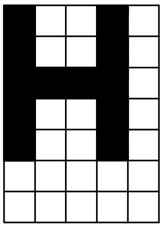


Every character is composed of bit map. The graph shows that an H with the size of 4×5 is put inside a grid of 8×8. The right is the value of hexadecimal system of its bit map. In building a character, you just input the hex data of its each line by this way.

In addition, through the reference of Appendix C-1, we know that the largest size of the 50 characters, # 500 ~ 549, is 8×8, and that of # 550 ~ 599, 16×16. But sometimes, we do not need so large a space, therefore we have to set character size; that is, to set the pixel numbers displayed by H and V directions of the character. For the example mentioned above, if character size is set as H = 4 and V = 5, the display will be as follows (Grids will not be displayed).



If character size is set as H = 5 and V = 7, the display will be as follows (Grids will not be displayed).



The input way of the character of 8 × 8 can be applied to those of 16 × 16, 32 × 32, and 64 × 64. The only difference is that the hex data of each line will become longer. The operation is to set a character by pressing **WRITE** . The display is as follows after pressing **WRITE** .

```
WRITE TYPE＝CHARACTER
PRESS 1 - 7
```

Press **ENTER** after you have chosen WRITE TYPE = CHARACTER.

```
CHARACTER No.＝XXX
500 - 611，700 - 999
```

The numbers of characters in NVRAM and Memory Card are at the second row. Press **ENTER** after you have chosen a proper position.

```
CHAR SIZE  H＝XX，V＝XX
1 - 64
```

Here you can set the values of H, V for a character size. The range of the character setting is at the second row. 1-64 means that the character is 64 × 64 at most. The range for other character can be 1-8 (8 × 8 at most), 1-16 (16 × 16 at most), or 1-32 (32 × 32 at most).

```
ENTRY  LINE ＃＝01
1 - 64
```

First, choose to start with which line. In this example, we start with line # 1.

```
LINE ＃01（KEY＝0 - 9）
＝XXXXXXXXXXXXXXXX
```

Input the hex data of line # 1. By pressing **SELECT** you can input characters from A to F.

:
:

LINE ＃64（KEY＝0 - 9）
＝XXXXXXXXXXXXXXXX

After the data of all lines have been established, if you press **QUIT** , you can return to "ENTRY LINE", and choose the beginning line number again.

3.6 The Setting of String

The system can let you build 150 strings. # 1 ~ 36 are stored in NVRAM while # 37 ~ 150 in Memory Card. Every string is composed of 15 characters at most. Every character is input by its character number.

For example, string # 1 = 67, 72, 82, 79, 77, 65, 0, 0, and the arranged character is **CHROMA** through reference to Appedix C.

The appearance of two zeros (0) means that the end of string. Of course, the end of string will come after 15 codes are used up.

If there is a zero appearing in the 15 codes, it means the next line. For example, string # 1 = 67, 72, 0, 82, 79, 0, 77, 65, 0, 0, and the arranged picture is as follows.

CH
RO
MA

The operation on the panel begins with pressing **WRITE** as follows.

WRITE TYPE ＝ XXXXXX
PRESS 1 - 7，SEL

Press **ENTER** after you have chosen TYPE = STRING.

STRING No. = XXX
1 - 150

Specify the string number you want to input.

STRING = 001 CODE 1 - 05
= XXX,XXX,XXX,XXX,XXX

The example shows the input position of the previous five characters of string # 001.

```
STRING = 001 CODE 6 - 10
= XXX,XXX,XXX,XXX,XXX
```

The second row shows the input position for the middle five characters.

```
STRING = 001 CODE 11 - 15
= XXX,XXX,XXX,XXX,XXX
```

The second row shows the input position for the last five characters.

3.7 The Setting of Color Pen

There are four kinds of TTL and three kinds of Analog in the built-in color pen as shown in Appendix D. Besides, you can build three kinds of analog pen form such as User 1, User 2 and User 3. User 1 is stored in NVRAM. User 2 and User 3 are stored in Memory Card. Each kind of analog pen form has 256 pens, and each pen defines the output level of R, G, B as x/1023. X can be 0 to 1023. For the sake of simplicity, you need only to input the value of x, not the denominator. Moreover, because of the need of internal control, pen 0 has to be set as R=G=B=0, and pen 255 as R=G=B=1023 without exception. Therefore, you can only input 254 pens.

The operation on the panel begins with pressing **WRITE** as follows.

```
WRITE TYPE＝XXXXXX
PRESS 1 - 7，SEL
```

Press **ENTER** after you have chosen COLOR PEN.

```
COLOR PEN FORM = XXXX
1 - 3
```

Choose one of the three forms: User 1, User 2, and User 3.

```
START PEN No. = XXX
1 - 254
```

Choose the beginning number for input.

```
PEN No. 001
R = 1023，G = 1023，B = 0
```

In the above example, the three-set values of Pen No. 001 are set as R = 1023, G = 1023, B = 0. The color of the pen is the brightest color of R + G.

⋮

```
PEN No. 254
R = XXX，G = XXX，B = XXX
```

If you quit in the middle, you will return to the input place of “START PEN No.”, and need to choose another place to enter.

3.8 The Function of WRITE

The display is as follows after pressing WRITE .

```
WRITE TYPE = XXXXXX
PRESS 1 - 7，SEL
```

Apart from the three functions of WRITE stated from 3.5 to 3.7, there are three more functions as follows.

TYPE 4 = ICON
5 = CARD NAME
6 = LOAD DATA
7 = COPY DATA

The meaning of Write Icon is all the same as that stated on 3.4. Write Card Name is that you can set each memory card as a name of 12 letters for identity. The method is as follows.

```
MEMORY CARD（KEY= 0 - 9）
NAME = XXXXXXXXXXXX
```

3.8.1 Load Data

In choosing WRITE TYPE = LOAD DATA, you can use memory card to back up all data in NVRAM, or update the data stored in memory card onto NVRAM. It is a good way to transfer a large number of data. The methods are as follows.

```
LOAD TYPE = XXXXX
PRESS 1 - 4，SEL
```

There are four methods: 1 = BACKUP-1
2 = BACKUP-2
3 = RESTORE-1
4 = RESTORE-2

Backup is to copy the data in NVRAM onto Memory Card. The positions are as follows.

NVRAM	COPY TO	BACKUP-1 MEMORY CARD	BACKUP-2 MEMORY CARD
TIMING	＃101-400	＃401-700	＃701-1000
PATTERN	＃101-200	＃201-300	＃301-400
PROGRAM	＃1-100	＃101-200	＃201-300
ICON	＃21-40	＃41-60	＃61-80
CHARACTER	＃500-611	＃700-811	＃812-923
STRING	＃1-36	＃37-72	＃73-108
COLOR PEN	USER-1	USER-2	USER-3

In Restore 1 and Restore 2, the copying is from Memory Card to NVRAM. Restore-1 and Restore-2 are the back actions of Backup-1 and Backup-2 respectively.

3.8.2 Copy Data

The display is as follows after choosing WRITE TYPE = COPY DATA.

```
COPY TYPE = XXXXX
PRESS 1 - 7，SEL
```

Here you can copy any of the following seven kinds of data: Timing, Pattern, Program, Icon, Character, String, and Color Pen.

You can copy the selected data's source into a destination from start format to end format. The copying of Timing is as follows.

```
COPY TIMING
= 105 - 200 TO 800
```

It means that Timing # 105-200 is copied to Timing # 800-895. The Start No. of source cannot be larger than the End No., otherwise there will be an error message of Start > End.

Table of Contents

5. Operation of RS-232C

In this chapter, subsection 5.1 describes the setting of basic parameters in the system.
subsection 5.2 describes the operation of RS-232C.
subsection 5.3 lists the command set for reference.

5.1 Setting of Parameters

Before using RS-232C some parameters in the system must be set and stored in NVRAM for the same loading as the instrument is turned on every time.

Press **CONFIG** and ▼ several times. LCD will show as follows.

```
RS232C  SETUP？
0 = NO，1 = YES
```

Choose YES and press **ENTER** . Then, set the following parameters.

```
ENABLE  RS232C？
```

```
BAUD RATE = XXXXX
PRESS 1 - 8，SEL
```

1 = 2400	5 = 23040
2 = 4800	6 = 28800
3 = 9600	7 = 38400
4 = 19200	8 = 57600

```
PARITY CHECK = XXXX
PRESS 0 - 2，SEL
```

There are three options of None, Even and Odd.

```
RS232C DATA = X BITS
PRESS 0 - 1，SEL
```

7 or 8 bits.

The two parameters mentioned above, Baud Rate and Parity Check, control RS-232C in the system simultaneously. In use of the interface, all systems on bus and the computer should be set similarly to communicate. RS-232C can be enabled or disabled. When it is disabled, the data transmission on bus will not be recognized by the system.

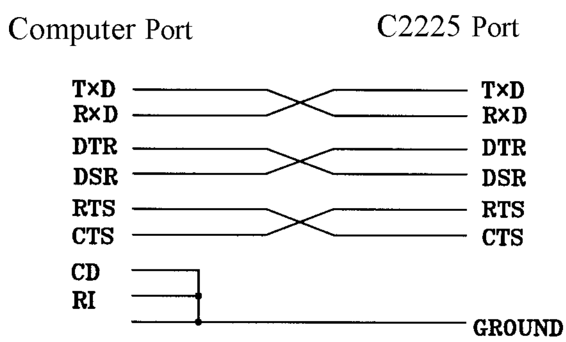
5.2 The Operation of RS-232C

5.2.1 Hardware Configuration

The interface of RS-232C consists of the following six signals:

1. TRANSMIT DATA (TxD)
2. RECEIVE DATA (RxD)
3. DATA TERMINAL READY (DTR)
4. DATA SET READY (DSR)
5. REQUEST TO SEND (RTS)
6. CLEAR TO SEND (CTS)

Its wiring with the computer is shown below.



The PC must set DTR as True to indicate power-on and communicate with RS-232C.

Data can be sent when DSR and CTS of the transmitting devices are set as True. But data transmission will be suspended when DTR and RTS of the receiving devices are set as False. The hardware handshake adopts RTS/CTS protocol. The interface is full duplex, so it can transmit and receive data simultaneously. Baud rates include 2400, 4800, 9600, 19200, 23040, 28800, 38400, and 57600. If the computer is at or above 28800, 2 stop bit must be set to ensure stable transmission.

5.2.2 Software Configuration

The system has a buffer RAM of 16K bytes for RS-232C to receive data.

The basic action is to decode and execute data while receiving them. If there is an error, it will be reported to the computer. All the action is not displayed on LCD.

You can do the following jobs by use of the commands listed on 5.3.

(1) Output in Enable or Disable.
(2) Call up any data file into buffer RAM.
(3) Modify any parameter of any file.
(4) Store the files in buffer RAM onto NVRAM or Memory Card.
(5) Upload the data of any file to the computer.
(6) Other functions are inquiries of system model, software version number, VRAM size, etc.

Commands for transmission can be separated by " ; ", and sent out together in one string. The commands are as follows:
[command]; [command]; ... [command];

The system executes the commands while receiving them, and will return to the computer according to the situation of OK or NG after the completion of execution. Note that if the computer has not transmitted all commands, and is in pause mode, the system will not know and will continue returning data to the computer. If you request that the system will not execute and return data until the computer has transmitted them completely, you must put TASK XXX and TASKEND separately before and after all commands. Thus doing, the system will execute the whole task only after receiving TASKEND.

For example : TASK 001; [command]; [command]; ... [command]; TASKEND;

And the system will return the following data to the computer:

REPORTTSK 001；

RECEIVED XX COMMANDS；

EXECUTED XX COMMANDS；

REPORTEND；

For details refer to 5.3.3.

5.3 Command Set

The basic form of the commands recognized by the system is as follows:
marker + [parameter] + [marker] + [parameter] + ... + terminator

At first, there must be a marker, then followed by a combination of parameters or markers or nothing at all, and at last there must be a terminator. The terminator for the system is a semicolon (;). Markers and parameters must be separated by space, comma (,), carriage return (0DH), or line feed (0AH) to be more readable. The commands are all in ASCII codes, and can be written by use of any text editing software. A marker can be written in upper or lower case.

For example : ENABLE；
KEYBOARD LOCK；
H TOTAL 1280；

When the system successfully receives a command from RS-232C bus, it will begin parsing the command, and check if the parameters are in the acceptable range. If the check is all right, the execution will start. During execution, if all is normal, the system will return an OK, otherwise an NG. NG means NOGO.

For example :
OK；
NG；BOUNDARY ERROR：H TOTAL 9000；

The commands are divided into six subsections for explanations below. Note that commands enclosed in the square brackets are optional.

5.3.1 General Commands
5.3.2 Commands for Data Setting
5.3.3 Task Commands
5.3.4 Upload Commands
5.3.5 Error Messages of Parser and Execution
5.3.6 Abbreviations of Commands

5.3.1 General Commands

(1) LOAD TIMING, PATTERN, PROGRAM FORMAT

The commands used to read data from FLASH, NVRAM or Memory Card to the buffer in the system are as follows:

LOAD TIMING XXXX；XXXX = 1 ~ 3000，

LOAD PATTERN XXX；XXX = 1 ~ 800，

LOAD PROGRAM XXX；XXX = 1 ~ 999，

(2) STORE TIMING, PATTERN, PROGRAM, ICON

The commands used to store data in the buffer onto NVRAM or Memory Card are as follows:

STROE TIMING XXXX；XXXX = 101 ~ 3000，

STROE PATTERN XXX；XXX = 101 ~ 800，

STROE PROGRAM XXX；XXX = 1 ~ 999，

STROE DRAM XX ICON YY；XX = 1 ~ 20，
YY = 21 ~ 99

(store the Icon data of Draw XX in Pattern into the file of #YY)

(3) ENABLE/DISABLE

The commands used to enable or disable output are as follows:

DISABLE；：Stop output.

RUN；：Do a single output by using Timing/Pattern in the buffer.

ENABLE；：ditto.

OUTPUT；：ditto.

RUN PROGRAM；：Do a sequential output using Program in the buffer.

ENABLE PROGRAM；：ditto.

OUTPUT PROGRAM；：ditto.

RUN TIMING XXXX；： Load Timing XXXX, then enable.

RUN PATTERN XXX；：Load Pattern XXX, then enable.

RUN TIMING XXXX PATTERN YYY；：It is equal to the combination of the above two steps.

RUN PATTERN XXX TIMING YYYY；：ditto.

RUN，TXXX，PYYY，（0AH）： It is the command of Chroma 2000, and can be run by the system too. T means Timing while P Pattern. It returns DOWNLOAD DATA OK <0AH> <0DH> to emulate Chroma 2000.

RUN PROGRAM XXX；：Load Program XXX, then enable.

RED ON ；：SET RED = ON.

RED YES；：ditto.

RED OFF；：SET RED = OFF.

RED NO；：ditto.

RED；：Change RED Status from ON to OFF and vice versa.

GREEN ON；：It is the same as RED.

GREEN YES；：It is the same as RED.

GREEN OFF；：It is the same as RED.

GREEN NO；：It is the same as RED.

GREEN；：It is the same as RED.

BLUE ON ；：It is the same as RED.

BLUE YES；：It is the same as RED.

BLUE OFF；：It is the same as RED.

BLUE NO；：It is the same as RED.

BLUE；：It is the same as RED.

REVERSE ON；：It is the same as RED.

REVERSE YES；：It is the same as RED.

REVERSE OFF；：It is the same as RED.

REVERSE NO；：It is the same as RED.

REVERSE ；：It is the same as RED.

(4) STATUS CHECK /SET COMMAND

KEYBOARD LOCK [ON]；：Disable keyboard.

KEYBOARD LOCK OFF；：Enable keyboard.

This command can be used to avoid the trouble which results from the simultaneous control of the PC and the front panel upon the system. As the machine is powered on, the status of the system is KEYBOARD ENABLE. Once the status is KEYBOARD LOCK, only by giving the command of KEYBOARD LOCK OFF or powering on the machine again can you return to KEYBOARD ENABLE.

REPORT ON；

REPORT YES；

REPORT OFF；

REPORT NO；

REPORT ERROR ON；

REPORT ERROR YES；

The above six commands are divided into three pairs. Each pair has two commands with the same meaning. REPORT ON means that after successfully receiving a command, the system has to return the result of execution, OK or NG, to the computer. REPORT OFF means that the system does not return the result to the computer. REPORT ERROR ON means that if there is an error, the system has to return, otherwise does not have to do so.

REPORT VERSION [NUMBER]；inquires software version, and the reply is as V1.0 ;

REPORT MODEL [TYPE]；inquires model, and the reply is as C2213 or C2225 ;

REPORT VRAM [SIZE]；VRAM SIZE, and the reply is as 2048 × 2048 ;

REPORT CARD NAME； the reply is as CARD NAME “ABC” ;

REPORT CARD WP [STATUS]；or

REPORT CARD WRITE PROTECT [STATUS]；

the reply is as CARD WP ON ; or CARD WP OFF ;

REPORT CARD BATTERY [STATUS]；

the reply is as CARD BATTERY OK；
CARD BATTERY LOW；
CARD BATTERY NG；

REPORT BOOT STATUS；returns POWER ON ERROR LIST (ERROR at power-on)

SELF TEST；executes SELF TEST, and returns the result (it takes about 15 seconds)

DUMMY；executes BUS TEST, and returns OK after receiving correct data ;

REPORT TASK STATUS；returns the results executed by TASK last time.

For SELF TEST refer to 4.2.1. For POWER ON ERROR LIST refer to 2.5.1.

RESTART（or REBOOT）；performs WARM START, but does not return data.

RESET；comes back to DISABLE STATE at power-on.

No matter the above report commands are in REPORT ON or REPORT OFF, they will all return the results as follows:

OK；	or	NG；
REPORTBGN；		REPORTBGN；
⋮		
REPORTEND；		REPORTEND；

The middle parts are the returned data like V1.0 or 2048 × 2048.

5.3.2 Commands for Data Setting

The following detailed explanations are about Timing, Pattern, Program, Icon, Character, String, Color Pen, etc. For the abbreviations of some commands refer to 5.3.6.

(1) The Commands for Setting of Timing Parameters

TIMING NAME "string" or TIMING NAME 'string'；
PIXEL xxx.xxx or DOT [RATE] xxx.xxx；
INTERLACE [ON] or INTERLACE [YES]；
NON INTERLACE or NON-INTERLACE or INTERLACE OFF or INTERLACE NO；
VIDEO ANALOG - COLOR；
VIDEO ANALOG - MONO；
VIDEO TTL - RGBrgb；
VIDEO TTL - RGBI；
VIDEO TTL - MONO+I；
VIDEO TTL - MONO；
VIDEO DIGITAL;
VIDEO LVDS;
VIDEO PANELLINK;
CLOCK MODE LCD-FD;
CLOCK MODE LCD-1/2FD;
FD OUTPUT FULL (+);
FD OUTPUT FULL (-);
FD OUTPUT DISP (+);
FD OUTPUT DISP (-);
FD DELAY XX NS; XX = 3, 6, 9, 12, 15, 18, 21, 24
RGB OUTPUT XX BIT; XX = 1 ~ 8
R BIT XX; XX = 0 ~ 255
G BIT XX;
B BIT XX;
RGB PERMUTATION RGB;
RGB PERMUTATION RBG;
RGB PERMUTATION GRB;
RGB PERMUTATION GBR;
RGB PERMUTATION BRG;
RGB PERMUTATION BGR;
SYNC ON G [ON] or SOG [ON] or SYNC ON G [YES] or SOG [YES]；
SYNC ON G OFF or SOG OFF or SYNC ON G NO or SOG NO；
SYNC LEVEL xxx； /* force sync on g */
VIDEO LEVEL xxx；
WHITE LEVEL xxx；
BLACK LEVEL 0；
BLACK LEVEL 7.5；
HEX DATA xxxx or HEX CONTROL xxxx；
DATA UNIT PIXEL；
DATA UNIT US/MS or DATA UNIT TIMING；

H TOTAL xxxx；
H DISPLAY xxxx；
H B-PORCH xxxx；
HS WIDTH xxxx；
H BORDER xxx；
H SIZE xxx.xxx；

V TOTAL xxxx；
V DISPLAY xxxx；
V B-PORCH xxxx；
VS WIDTH xxxx；
V BORDER xxx；
V SIZE xxx.xxx；

HS OUTPUT ON（+）；
HS OUTPUT ON（-）；
HS OUTPUT OFF - LOW；
HS OUTPUT OFF - HIGH；

VS OUTPUT ON（+）；
VS OUTPUT ON（-）；
VS OUTPUT OFF - LOW；
VS OUTPUT OFF - HIGH；

XS OUTPUT ON（+）；
XS OUTPUT ON（-）；
XS OUTPUT OFF - LOW；
XS OUTPUT OFF - HIGH；

XS SELECT H+V；
XS SELECT H EOR V；
XS SELECT SERR；
XS SELECT H；
XS SELECT V；
PEN SIZE SCALE xx.x；   xx.x = 0.1 ~ 12.7

The above parameters are all the same as those watched through operation on the front panel. The parameters are only used to modify the data of buffer in the system. They cannot be used to directly modify the data in NVRAM or Memory Card. If you want to modify the data file, you have to load it onto buffer first (load Timing XXX ;), then modify all or part of the data, and store back onto data file (store Timing XXX ;). For simplification the following two commands are provided:

DEFINE TIMING XXX [YYY]；
⋮
⋮
DEFEND ；

Define Timing XXX [YYY] means to load Timing YYY to buffer first, then modify according to the following commands until Defend, and store the results onto Timing XXX. If YYY is not given, it will be regarded as Load Timing XXX. If Defend is omitted, the storage will not be done, and it will not be an error either. If there are more than two Defines before Defend, except the first Define, other Defines will be regarded as errors and omitted.

The following example is to be read from Timing 101, and stored back onto Timing 101 after modification.

```
/*example 1*/
define timing 101；
timing name "VGA640x480-6"；
pixel 25.175；
non-interlace；
video analog-color；
sync level 300；
sync on g off；
video level 700；
white level 700；
black level 0；
hex data 0x55aa；
data unit pixel；
h total 800；
h display 640；
h b-porch 48；
hs width 96；
h border 8；
h size 4.000；
v total 525；
v display 480；
v b-porch 33；
vs width 2；
v border 8；
v size 3.000；
hs output on（-）；
vs output on（-）；
xs output on（+）；
xs select serr；
defend；
```

(2) The Commands for Setting of Pattern Parameters

```
PATTERN NAME "string"or PATTERN NAME 'string'；
COLOR [ FORM ] NORM；
COLOR [ FORM ] GRAY；
COLOR [ FORM ] USER x；
```

```
BACKGROUND [ COLOR ] xxx；
FOREGROUND [ COLOR ] xxx；
POSITIVE [ ON ] or POSITIVE [ YES ]；
NEGATIVE or POSITIVE OFF or POSITIVE NO；
BLINK [ ON ] or BLINK [ YES ]；
BLINK OFF or BLINK NO；
BLINK SPEED xxx，xxx；  /*force blink on */
BLINK DRAW xx [，xx] [，xx]；/*force blink on */
SPECIAL PATTERN TYPE xxx；
CLEAR DRAW；  /*clear all draws */
CLEAR DRAW xx；  /*clear icon draw xx */
CLEAR DRAW xx yy；  /*clear icon draw xx - yy */
DEFINE DRAW xx DOT yy；
DEFINE DRAW xx CIRCLE yy；
DEFINE DRAW xx LINE yy；
DEFINE DRAW xx X-HATCH yy；
DEFINE DRAW xx RECTANGLE yy；
DEFINE DRAW xx MARKER yy；
DEFINE DRAW xx CHARACTER yy；
DEFINE DRAW xx STRING yy；
DEFINE DRAW xx COLORBAR yy；
DEFINE DRAW xx GRAYSCALE yy；
DEFINE DRAW xx DUMMY [ yy ]；  /*same as CLEAR DRAW xx；  */
DEFEND；  /* end of define draw */
DEFEND；  /* end of define pattern */
```

The explanations of special pattern types are as follows:
(general type = 0)

```
/* special pattern type = 00 ~ 04 */
/* 00：normal pattern */
/* 01：raster pattern */
/* 02：border pattern */
/* 03：smpte rp-133 pattern */
/* 04：rgb x-hatch */
```

The explanation of Define Pattern XXX [YYY]; ... Defend ; is as same as that of Define Timing XXX [YYY] ; ... Defend ; . The difference is that in the middle of the former there can be 20 define draws at most. Each define draw can be followed by a Defend, or all define draws by a Defend. The purpose of this design is that when it is not necessary to store pattern, data can be directly downloaded from the computer to buffer and enabled to output. After define draw 1 the commands of Icon parameters can be downloaded (see **(4)** below). Then, after define draw 2 till 20 a whole pattern can be downloaded for direct use. It is not necessary to store Icon onto NVRAM or Memory Card in advance. But if Define Pattern XXX ; ... Defend ; is used in the beginning and end, only define draws can be used in the middle. Icon parameters cannot be modified. It will be an error if they are modified.

For special pattern type XXX, you are recommended to use type 0 : normal pattern. If you want to use special pattern, you may directly load pattern. In pattern 1~100 there are built-in patterns for use. An example is given below.

```
/* example 2 */
define pattern 101；
pattern name "GENERAL-1"；
color form norm；
background 0；
foreground 15；
positive；
blink speed 1，1；
blink draw 0，0，0；
blink off；
special pattern type 0；
clear draw；
def draw 1 x-hatch 4；
def draw 2 circle 1；
def draw 3 marker 1；
def draw 4 colorbar 3；
def draw 5 dot 1；
def draw 6 str 1；
def draw 7 str 5；
defend； /* end of define draw */
defend； /* end of define pattern */
```

(3) The Commands for Setting of Program Parameters

```
PROGRAM NAME "string" or PROGRAM NAME 'string'；
CLEAR PROGRAM； /* clear all sequences */
CLEAR SEQUENCE；/* same as CLEAR PROGRAM */
CLEAR SEQUENCE xx； /* clear 1 sequence，no. = xx */
CLEAR SEQUENCE xx yy； /* clear sequence xx - yy */
SEQUENCE xx TIMING xxxx PATTERN xxx SECOND xx.x； /* define sequence */
```

The explanation of Define Program XXX [YYY] ; ... Defend ; is as same as that of Define Timing XXX [YYY] ; ... Defend ; . An example is given below.

```
/* example 3 */
define program 1；
program name "test"；
clear program； /* clear all sequences */
sequence 1 timing 13 pattern 1 second 5.0；
sequence 2 timing 67 pattern 2 second 5.0；
sequence 3 timing 13 pattern 3 second 5.0；
sequence 4 timing 67 pattern 4 second 5.0；
```

```
sequence 5 timing 13 pattern 5 second 5.0；
defend；
```

(4) The Commands for Setting of Icon Parameters

Icon is divided into ten kinds. Define Icon and Defend is the same as above. The command, Define Draw XX Dot YY, is used to download data from the computer to buffer for output. Each icon is followed by an example for reference.

```
/* Define dot command */
DEFINE DRAW xx DOT yy；  /* define working draw xx，icon type DOT，# yy */
DEFINE ICON DOT xx；  /* define library xx（read xx，modify ，write xx）*/
DEFINE ICON DOT xx yy；  /* define library xx （read yy，modify，write xx）*/
[ ICON ] NAME “string”；
SPECIAL COLOR [ ON ] or SPECIAL COLOR [ YES ]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xxx；  /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；  /* force window define pixel */
WINDOW START xxx / xxx，xxx / xxx；/*force window define ratio */
WINDOW SIZE xxx，xxx；  /* force window define pixel */
WINDOW SIZE xxx / xxx，xxx / xxx；/* force window define ratio */
[ DOT ] SPACING xxx，xxx；
VERTICAL SHIFT xxx；
REPEAT NONE or REPEAT OFF or REPEAT NO；
REPEAT MIRROR H；
REPEAT MIRROR V；
REPEAT MIRROR H＆V；
REPEAT MIRROR H＆V＆C；
REPEAT FULL [ PAGE ]；
DEFEND；

/* example 4 */
define icon dot 21；
icon name “5 BLOCKS”；
special color 15；
special color off；
pen size 1；
window def ratio；
window start 9 / 128，9 / 96；
window size 14 / 128，14 / 96；
dot spacing 1，1；
vertical shift 1；
repeat mirror h＆v＆c；
```

defend；

/* ------------------------------------ Define circle command --- */

DEFINE DRAW xx CIRCLE yy； /* define working draw xx，icon type CIRCLE，# YY */

DEFINE ICON CIRCLE xx； /* define library xx（read xx，modify，write xx）*/

DEFINE ICON CIRCLE xx yy； /* define library xx（read yy，modify，write xx）*/

[ICON] NAME "string"；

SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xxx； /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；
DIAMETER xxxx；
DIAMETER xxx / xxx；
TYPE 6 CIRCLES；
TYPE 1 CIRCLE or TYPE USER [DEFINE]；
REPEAT NONE or REPEAT OFF or REPEAT NO；
REPEAT MIRROR H；
REPEAT MIRROR V；
REPEAT MIRROR H＆V；
REPEAT MIRROR H＆V＆C；
REPEAT FULL [PAGE]；
DEFEND；

/* example 5 */
define icon circle 21；
icon name "6 CIRCLES"；
special color 15；
special color off；
pen size 1；
window def ratio；
window start 0 / 1， 0 /1；
diameter 1 / 1；
type 6 circles；
repeat none；
defend；

/* --------------------------------- Define line command -------------------------------------- */

DEFINE DRAW xx LINE yy； /* define working draw xx，icon type LINE，＃yy */

DEFINE ICON LINE xx； /* define library xx（read xx，modify，write xx）*/

DEFINE ICON LINE xx yy； /* define library xx（read yy，modify，write xx）*/

[ICON] NAME "string"；

SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；

SPECIAL COLOR xxx； /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；
WINDOW START xxx / xxx，xxx / xxx；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，xxx / xxx；
TYPE “│” LINES or TYPE V LINES；
TYPE “-” LINES or TYPE H LINES；
TYPE “ / ” LINES；
TYPE “ \ ” LINES；
TYPE PAIRING；
TYPE RESOLUTION；
INTERVAL xxxx；
REPEAT NONE or REPEAT OFF or REPEAT NO；
REPEAT MIRROR H；
REPEAT MIRROR V；
REPEAT MIRROR H＆V；
REPEAT MIRROR H＆V＆C；
REPEAT FULL [PAGE]；

DEFEND；

/* example 6 */
define icon line 21；
icon name “X-TALK”；
special color 15；
special color off；
pen size 1；
window def ratio；
window start 1/100，1/5；
window size 98/100，1/5；
type v lines；
interval 1；
repeat none；
defend；

/* -------------------------------------- Define x-hatch command -- */

DEFINE DRAW xx X-HATCH yy； /* define working draw xx，icon type X-HATCH，＃yy */
DEFINE ICON X-HATCH xx； /*define library xx read xx，modify，write xx）*/
DEFINE ICON X-HATCH xx yy； /* define library xx（read yy，modify，write xx）*/

[ICON] NAME “string”；
SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xxx； /* force special color on */
PEN SIZE xxxx；

```
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；
WINDOW START xxx / xxx，xxx / xxx；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，xxx / xxx；
VERTICAL BLOCK xxx；
HORIZONTAL BLOCK xxx；
TYPE [REM ON] CENTER；
TYPE [REM ON] EDGES；
TYPE USER HORIZONTAL BLOCK；
REPEAT NONE or REPEAT OFF or REPEAT NO；
REPEAT MIRROR H；
REPEAT MIRROR V；
REPEAT MIRROR H＆V；
REPEAT MIRRORH＆V＆C；
REPEAT FULL [PAGE]；
DEFEND；
/* example 7 */
define icon x-hatch 21；
icon name "V8 CENTER"；
special color 15；
special color off；
pen size 1；
window def ratio；
window start 0/1，0/1；
window size 1/1，1/1；
vertical block 8；
type rem on center ；
repeat none；
defend；
/* --------------------------------- Define rectangle command ------------------------------------ */
DEFINE DRAW xx RECTANGLE yy； /* define working draw xx，icon RECTANGLE，
＃yy */
DEFINE ICON RECTANGLE XX； /* define library xx（read xx，modify，writexx）*/
DEFINE ICON RECTANGLE xx yy；/* define library xx（read yy，modify，writexx）*/
[ ICON ] NAME "string"；
SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xxx； /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；
```

WINDOW START xxx / xxx，xxx / xxx；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，xxx / xxx；
REPEAT NONE or REPEAT OFF or REPEAT NO；
REPEAT MIRROR H；
REPEAT MIRROR V；
REPEAT MIRROR H＆V；
REPEAT MIRROR H＆V＆C；
REPEAT FULL [PAGE]；

DEFEND；

/* example 8 */
define icon rectangle 21；
icon name “SIDE LINES”；
special color 15；
special color off；
pen size 2；
window def ratio；
window start 0/1，0/1；
window size 1/1，1/1；
repeat none；
defend；

/* -------------------------------------- Define marker command --- */

DEFINE DRAW xx MARKER yy； */define working draw xx，icon type MARKER，＃yy */

DEFINE ICON MARKER xx； /* define library xx（read xx，modify，write xx）*/

DEFINE ICON MARKER xx yy； /* define library xx（read yy，modify，write xx）*/

[ICON] NAME “string”；
SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xx； /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，xxx / xxx；
TYPE CENTER “+”；
TYPE CENTER “× ”；
TYPE CENTER “ 0 ”；
TYPE CORNER [MARK]；
TYPE EDGE “ T ”；

DEFEND；

/* example 9 */
define icon marker 21；
icon name “CENTER CROSS”；
special color 15；

special color off；
pen size 2；
window def ratio；
window size 1/1，1/1；
type center "+"；
defend；

/* -------------------------------- Define character command -------------------------------------- */

DEFINE DRAW xx CHARACTER yy； /* define working draw xx，icon CHARACTER，＃yy */

DEFINE ICON CHARACTER xx； /* define library xx（read xx，modify，writexx）*/

DEFINE ICON CHARACTER xx yy ； /* define library xx（read yy，modify，writexx）*/

[ICON] NAME "string"；

SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xxx； /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；
WINDOW START xxx / xxx ， xxx / xxx；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，XXX / xxx；
[CHAR] NUMBER xxx or [CHAR]＃xxx；
[CHAR] SPACING xxx，xxx；
[DRAW] AREA FULL [AREA] or DRAW FULL AREA；
[DRAW] AREA [4] CORNERS or DRAW [4] CORNERS；
[DRAW] AREA EDGES or DRAW EDGES；
[DRAW] AREA MIDDLES or DRAW MIDDLES；
[DRAW] AREA [1] ROW or DRAW [1] ROW；
[DRAW] AREA [1] COLUMN or DRAW [1] COLUMN；
REPEAT NONE or REPEAT OFF or REPEAT NO；
REPEAT MIRROR H；
REPEAT MIRROR V；
REPEAT MIRROR H＆V；
REPEAT MIRROR H＆V＆C；
REPEAT FULL [PAGE]；

DEFEND；

/* example 10 */
define icon character 21；
icon name "H-5x7"；
special color 15；
special color off；
pen size 1；
window def ratio；

window start 0/1，0/1；
window size 1/1，1/1；
＃72；
spacing 2，0；
draw area full area；
repeat none；
defend；

/* -- Define string command -- */

DEFINE DRAW xx STRING yy； /* define working draw xx，icon type STRING ，＃yy */

DEFINE ICON STRING xx； /* define library xx，（read xx，modify，write xx）*/

DEFINE ICON STRING xx yy； /* define library yy，（read yy，modify，write xx）*/

[ICON] NAME “string”；
SPECIAL COLOR [ON] or SPECIAL COLOR [YES]；
SPECIAL COLOR OFF or SPECIAL COLOR NO；
SPECIAL COLOR xxx； /* force special color on */
PEN SIZE xxxx；
WINDOW DEFINE RATIO；
WINDOW START xxx，xxx；
WINDOW START xxx / xxx，xxx / xxx；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，xxx / xxx；
TYPE TIMING [NAME]；
TYPE PATTERN [NAME]；
TYPE TIMING + PATTERN or TYPE TIMING+PATTERN；
TYPE SIZE；
TYPE H + V or TYPE H+V；
TYPE [TEXT] 5*7；
TYPE [TEXT] 7*9；
TYPE USER [STRING] or TYPE USER [DEFINE]；
[STRING] NUMBER xx or [STRING]＃ xx；

DEFEND；

/* example 11 */
define icon string 21；
icon name “TIMING / PATTN”；
special color 15；
special color off；
pen size 1；
window def ratio；
window start 41/128，9/96；
window size 1/2，1/4；
type timing+pattern；
＃1；
defend；

/* Define colorbar command */

DEFINE DRAW xx COLORBAR yy；/* define working draw xx，icon COLORBAR，＃ yy */

DEFINE ICON COLORBAR xx；/* define library xx（read xx，modify，write xx）*/

DEFINE ICON COLORBAR xx yy；/* define library xx（read yy，modify，write xx）*/

[ICON] NAME “string”；
WINDOW DEFINE RATIO；
WINDOW DEFINE PIXEL；
WINDOW START xxx，xxx；
WINDOW START xxx / xxx，xxx / xxx；
WINDOW SIZE xxx，xxx；
WINDOW SIZE xxx / xxx，xxx / xxx；
TYPE RGB；
TYPE RGB + INTENSIFY or TYPE RGB＆INTENSIFY；
TYPE RGB DELAY；
TYPE xxx COLORS； /* xxx = 16，64，256 */
TYPE USER [DEFINE]；
[COLOR] DIRECTION H；
[COLOR] DIRECTION V；
COLOR x；
[COLOR] ＃x xxx or [COLOR] number x xxx or color x xxx；

DEFEND；

/* example 12 */
define icon colorbar 21；
icon name “6 COLORS”；
window def ratio；
window start 0/1，0/1；
window size 1/1，1/1；
type rgb + intensify；
color dir h；
color 1；
＃1，0；
＃2，0；
＃3，0；
＃4，0；
＃5，0；
＃6，0；
＃7，0；
＃8，0；

defend；

/* ---------------------------------- Define grayscale command ---------------------------------- */

DEFINE DRAW xx GRAYSCALE yy； /* define working draw xx，icon GRAYSCALE，＃yy */

DEFINE ICON GRAYSCALE xx； /* define library xx（read xx，modify，writexx）*/

DEFINE ICON GRAYSCALE xx yy； /* define library xx（read yy，modify，writexx）*/

```
[ ICON ] NAME “string” ;
WINDOW DEFINE RATIO ;
WINDOW DEFINE PIXEL ;
WINDOW START xxx，xxx ;
WINDOW START xxx / xxx，xxx / xxx ;
WINDOW SIZE xxx，xxx ;
WINDOW SIZE xxx / xxx，xxx / xxx ;
TYPE 4 BLOCKS ;
TYPE CONTRAST ;
TYPE xx GRAYS ;   /* xxx = 10，16，32，256 */
TYPE USER [DEFINE] ;
[GRAY] DIRECTION H ;
[GRAY] DIRECTION V ;
GRAYS x ;
[GRAY] ＃x xxx or [GRAY] number x xxx or GRAY x xxx ;
DEFEND ;
```

```
/* example 13 */
define icon grayscale 21 ;
icon name “4 GRAYS” ;
window def ratio ;
window start 0/1，0/1 ;
window size 1/1，1/1 ;
type 4 block ;
gray dir h ;
grays 1 ;
＃1，0 ;
＃2，0 ;
＃3，0 ;
＃4，0 ;
＃5，0 ;
＃6，0 ;
＃7，0 ;
＃8，0 ;
defend ;
```

(5) The Commands for Setting of Character Font Parameters

Define [User] Character XXX [YYY] ;
(Read YYY, Modify, Write XXX)
(If there is no YYY, the command will be Read XXX.)
[Size] Width XX ;
[Size] Height XX ;
[Line]＃XX YYY [AAA][BBB]...[NNN]
(＃can be also written as Number). This means the data of XX Line. YYY, AAA, ...

NNN are all data of one byte. They can be expressed as 0 ~ 255 or 0x00 ~ 0xFF in HEX.
Defend ;

An example is given below.

```
/* example 14 */
/* define character code = 500，ASCII 'E'，size = 5× 8 */
define user character 500；
width 5；
height 8；
＃1，0xF8；
＃2，0x80；
＃3，0x80；
＃4，0xF0；
＃5，0x80；
＃6，0x80；
＃7，0xF8；
＃8，0x00；
defend；

/* example 15 */
/* define character code = 550，symbol 'me'，size = 11× 11 */
define user character 550；
width 11；
height 11；
＃1，0xF8，0xE0；
＃2，0xAA，0x00；
＃3，0xAB，0xE0；
＃4，0xAA，0x00；
＃5，0xAB，0xE0；
＃6，0x00，0x00；
＃7，0xFA，0xA0；
＃8，0x0A，0xA0；
＃9，0xFA，0xA0；
＃10，0x0A，0xA0；
＃11，0xFB，0xE0；
＃12，0x00，0x00；
＃13，0x00，0x00；
＃14，0x00，0x00；
＃15，0x00，0x00；
＃16，0x00，0x00；
defend；
```

(6) The Commands for Setting of String Parameters

Define [User] String XX ;

Code XXX [XXX] ... [XXX] ;
or Data XXX [XXX] ... [XXX] ;
Defend ;
If it is Define String, its 15-character default data are 0. 15 codes can be set at most per time. The following command can be used too. It is unnecessary to add Defend.

```
DEF [USER] STRING XX CODE YYY. . . [YYY]；
or DEF [USER] STRING XX DATA YYY . . . [YYY]；
```

An example is given below.

```
/* example 16 */
def str 1 Code 272，273，274，275；
```

(7) The Commands for Setting of Color Pen Parameters

The command is Define User X Pen YYY ; selecting Pen YYY in User 1, 2 or 3 Form.
R XXX ; set the value of R as 0 ~ 1023.
G XXX ; set the value of G as 0 ~ 1023.
B XXX ; set the value of B as 0 ~ 1023.
Defend ; . Besides, the following command can be used too: Define User X Pen YYY R 222 G 222 B 222; . It is unnecessary to add Defend.

An example is given below.

```
/* example 17 */
def user 1，pen 1，R 0，G 512，B 1023；
```

(8) The Commands for Setting of DDC Parameters

The commands, Extended Display Identification Data (EDID), should be used in Display Data Channel (DDC):

1. DEFINE EDID [XX] ；XX means Structure＃

```
＃1.    XX, XX, XX, XX, XX, XX, XX, XX;
.
.
.
＃32.   XX, XX, XX, XX, XX, XX, XX, XX;
DEFEND;

256 Bytes Structure      ＃= 1, 3, 5, 7, 9
128 Bytes Structure      ＃= 1 ~ 10
```

There are 32 lines defining the contents of EDID Structure in the system. Each line has

8 bytes, and there are 256 bytes in total (EDID data structure of Version 2 Revision 0). If you input 16 lines, and each line has 8 bytes, there will be 128 bytes in total (EDID data structure of Version 1). If there are 256 bytes, please input structure＃=1, 3, 5, 7, 9. If there are 128 lines, please input structure＃=1~10. If structure＃ is omitted, that means Working Buffer is aimed at. The same condition can be applied to Report, Write, and Read Command as well. An example is given below.

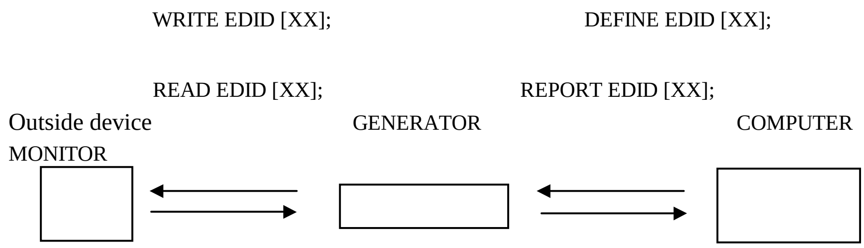
```
/* example 18 */
define edid 1;
＃1,    0x20, 0x3A, 0xAC, 0x00, 0x00, 0x00, 0xC6, 0x07;
＃2,    0x4E, 0x55, 0x4C, 0x0A, 0x00, 0x00, 0x00, 0x00 ;
＃3,    0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃4,    0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃5,    0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃6,    0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30 ;
＃7,    0x0A, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20 ;
＃8,    0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20 ;
＃9,    0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃10,   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃11,   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃12,   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 13,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 14,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 15,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 16,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 17,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 18,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 19,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 20,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 21,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 22,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 23,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 24,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 25,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 26,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 27,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 28,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 29,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 30,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 31,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 ;
＃ 32,  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xCA ;
defend;
```

2. Report EDID [XX] ; XX means that Structure＃ asks the system to report to the computer with EDID Structure. The format is as same as Define EDID.

3. WRITE EDID [XX] ; XX means that Structure# writes into the outside device by DDC2B according to EDID contents in the system.

4. READ EDID [XX] ; XX means that Structure# reads outside EDID contents back into the system by DDC2B.

The following flowchart of data shows the flowing of data.



There are two applications:

1. The command, Define + Write, makes EDID data in the compurer written into the monitor through the generator.
2. The command, Read + Report, makes EDID data in the monitor read back into the computer through the generator.

(9) The Commands for Setting of Other Parameters

The command is Card Name “String” ; setting the name of Memory Card with a string of 12 characters at most, and putting it within “ ”.
The command is Erase Timing XXX [YYY] ; erasing Timing XXX ~ YYY. If there is no YYY, just erase Timing XXX.
Erase Pattern XXX [YYY] ; the meaning is as same as above.
Erase Program XXX [YYY] ; the meaning is as same as above.
Erase Icon Dot XX [YYY] ; the meaning is as same as above.
Dot mentioned above can be changed into any of the ten kinds of Icon.

5.3.3 Task Commands

The transmission of commands through RS-232C perhaps has to be done a number of times, and it is expected that the system does not execute until it has received all commands rightly. In order to achieve the aim, the following command can be used.

TASK [NUMBER] XXX ;
or TASK [#] XXX ;

TASKEND；

⋮ general command

or TASKEND YYY；

At first, TASK [#] XXX stands for the beginning of a mission and gives number XXX. It will not do parsing until TASKEND. If there is any error, the execution will not be done. If it is TASKEND XXX in the end, XXX stands for the CHECKSUM value of the middle commands. The system will check the value for the commands. If there is something wrong, the execution will not be done either. CHECKSUM is a 16-bit value produced by plus of every byte of the data in the middle except those of TASK [#] XXX, TASKEND YYY. An example is given below.

/* example 19 */
task 1；
load timing 101；
load pattern 101；
enable；
taskend；
When the system is in Report On, it will return the following message：
OK；
reporttsk 1；
received 3 commands；
executed 3 commands；
reportend xxx；
The example of Parsing Error is as follows:
/* example 20 */
task 2；
load pattern101；（there is no space before 101）
enable；
taskend；
Return as follows：
ng；
reporttsk 2general command
Syntax error：load pattern101；
received 2 commands；
executed 0 commands；
reportend xxx；
The example of Execution Error is as follows：

```
/* example 21 */
task 3；
load pattern 199；
enable；
Return as follows：
ng；
reporttsk 3；
empty error：load pattern 199；
received 2 commands；
executed 2 commands；
reportend   xxx；
```

For all kinds of Parsing Errors and Execution Errors please refer to 5.3.5.

5.3.4 Upload Commands

The command is Report Timing [XXX] [YYY] ; . The system is asked to upload the data of Timing XXX ~ YYY to the computer. If there is no YYY, only Timing XXX will be uploaded. If there are no XXX and YYY, Timing parameters in the buffer will be uploaded. The form of return is as follows:

```
OK；
REPORTBGN；
DEFINE TIMING XXX
    ⋮

DEFEND   ;
    ⋮

DEFINE TIMING YYY  ；
    ⋮

DEFEND；
REPORTEND XXXX；
```

XXXX in REPORTEND XXXX ; stands for the CHECKSUM value of returned data. The CHECKSUM is a 16-bit value produced by plus of every byte of data (adding from OK ; till the space before CHECKSUM XXX).

The contents in the middle are as same as those in the example of the commands for setting of Timing parameters on 5.3.2. In reading the data of Buffer Timing, there are no Define

Timing XXX and Defend in the returned message. As for others, they are the same. Thus, the system can directly transmit the middle part between REPORTBGN and REPORTEND to another system for the same setting by copying.

Other commands with the same meaning are as follows:

```
REPORT PATTERN [XXX] [YYY]；
REPORT PROGRAM [XXX] [YYY]；
REPORT DRAW [XX] [YY]；
REPORT ICON DOT XX [YY]；
```

Dot can be changed into Circle, Line, X-Hatch, Rectangle, Marker, Character, String, Colorbar, Grayscale.

```
REPORT [USER] CHARACTER XXX [YYY]；
REPORT [USER] STRING XX [YY]；
REPORT USER X PEN YYY [ZZZ]；
REPORT ANALOG - COLOR PEN XXX [YYY]；
REPORT ANALOG - MONO PEN XXX [YYY]；
REPORT GRAY PEN XXX [YYY]；
```

The last three sets are the three Color Pen Forms built in the REPORT system (see Appendix D).

5.3.5 Error Messages of Parser and Execution

There are two kinds of errors. One is the parser error, and another is the execution error. They are listed separately below:

```
/* a. parsing error */
syntax error          /* input sequence syntax error */
boundary error    /* input parameter boundary error */
definition error    /* define icon command */
missing definition error /* define icon command */
window definition error /* define window command */
parameter buffer overflow
/* parameters too many，maximum 16 parameters in a command line */
name buffer overflow /* above structure name size */
task error                  /* task command in task block */
task buffer overflow
/* commands in task too large，maximum 65536
 bytes in task buffer */
/* b. execution error */
```

empty error /* structure empty */
icon empty error /* read / load pattern */
checksum error /* structure checksum error */
icon checksum error /* read / load pattern */
write error /* write EEPROM or Memory card error */
write protect error /* memory card write protect */
relation error /* timing relation error */
simulation error /* timing simulation error */
timing transfer error /* timing < - > pixel transfer error */
string buffer overflow /* too many code in user string */
memory card not exist error /* read / load pattern */
no action /* R，G，B，Reverse LED */

If there is an error, there will be a colon (:) at the end of the returned data, and followed by its command for check. For example:

LOAD TIMING 101；
LOAD PATTERN 105；
Returned data can be：
ng；EMPTY ERROR： LOAD TIMING 101；
ng；EMPTY ERROR：LOAD PATTERN 105；

5.3.6 Abbreviations of Commands

The following commands listed on the left of the slash (/) can be expressed in any of the abbreviations on the right too.

BACKGROUND / BACK
BLUE / B
CHARACTER / CHAR
CIRCLE / CIRCL/ CIRC / CIR
COLORBAR / COLORBA / COLORB
CORNERS / CORNER
CLEAR / CLR
DEFINE / DEF
DIAMETER / DIAM
DIRECTION / DIR
EDGES / EDGE
ERROR / ERR
FOREGROUND / FORE
GRAYSCALE / GRAY
GREEN / G
INTENSIFY / INTEN
INTERLACE / INTERL
INTERVAL / INTERV
KEYBOARD/ KB
LINE / LIN
MARKER / MARK

MIDDLES / MIDDLE
NUMBER / NUM / #
PATTERN / PATT / PATN / PAT / PTN
PROGRAM / PROG / PRG / PGM
RECTANGLE / RECT
RED / R
RESOLUTION / RESO / RES
REVERSE / REV
SECOND / SEC
SEQUENCE / SEQ
SPACING / SPACE
STORE / STOR / STO
STRING / STR
TIMING / TIM / TMG
VERSION / VER
VERTICAL / VERT

APPENDIX A TIMING 1-100

TIMING NO.	# 001	# 002	# 003	# 004	# 005
NAME	MDA/HGC	INCOLOR	CGA	EGA	PGA
PIXEL RATE	16.257 MHz	19.000 MHz	14.364 MHz	16.257 MHz	24.872 mHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	TTL-MONO+I	TTL-RGBrgb	TTL-RGBI	TTL-RGBrgb	ANALOG-COLOR
SYNC ON G?	-	-	-	-	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	-	-	-	-	700 mV
WHITE LEVEL	-	-	-	-	700 mV
BLACK LEVEL	-	-	-	-	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	882 =54.254 uS	882 =46.421 uS	912 =63.492 uS	744 =45.765 uS	816 =32.808 uS
H DISPLAY	720 =44.289 uS	720 =37.895 uS	640 =44.556 uS	640 =39.368 uS	640 =25.732 uS
H B-PORCH	9 =0.554 uS	9 =0.474 uS	112 =7.797 uS	16 =0.984 uS	72 =2.895 uS
HS WIDTH	135 =8.304 uS	135 =7.105 uS	64 =4.456 uS	88 =5.413 uS	96 =3.860 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	145.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	370 =20.074 mS	370 =17.176 mS	262 =16.635 mS	366 =16.750 mS	508 =16.667 mS
V DISPLAY	350 =18.989 mS	350 =16.247 mS	200 =12.698 mS	350 =16.018 mS	400 =13.123 mS
V B-PORCH	4 =0.217 mS	4 =0.186 mS	34 =2.159 mS	0 =0.000 mS	69 =2.264 mS
VS WIDTH	16 =0.868 mS	16 =0.743 mS	3 =0.190 mS	13 =0.595 mS	2 =0.066 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	100.000 mm	3.000 mm	3.000 mm	3.000 mm	3.000 mm
HS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
VS OUTPUT	ON(-)	ON(-)	ON(+)	ON(-)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(-)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=18.432 KHz	=21.542K Hz	=15.750 KHz	=21.851 KHz	=30.480 KHz
FV.	=49.816 Hz	=58.222 Hz	=60.115 Hz	=59.702 Hz	=60.000 Hz

TIMING NO.	# 006	# 007	# 008	# 009	# 010
NAME	VGA640X350-5	VGA640X350-6	VGA640X350-7	VGA640X400-5	VGA640X400-6
PIXEL RATE	25.175 MHz	25.175 MHz	25.175 MHz	25.175 MHz	25.175 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	800 =31.778 uS	800 =31.778 uS	800 =31.778 uS	800 =31.778 uS	800 =31.778 uS
H DISPLAY	640 =25.422 uS	640 =25.422 uS	640 =25.422 uS	640 =25.422 uS	640 =25.422 uS
H B-PORCH	48 =1.907 uS	48 =1.907 uS	48 =1.907 uS	48 =1.907 uS	48 =1.907 uS
HS WIDTH	96 =3.813 uS	96 =3.813 uS	96 =3.813 uS	96 =3.813 uS	96 =3.813 uS
H BORDER	8 =0.318 uS	8 =0.318 uS	8 =0.318 uS	8 =0.318 uS	8 =0.318 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	629 =19.988 mS	525 =16.683 mS	449 =14.268 mS	629 =19.988 mS	525 =16.683 mS
V DISPLAY	350 =11.122 mS	350 =11.122 mS	350 =11.122 mS	400 =12.711 mS	400 =12.711 mS
V B-PORCH	150 =4.767 mS	98 =3.114 mS	60 =1.907 mS	125 =3.972 mS	73 =2.320 mS
VS WIDTH	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS
V BORDER	6 =0.191 mS	6 =0.191 mS	6 =0.191 mS	7 =0.222 mS	7 =0.222 mS
V SIZE	3.000 mm	3.000 mm	3.000 mm	3.000 mm	3.000 mm
HS OUTPUT	ON(+)	ON(+)	ON(+)	ON(-)	ON(-)
VS OUTPUT	ON(-)	ON(-)	ON(-)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=31.469 KHz	=31.469 KHz	=31.469 KHz	=31.469 KHz	=31.469 KHz
FV.	=50.030 Hz	=59.941 Hz	=70.087 Hz	=50.030 Hz	=59.941 Hz

APPENDIX A TIMING 1-100

TIMING NO.	# 011	# 012	# 013	# 014	# 015
NAME	VGA640X400-7	VGA640X480-5	VGA640X480-6	VGA720X350-5	VGA720X350-6
PIXEL RATE	25.175 MHz	25.175 MHz	25.175 MHz	28.322 MHz	28.322 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	800 =31.778 uS	800 =31.778 uS	800 =31.778 uS	900 =31.777 uS	900 =31.777 uS
H DISPLAY	640 =25.422 uS	640 =25.422 uS	640 =25.422 uS	720 =25.422 uS	720 =25.422 uS
H B-PORCH	48 =1.907 uS	48 =1.907 uS	48 =1.907 uS	54 =1.907 uS	54 =1.907 uS
HS WIDTH	96 =3.813 uS	96 =3.813 uS	96 =3.813 uS	108 =3.813 uS	108 =3.813 uS
H BORDER	8 =0.318 uS	8 =0.318 uS	8 =0.318 uS	9 =0.318 uS	9 =0.318 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	449 =14.268 mS	629 =19.988 mS	525 =16.683 mS	629 =19.988 mS	525 =16.683 mS
V DISPLAY	400 =12.711 mS	480 =15.253 mS	480 =15.253 mS	350 =11.122 mS	350 =11.122 mS
V B-PORCH	35 =1.112 mS	85 =2.701 mS	33 =1.049 mS	150 =4.767 mS	98 =3.114 mS
VS WIDTH	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS
V BORDER	7 =0.222 mS	8 =0.254 mS	8 =0.254 mS	6 =0.191 mS	6 =0.191 mS
V SIZE	3.000 mm	3.000 mm	3.000 mm	3.000 mm	3.000 mm
HS OUTPUT	ON(-)	ON(-)	ON(-)	ON(+)	ON(+)
VS OUTPUT	ON(+)	ON(-)	ON(-)	ON(-)	ON(-)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=31.469 KHz	=31.469 KHz	=31.469 KHz	=31.469 KHz	=31.469 KHz
FV.	=70.087 Hz	=50.030 Hz	=59.941 Hz	=50.030 Hz	=59.941 Hz

TIMING NO.	# 016	# 017	# 018	# 019	# 020
NAME	VGA720X350-7	VGA720X400-5	VGA720X400-6	VGA720X400-7	VGA-8514A
PIXEL RATE	28.322 MHz	28.322 MHz	28.322 MHz	28.322 MHz	44.900 MHz
INTERLACE?	NO	NO	NO	NO	YES
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	900 =31.777 uS	900 =31.777 uS	900 =31.777 uS	900 =31.777 uS	1264 =28.151 uS
H DISPLAY	720 =25.422 uS	720 =25.422 uS	720 =25.422 uS	720 =25.422 uS	1024 =22.806 uS
H B-PORCH	54 =1.907 uS	54 =1.907 uS	54 =1.907 uS	54 =1.907 uS	56 =1.247 uS
HS WIDTH	108 =3.813 uS	108 =3.813 uS	108 =3.813 uS	108 =3.813 uS	176 =3.920 uS
H BORDER	9 =0.318 uS	9 =0.318 uS	9 =0.318 uS	9 =0.318 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	449 =14.268 mS	629 =19.988 mS	525 =16.683 mS	449 =14.268 mS	408+0.5 =11.500 mS
V DISPLAY	350 =11.122 mS	400 =12.711 mS	400 =12.711 mS	400 =12.711 mS	384 =10.810 mS
V B-PORCH	60 =1.907 mS	125 =3.972 mS	73 =2.320 mS	35 =1.112 mS	20 =0.563 mS
VS WIDTH	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS	2 =0.064 mS	4 =0.113 mS
V BORDER	6 =0.191 mS	7 =0.222 mS	7 =0.222 mS	7 =0.222 mS	0 =0.000 mS
V SIZE	3.000 mm	3.000 mm	3.000 mm	3.000 mm	3.000 mm
HS OUTPUT	ON(+)	ON(-)	ON(-)	ON(-)	ON(+)
VS OUTPUT	ON(-)	ON(+)	ON(+)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=31.469 KHz	=31.469 KHz	=31.469 KHz	=31.469 KHz	=35.522 KHz
FV.	=70.087 Hz	=50.030 Hz	=59.941 Hz	=70.087 Hz	=86.958 Hz

TIMING NO.	# 021	# 022	# 023	# 024	# 025
NAME					
PIXEL RATE					
INTERLACE?					
VIDEO					
SYNC ON G?					
SYNC LEVEL					
VIDEO LEVEL					
WHITE LEVEL					
BLACK LEVEL					
16 BIT DATA					
H TOTAL					
H DISPLAY					
H B-PORCH					
HS WIDTH					
H BORDER					
H SIZE					
V TOTAL					
V DISPLAY					
V B-PORCH					
VS WIDTH					
V BORDER					
V SIZE					
HS OUTPUT					
VS OUTPUT					
XS OUTPUT					
XS SELECT					
Fh.					
FV.					

TIMING NO.	# 026	# 027	# 028	# 029	# 030
NAME	COMPAQ1024				
PIXEL RATE	71.644 MHz				
INTERLACE?	NO				
VIDEO	ANALOG-COLOR				
SYNC ON G?	NO				
SYNC LEVEL	-				
VIDEO LEVEL	700 mV				
WHITE LEVEL	700 mV				
BLACK LEVEL	0 IRE				
16 BIT DATA	0000				
H TOTAL	1328 =18.531 uS				
H DISPLAY	1024 =14.289 uS				
H B-PORCH	112 =1.563 uS				
HS WIDTH	176 =2.456 uS				
H BORDER	0 =0.000 uS				
H SIZE	4.000 mm				
V TOTAL	816 =15.121 mS				
V DISPLAY	768 =14.232 mS				
V B-PORCH	36 =0.667 mS				
VS WIDTH	4 =0.074 mS				
V BORDER	0 =0.000 mS				
V SIZE	3.000 mm				
HS OUTPUT	ON(+)				
VS OUTPUT	ON(+)				
XS OUTPUT	ON(+)				
XS SELECT	SERR				
Fh.	=53.964 KHz				
FV.	=66.132 Hz				

APPENDIX A TIMING 1-100

TIMING NO.	# 031	# 032	# 033	# 034	# 035
NAME	VESA640X350	VESA640X400	VESA640X480	VESA720X400	VESA800-5
PIXEL RATE	31.500 MHz	31.500 MHz	31.500 MHz	36.000 MHz	36.000 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	832 =26.413 uS	832 =26.413 uS	832 =26.413 uS	954 =26.500 uS	1024 =28.444 uS
H DISPLAY	640 =20.317 uS	640 =20.317 uS	640 =20.317 uS	720 =20.000 uS	800 =22.222 uS
H B-PORCH	128 =4.063 uS	128 =4.063 uS	128 =4.063 uS	162 =4.500 uS	128 =3.556 uS
HS WIDTH	40 =1.270 uS	40 =1.270 uS	40 =1.270 uS	45 =1.250 uS	72 =2.000 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	450 =11.886 mS	450 =11.886 mS	520 =13.734 mS	449 =11.898 mS	625 =17.778 mS
V DISPLAY	350 =9.244 mS	400 =10.565 mS	480 =12.678 mS	400 =10.600 mS	600 =17.067 mS
V B-PORCH	62 =1.638 mS	38 =1.004 mS	28 =0.740 mS	37 =0.981 mS	22 =0.626 mS
VS WIDTH	3 =0.079 mS	3 =0.079 mS	3 =0.079 mS	3 =0.080 mS	2 =0.057 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mm	3.000 mS	3.000 mS	3.000 mS	3.000 mS
HS OUTPUT	ON(+)	ON(-)	ON(-)	ON(-)	ON(+)
VS OUTPUT	ON(-)	ON(+)	ON(-)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=37.861KHz	=37.861KHz	=37.861 KHz	=37.736 KHz	=35.156 KHz
FV.	=84.136 Hz	=84.136 Hz	=72.810 Hz	=84.045 Hz	=56.250 Hz

TIMING NO.	# 036	# 037	# 038	# 039	# 040
NAME	VESA800-6	VESA800-7	VESA1024-6	VESA1024-7	1024X768-43
PIXEL RATE	40.000 MHz	50.000 MHz	65.000 MHz	75.000 MHz	44.900 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	1056 =26.400 uS	1040 =20.800 uS	1344 =20.677 uS	1328 =17.707 uS	1264 =28.151 uS
H DISPLAY	800 =20.000 uS	800 =16.000 uS	1024 =15.754 uS	1024 =13.653 uS	1024 =22.806 uS
H B-PORCH	88 =2.200 uS	64 =1.280 uS	160 =2.462 uS	144 =1.920 uS	56 =1.247 uS
HS WIDTH	128 =3.200 uS	120 =2.400 uS	136 =2.092 uS	136 =1.813 uS	176 =3.920 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	628 =16.579 mS	666 =13.853 mS	806 =16.666 mS	806 =14.272 mS	817 =23.000 mS
V DISPLAY	600 =15.840 mS	600 =12.480 mS	768 =15.880 mS	768 =13.599 mS	768 =21.620 mS
V B-PORCH	23 =0.607 mS	23 =0.478 mS	29 =0.600 mS	29 =0.513 mS	20 =0.563 mS
VS WIDTH	4 =0.106 mS	6 =0.125 mS	6 =0.124 mS	6 =0.106 mS	4 =0.113 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mS	3.000 mS	3.000 mS	3.000 mS	3.000 mS
HS OUTPUT	ON(+)	ON(+)	ON(-)	ON(-)	ON(+)
VS OUTPUT	ON(+)	ON(+)	ON(-)	ON(-)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=37.879 KHz	=48.077 KHz	=48.363 KHz	=56.476 KHz	=35.522 KHz
FV.	=60.317 Hz	=72.188 Hz	=60.004 Hz	=70.069 Hz	=43.479 Hz

APPENDIX A TIMING 1-100

TIMING NO.	# 041	# 042	# 043	# 044	# 045
NAME	1024X768-75	1024X768-85	1152X864-75	1280X960-60	1280X960-85
PIXEL RATE	78.750 MHZ	94.500 MHz	108.000 MHz	108.000 MHz	148.500 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mv	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mv	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	1312 =16.660 uS	1376 =14.561 uS	1600 =14.815 uS	1800 =16.667 uS	1728 =11.636 uS
H DISPLAY	1024 =13.003 uS	1024 =10.836 uS	1152 =10.667 uS	1280 =11.852 uS	1280 =8.620 uS
H B-PORCH	176 =2.235 uS	208 =2.201 uS	256 =2.370 uS	312 =2.889 uS	224 =1.508 uS
HS WIDTH	96 =1.219 uS	96 =1.016 uS	128 =1.185 uS	112 =1.037 uS	160 =1.077 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	800 =13.328 mS	808 =11.765 mS	900 =13.333 mS	1000 =16.667 mS	1011 =11.764 mS
V DISPLAY	768 =12.795 mS	768 =11.183 mS	864 =12.800 mS	960 =16.000 mS	960 =11.171 mS
V B-PORCH	28 =0.466 mS	36 =0.524 mS	32 =0.474 mS	36 =0.600 mS	47 =0.547 mS
VS WIDTH	3 =0.050 mS	3 =0.044 mS	3 =0.044 mS	3 =0.050 mS	3 =0.035 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mS	3.000 mS	3.000 mS	3.000 mS	3.000 mS
HS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
VS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=60.023 KHz	=68.677 KHz	=67.500 KHz	=60.000 KHz	=85.938 KHz
FV.	=75.029 Hz	=84.996 Hz	=75.000 Hz	=60.000 Hz	=85.003 Hz

TIMING NO.	# 046	# 047	# 048	# 049	# 050
NAME	SUN-66 HZ	SUN-76 HZ	SUN-84 HZ		
PIXEL RATE	92.940 MHz	105.56 MHz	92.940 MHz		
INTERLACE?	NO	NO	NO		
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR		
SYNC ON G?	NO	NO	NO		
SYNC LEVEL	-	-	-		
VIDEO LEVEL	714 mV	700 mV	700 mV		
WHITE LEVEL	714 mV	700 mV	700 mV		
BLACK LEVEL	7.5 IRE	0 IRE	0 IRE		
16 BIT DATA	0000	0000	0000		
H TOTAL	1504 =16.182 uS	1472 =13.945 uS	1312 =14.117 uS		
H DISPLAY	1152 =12.395 uS	1152 =10.913 uS	1024 =11.018 uS		
H B-PORCH	195 =2.098 uS	208 =1.970 uS	168 =1.808 uS		
HS WIDTH	128 =1.377 uS	96 =0.909 uS	96 =1.033 uS		
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS		
H SIZE	295.000 mm	295.000 mm	295.000 mm		
V TOTAL	937 =15.163 mS	943 =13.150 mS	843 =11.900 mS		
V DISPLAY	900 =14.564 mS	900 =12.550 mS	800 =11.293 mS		
V B-PORCH	31 =0.502 mS	33 =0.460 mS	33 =0.466 mS		
VS WIDTH	4 =0.065 mS	8 =0.112 mS	8 =0.113 mS		
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS		
V SIZE	230.000 mm	230.000 mm	230.000 mm		
HS OUTPUT	OFF-LOW	OFF-LOW	OFF-LOW		
VS OUTPUT	OFF-LOW	OFF-LOW	OFF-LOW		
XS OUTPUT	ON(-)	ON(-)	ON(-)		
XS SELECT	SERR	SERR	SERR		
Fh.	=61.795 KHz	=71.713 KHz	=70.838 KHz		
FV.	=65.950 Hz	=76.048 Hz	=84.031 Hz		

APPENDIX A TIMING 1-100

TIMING NO.	# 051	# 052	# 053	# 054	# 055
NAME	MAC-II				
PIXEL RATE	30.240 MHz				
INTERLACE?	NO				
VIDEO	ANALOG-COLOR				
SYNC ON G?	NO				
SYNC LEVEL	-				
VIDEO LEVEL	700 mV				
WHITE LEVEL	700 mV				
BLACK LEVEL	0 IRE				
16 BIT DATA	0000				
H TOTAL	864 =28.571 uS				
H DISPLAY	640 =21.164 uS				
H B-PORCH	96 =3.175 uS				
HS WIDTH	64 =2.116 uS				
H BORDER	0 =0.000 uS				
H SIZE	4.000 mm				
V TOTAL	525 =15.000 mS				
V DISPLAY	480 =13.714 mS				
V B-PORCH	39 =1.114 mS				
VS WIDTH	3 =0.086 mS				
V BORDER	0 =0.000 mS				
V SIZE	3.000 mm				
HS OUTPUT	ON(+)				
VS OUTPUT	ON(-)				
XS OUTPUT	ON(-)				
XS SELECT	SERR				
Fh.	=35.000 KHz				
FV.	=66.667 Hz				

TIMING NO.	# 056	# 057	# 058	# 059	# 060
NAME	NEC 1280-60	NEC 1280-70	NEC 1280-74	SONY 1280-74	HITA 1280-72
PIXEL RATE	107.012 MHz	127.000 MHz	135.000 MHz	135.000 MHz	135.000 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	YES	YES	YES	YES	YES
SYNC LEVEL	300 mV	300 mV	300 mV	286 mV	300 mV
VIDEO LEVEL	700 mV	700 mV	700 mV	714 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	714 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	1664 =15.550 uS	1696 =13.354 uS	1712 =12.681 uS	1712 =12.681 uS	1728 =12.800 uS
H DISPLAY	1280 =11.961 uS	1280 =10.079 uS	1280 =9.481 uS	1280 =9.481 uS	1280 =9.481 uS
H B-PORCH	240 =2.243 uS	224 =1.764 uS	256 =1.896 uS	256 =1.896 uS	192 =1.422 uS
HS WIDTH	104 =0.972 uS	160 =1.260 uS	144 =1.067 uS	144 =1.067 uS	192 =1.422 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	343.000 mm	340.000 mm
V TOTAL	1065 =16.560 mS	1072 =14.316 mS	1064 =13.493 mS	1064 =13.493 mS	1085 =13.888 mS
V DISPLAY	1024 =15.923 mS	1024 =13.675 mS	1024 =12.986 mS	1024 =12.986 mS	1024 =13.107 mS
V B-PORCH	32 =0.498 mS	42 =0.561 mS	37 =0.469 mS	34 =0.431 mS	55 =0.704 mS
VS WIDTH	3 =0.047 mS	4 =0.053 mS	3 =0.038 mS	3 =0.038 mS	3 =0.038 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mm	3.000 mm	3.000 mm	274.000 mm	270.000 mm
HS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
VS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=64.310 KHz	=74.882 KHz	=78.855 KHz	=78.855 KHz	=78.125 KHz
FV.	=60.385 Hz	=69.853 Hz	=74.112 Hz	=74.112 Hz	=72.005 Hz

APPENDIX A TIMING 1-100

TIMING NO.	# 061	# 062	# 063	# 064	# 065
NAME	HITA 1280-60	ADI 1280-60		1664X1200-60	
PIXEL RATE	100.000 MHz	110.160 MHz		160.000MHz	
INTERLACE?	NO	NO		NO	
VIDEO	ANALOG-COLOR	ANALOG-COLOR		ANALOG-COLOR	
SYNC ON G?	NO	NO		NO	
SYNC LEVEL	-	-		-	
VIDEO LEVEL	700 mV	700 mV		700 mV	
WHITE LEVEL	700 mV	700 mV		700 mV	
BLACK LEVEL	0 IRE	0 IRE		0 IRE	
16 BIT DATA	0000	0000		0000	
H TOTAL	1648 =16.480 uS	1728 =15.686 uS		2144 =13.400 uS	
H DISPLAY	1280 =12.800 uS	1280 =11.619 uS		1664 =10.400 uS	
H B-PORCH	232 =2.320 uS	220 =1.997 uS		128 =0.800 uS	
HS WIDTH	112 =1.120 uS	164 =1.489 uS		352 =2.200 uS	
H BORDER	0 =0.000 uS	0 =0.000 uS		0 =0.000 uS	
H SIZE	4.000 mm	343.000 mm		4.000 mm	
V TOTAL	1064 =17.535 mS	1067 =16.737 mS		1245 =16.683 mS	
V DISPLAY	1024 =16.876 mS	1024 =16.063 mS		1200 =16.080 mS	
V B-PORCH	34 =0.560 mS	37 =0.580 mS		28 =0.375 mS	
VS WIDTH	3 =0.049 mS	3 =0.047 mS		16 =0.214 mS	
V BORDER	0 =0.000 mS	0 =0.000 mS		0 =0.000 mS	
V SIZE	3.000 mm	274.000 mm		3.000 mm	
HS OUTPUT	ON(+)	ON(-)		ON(+)	
VS OUTPUT	ON(+)	ON(-)		ON(+)	
XS OUTPUT	ON(+)	ON(-)		ON(+)	
XS SELECT	SERR	SERR		SERR	
Fh.	=60.680 KHz	=63.750 KHz		=74.627KHz	
FV.	=57.030 Hz	=59.747 Hz		=59.941 Hz	

TIMING NO.	# 066	# 067	# 068	# 069	# 070
NAME	OAK 800X600	OAK 1024X768			
PIXEL RATE	36.000 MHz	65.000 MHz			
INTERLACE?	NO	NO			
VIDEO	ANALOG-COLOR	ANALOG-COLOR			
SYNC ON G?	NO	NO			
SYNC LEVEL	-	-			
VIDEO LEVEL	700 mV	700 mV			
WHITE LEVEL	700 mV	700 mV			
BLACK LEVEL	0 IRE	0 IRE			
16 BIT DATA	0000	0000			
H TOTAL	1024 =28.444 uS	1352 =20.800 uS			
H DISPLAY	800 =22.222 uS	1024 =15.754 uS			
H B-PORCH	34 =0.944 uS	202 =3.108 uS			
HS WIDTH	184 =5.111 uS	96 =1.477 uS			
H BORDER	0 =0.000 uS	0 =0.000 uS			
H SIZE	4.000 mm	4.000 mm			
V TOTAL	626 =17.806 mS	804 =16.723 mS			
V DISPLAY	600 =17.067 mS	768 =15.974 mS			
V B-PORCH	23 =0.654 mS	29 =0.603 mS			
VS WIDTH	1 =0.028 mS	4 =0.083 mS			
V BORDER	0 =0.000 mS	0 =0.000 mS			
V SIZE	3.000 mm	3.000 mm			
HS OUTPUT	ON(+)	ON(-)			
VS OUTPUT	ON(+)	ON(-)			
XS OUTPUT	ON(+)	ON(+)			
XS SELECT	SERR	SERR			
Fh.	=35.156 KHz	=48.077 KHz			
FV.	=56.160 Hz	=59.797 Hz			

APPENDIX A TIMING 1-100

TIMING NO.	# 071	# 072	# 073	# 074	# 075
NAME	TSENG800X600	TSENG1024-60	640X350-85	640X400-85	720X400-85
PIXEL RATE	36.000 MHz	65.000 MHz	31.500 MHz	31.500 MHz	35.500 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	1016 =28.222 uS	1336 =20.554 uS	832 =26.413 uS	832 =26.413 uS	936 =26.366 uS
H DISPLAY	800 =22.222 uS	1024 =15.754 uS	640 =20.317 uS	640 =20.317 uS	720 =20.282 uS
H B-PORCH	40 =1.111 uS	62 =0.954 uS	96 =3.048 uS	96 =3.048 uS	108 =3.042 uS
HS WIDTH	144 =4.000 uS	136 =2.092 uS	64 =2.032 uS	64 =2.032 uS	72 =2.028 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	634 =17.893 mS	808 =16.607 mS	445 =11.754 mS	445 =11.754 mS	446 =11.759 mS
V DISPLAY	600 =16.933 mS	768 =15.785 mS	350 =9.244 mS	400 =10.565 mS	400 =10.546 mS
V B-PORCH	27 =0.762 mS	28 =0.576 mS	60 =1.585 mS	41 =1.083 mS	42 =1.107 mS
VS WIDTH	2 =0.056 mS	6 =0.123 mS	3 =0.079 mS	3 =0.079 mS	3 =0.079 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mm	3.000 mm	3.000 mS	3.000 mS	3.000 mS
HS OUTPUT	ON(+)	ON(-)	ON(+)	ON(-)	ON(-)
VS OUTPUT	ON(+)	ON(-)	ON(-)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=35.433 KHz	=48.653 KHz	=37.861 KHz	=37.861 KHz	=37.927 KHz
FV.	=55.888 Hz	=60.214 Hz	=85.081 Hz	=85.081 Hz	=85.038 Hz

TIMING NO.	# 076	# 077	# 078	# 079	# 080
NAME	640X480-72	640X480-75	640X480-85	800X600-75	800X600-85
PIXEL RATE	31.500 MHz	31.500 MHz	36.000 MHz	49.500 MHz	56.250 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	832 =26.413 uS	840 =26.667 uS	832 =23.111 uS	1056 =21.333 uS	1048 =18.631 uS
H DISPLAY	640 =20.317 uS	640 =20.317 uS	640 =17.778 uS	800 =16.162 uS	800 =14.222 uS
H B-PORCH	128 =4.063 uS	120 =3.810 uS	80 =2.222 uS	160 =3.232 uS	152 =2.702 uS
HS WIDTH	40 =1.270 uS	64 =2.032 uS	56 =1.556 uS	80 =1.616 uS	64 =1.138 uS
H BORDER	8 =0.254 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	520 =13.734 mS	500 =13.333 mS	509 =11.764 mS	625 =13.333 mS	631 =11.756 mS
V DISPLAY	480 =12.678 mS	480 =12.800 mS	480 =11.093 mS	600 =12.800 mS	600 =11.179 mS
V B-PORCH	28 =0.740 mS	16 =0.427 mS	25 =0.578 mS	21 =0.448 mS	27 =0.503 mS
VS WIDTH	3 =0.079 mS	3 =0.080 mS	3 =0.069 mS	3 =0.064 mS	3 =0.056 mS
V BORDER	8 =0.211 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mS	3.000 mS	3.000 mS	3.000 mS	3.000 mS
HS OUTPUT	ON(-)	ON(-)	ON(-)	ON(+)	ON(+)
VS OUTPUT	ON(-)	ON(-)	ON(-)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=37.861 KHz	=37.500 KHz	=43.269 KHz	=46.875 KHz	=53.674 KHz
FV.	=72.810 Hz	=75.000 Hz	=85.008 Hz	=75.000 Hz	=85.062 Hz

APPENDIX A TIMING 1-100

TIMING NO.	# 081	# 082	# 083	# 084	# 085
NAME	1280X1024-60	1280X1024-75	1280X1024-85	1600X1200-60	1600X1200-65
PIXEL RATE	108.000 MHz	135.000 MHz	157.500 MHz	162.000 MHz	175.500 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?	NO	NO	NO	NO	NO
SYNC LEVEL	-	-	-	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	1688 =15.630 uS	1688 =12.504 uS	1728 =10.971 uS	2160 =13.333 uS	2160 =12.308 uS
H DISPLAY	1280 =11.852 uS	1280 =9.481 uS	1280 =8.127 uS	1600 =9.877 uS	1600 =9.117 uS
H B-PORCH	248 =2.296 uS	248 =1.837 uS	224 =1.422 uS	304 =1.877 uS	304 =1.732 uS
HS WIDTH	112 =1.037 uS	144 =1.067 uS	160 =1.016 uS	192 =1.185 uS	192 =1.094 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	1066 =16.661 mS	1066 =13.329 mS	1072 =11.761 mS	1250 =16.667 mS	1250 =15.385 mS
V DISPLAY	1024 =16.005 mS	1024 =12.804 mS	1024 =11.235 mS	1200 =16.000 mS	1200 =14.769 mS
V B-PORCH	38 =0.594 mS	38 =0.475 mS	44 =0.483 mS	46 =0.613 mS	46 =0.566 mS
VS WIDTH	3 =0.047 mS	3 =0.038 mS	3 =0.033 mS	3 =0.040 mS	3 =0.037 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mS	3.000 mS	3.000 mS	3.000 mS	3.000 mS
HS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
VS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS OUTPUT	ON(+)	ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	SERR	SERR
Fh.	=63.981 KHz	=79.976 KHz	=91.146 KHz	=75.000 KHz	=81.250 KHz
FV.	=60.020 Hz	=75.024 Hz	=85.024 Hz	=60.000 Hz	=65.000 Hz

TIMING NO.	# 086	# 087	# 088	# 089	# 090
NAME	1600X1200-70	1600X1200-75	1600X1200-85		
PIXEL RATE	189.000 MHz	202.500 MHz	229.500 MHz		
INTERLACE?	NO	NO	NO		
VIDEO	ANALOG-COLOR	ANALOG-COLOR	ANALOG-COLOR		
SYNC ON G?	NO	NO	NO		
SYNC LEVEL	-	-	-		
VIDEO LEVEL	700 mV	700 mV	700 mV		
WHITE LEVEL	700 mV	700 mV	700 mV		
BLACK LEVEL	0 IRE	0 IRE	0 IRE		
16 BIT DATA	0000	0000	0000		
H TOTAL	2160 =11.429 uS	2160 =10.667 uS	2160 =9.412 uS		
H DISPLAY	1600 =8.466 uS	1600 =7.901 uS	1600 =6.972 uS		
H B-PORCH	304 =1.608 uS	304 =1.501 uS	304 =1.325 uS		
HS WIDTH	192 =1.016 uS	192 =0.948 uS	192 =0.837 uS		
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS		
H SIZE	4.000 mm	4.000 mm	4.000 mm		
V TOTAL	1250 =14.286 mS	1250 =13.333 mS	1250 =11.765 mS		
V DISPLAY	1200 =13.714 mS	1200 =12.800 mS	1200 =11.294 mS		
V B-PORCH	46 =1.526 mS	46 =0.491 mS	46 =0.433 mS		
VS WIDTH	3 =0.034 mS	3 =0.032 mS	3 =0.028 mS		
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS		
V SIZE	3.000 mS	3.000 mS	3.000 mS		
HS OUTPUT	ON(+)	ON(+)	ON(+)		
VS OUTPUT	ON(+)	ON(+)	ON(+)		
XS OUTPUT	ON(+)	ON(+)	ON(+)		
XS SELECT	SERR	SERR	SERR		
Fh.	=87.500 KHz	=93.750 KHz	=106.250 KHz		
FV.	=70.000 Hz	=75.000 Hz	=85.000 Hz		

APPENDIX A TIMING 1-100

TIMING NO.	# 091	# 092	# 093	# 094	# 095
NAME		TEST-TTL2	TEST-TTL1	TEST-WAVE2	TEST-WAVE1
PIXEL RATE		80.000 MHz	50.000 MHz	135.000 MHz	135.000 MHz
INTERLACE?		NO	NO	NO	NO
VIDEO		TTL-RGBrgb	TTL-RGBrgb	ANALOG-COLOR	ANALOG-COLOR
SYNC ON G?		-	-	NO	YES
SYNC LEVEL		-	-	-	300 mV
VIDEO LEVEL		-	-	700 mV	700 mV
WHITE LEVEL		-	-	700 mV	700 mV
BLACK LEVEL		-	-	0 IRE	7.5 IRE
16 BIT DATA		0000	0000	0000	0000
H TOTAL		1024 =12.800 uS	1000 =20.000 uS	1024 =7.585 uS	1024 =7.585 uS
H DISPLAY		32 =0.400 uS	250 =5.000 uS	512 =3.793 uS	32 =0.237 uS
H B-PORCH		0 =0.000 uS	50 =1.000 uS	64 =0.474 uS	16 =0.119 uS
HS WIDTH		32 =0.400 uS	50 =1.000 uS	32 =0.237 uS	16 =0.119 uS
H BORDER		0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE		4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL		10 =0.128 mS	10 =0.200 mS	10 =0.076 mS	10 =0.076 mS
V DISPLAY		4 =0.051 mS	4 =0.080 mS	4 =0.030 mS	4 =0.030 mS
V B-PORCH		0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
VS WIDTH		2 =0.026 mS	2 =0.040 mS	2 =0.015 mS	2 =0.015 mS
V BORDER		0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE		3.000 mm	3.000 mm	3.000 mm	3.000 mm
HS OUTPUT		ON(+)	ON(+)	ON(+)	ON(+)
VS OUTPUT		ON(+)	ON(+)	ON(+)	ON(+)
XS OUTPUT		ON(+)	ON(+)	ON(+)	ON(+)
XS SELECT		SERR	H+V	SERR	SERR
Fh.		=78.125 KHz	=50.000 KHz	=131.836KHz	=131.836KHz
FV.		=7812.50 Hz	=5000.00 Hz	=13183.6 Hz	=13183.6 Hz

TIMING NO.	# 096	# 097	# 098	# 099	# 100
NAME	TEST-SYND/W	TEST-HTOTAL	TEST-SYNC	TEST-NORM	TEST-CPU
PIXEL RATE	135.000MHz	135.000MHz	50.000 MHz	50.000 MHz	65.000 MHz
INTERLACE?	NO	NO	NO	NO	NO
VIDEO	ANALOG-COLOR	ANALOG- COLOR	ANALOG- COLOR	ANALOG- COLOR	ANALOG- COLOR
SYNC ON G?	NO	NO	YES	NO	NO
SYNC LEVEL	-	-	300 mV	-	-
VIDEO LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
WHITE LEVEL	700 mV	700 mV	700 mV	700 mV	700 mV
BLACK LEVEL	0 IRE	0 IRE	0 IRE	0 IRE	0 IRE
16 BIT DATA	0000	0000	0000	0000	0000
H TOTAL	1024 =7.585 uS	1024 =7.585 uS	1000 =20.000 uS	1000 =20.000 uS	1344 =20.677 uS
H DISPLAY	32 =0.237 uS	16 =0.119 uS	250 =5.000 uS	250 =5.000 uS	1028 =15.815 uS
H B-PORCH	0 =0.000 uS	32 =0.237 uS	50 =1.000 uS	50 =1.000 uS	144 =2.215 uS
HS WIDTH	32 =0.237 uS	16 =0.119 uS	50 =1.000 uS	50 =1.000 uS	128 =1.969 uS
H BORDER	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS	0 =0.000 uS
H SIZE	4.000 mm	4.000 mm	4.000 mm	4.000 mm	4.000 mm
V TOTAL	10 =0.076 mS	10 =0.076 mS	10 =0.200 mS	10 =0.200 mS	806 =16.666 mS
V DISPLAY	4 =0.030 mS	4 =0.030 mS	4 =0.080 mS	4 =0.080 mS	768 =15.880 mS
V B-PORCH	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	29 =0.600 mS
VS WIDTH	2 =0.015 mS	2 =0.015 mS	2 =0.040 mS	2 =0.040 mS	6 =0.124 mS
V BORDER	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS	0 =0.000 mS
V SIZE	3.000 mm	3.000 mm	3.000 mm	3.000 mm	3.000 mm
HS OUTPUT	NO(+)	NO(+)	ON(+)	ON(+)	ON(-)
VS OUTPUT	NO(+)	NO(+)	ON(+)	ON(+)	ON(-)
XS OUTPUT	NO(+)	NO(+)	OFF-LOW	ON(+)	ON(+)
XS SELECT	SERR	SERR	SERR	H+V	SERR
Fh.	=131.836KHz	=131.836KHz	=50.000 KHz	=50.000 KHz	=48.363 KHz
FV.	=13183.6 Hz	=13183.6 Hz	=5000.00 Hz	=5000.00 Hz	=60.004 Hz

APPENDIX A TIMING 1-100

TIMING NO.	#	#	#	#	#
NAME PIXEL RATE INTERLACE? VIDEO SYNC ON G? SYNC LEVEL VIDEO LEVEL WHITE LEVEL BLACK LEVEL 16 BIT DATA H TOTAL H DISPLAY H B-PORCH HS WIDTH H BORDER H SIZE V TOTAL V DISPLAY V B-PORCH VS WIDTH V BORDER V SIZE HS OUTPUT VS OUTPUT XS OUTPUT XS SELECT Fh. FV.					
TIMING NO.	**#**	**#**	**#**	**#**	**#**
NAME PIXEL RATE INTERLACE? VIDEO SYNC ON G? SYNC LEVEL VIDEO LEVEL WHITE LEVEL BLACK LEVEL 16 BIT DATA H TOTAL H DISPLAY H B-PORCH HS WIDTH H BORDER H SIZE V TOTAL V DISPLAY V B-PORCH VS WIDTH V BORDER V SIZE HS OUTPUT VS OUTPUT XS OUTPUT XS SELECT Fh. FV.					

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APPENDIX B PATTERN 1 - 100

The system has established 86 patterns in pattern format 1-90. There are some empty formats left for use in the future. Pattern 91-100 are for use in Diagnosis.

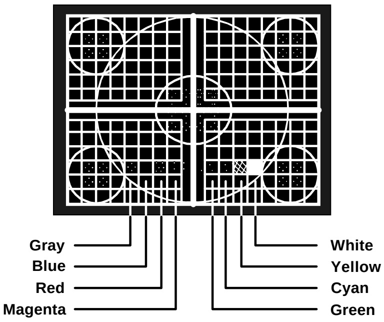
The major classification of patterns is given below :

PATTERN 1 - 10	: pictures for general test and dynamic pictures for DEMO.
11 - 17	: pictures for adjustment of position, size and central point.
21 - 29	: pictures for the test of R, G, B colors.
31 - 35	: pictures for the test of convergence.
41 - 49	: pictures for the test of luminance and gray.
51 - 60	: pictures of crosshatch for the test of linearity.
61 - 67	: pictures for the tests of high voltage stability, vertical and horizontal interference, interlace scanning and resolution.
71 - 86	: pictures of all kinds of characters and the text of 5×7/7×9.
91 - 100	: special pictures for diagnostic routine.

The arranged table is as follows. The patterns with further discription are provided below.

PATTERN NO.	NAME	Test Function	Discription	PATTERN NO.	NAME	Test Function	Discription
1	GENERAL-1	General	Color	51	X - HATCH - V8	Linear (square)	8 vertical grids
2	GENERAL-1R	General	Reverse Color	52	X - HATCH - V10	Linear (square)	10 vertical grids
3	GENERAL-2	General	Mone	53	X - HATCH - V12	Linear (square)	12 vertical grids
4	GENERAL-2R	General	Reverse Mono	54	X - HATCH - V9E	Linear (square)	9 vertical + sides
5	SMPTE RP-133	General	SMPTE type	55	X - HATCH - V12E	Linear (square)	12 vertical + sides
6	DEMO-1		Motion picture for display	56	LINEARITY / 8	Linear	8V by 10H
7	DEMO-2		Motion picture for display	57	LINEARITY / 9	Linear	9V by 12H
8	DEMO-3		Motion picture for display	58	LINEARITY / 10	Linear	10V by 13H
9	DEMO-4		Motion picture for display	59	LINEARITY / 12	Linear	12V by 16H
10	DEMO-5		Motion picture for display	60	X-HATCH / 1612	Linear (square)	12V by 16H
11	BLACK	Size/position	All black	61	H.V. - STATIC	High voltage	Static
12	RASTER	Size/position	RASTER	62	H.V. - BLINK	High voltage	Dynamic
13	BORDER	Size/position	BORDER	63	CROSSTALK	Interference	Video/deviation interference
14	CENTER-1	Size/position	4 sides & center lines	64	PAIRING	Ilnterlace	Interlaced scanning location
15	CENTER-2	Size/position	4 corners & center marks	65			
16	SIZE	Size/position	4 sides & diagonal lines	66	RESOLUTION - 1	Res./converge	Lines
17	PRE-TILT	Size/position	Pre-tilt adjustment	67	RESOLUTION - 2	Res./converge	Lines + density
18	USER-1			68	MOTION -1		Dynamic picture
19	USER-2		Windows picture	69	PICTURE-1		Natural picture
20				70			
21	R PURITY	Color	R purity	71	CHARAC / H-5	Res./converge	5*7 "H"
22	G PURITY	Color	G purity	72	CHARAC / H-5R	Res./converge	5*7 "H" (reverse)
23	B PURITY	Color	B purity	73	CHARAC / CX-5	Res./converge	5*7 "CX"
24	RGB DELAY	Color	RGB delay	74	CHARAC / CX-5R	Res./converge	5*7 "CX" (reverse)
25				75	CHARAC / ME	Res./converge	11*11 "ME"
26	RGB CHECK	Color	RGB connection/operation	76	CHARAC - ME-R	Res./converge	11*11 "ME" (reverse)
27	16 COLOR	Color	16 -color check	77	ROOTWEAVE	Res./converge	6*6 root
28	EGA 64 COLOR	Color	64-color check	78	CHARAC / 16*15	Res./converge	16*15 "惠", Hui
29	256 COLOR	Color	256-color check	79	CHARAC / 24*24	Res./converge	16*15 "鷹", Ying
30				80	CHARAC / @	Res./converge	5*7 "@"
31	R-B CONVERGE	Convergence	R,B Convergence	81	CHARAC / H-7	Res./converge	7*9 "H"
32	R-G CONVERGE	Convergence	R,G Convergence	82	CHARAC / H-7R	Res./converge	7*9 "H" (reverse)
33	B-G CONVERGE	Convergence	B,G Convergence	83	CHARAC / CX-7	Res./converge	7*9 "CX"
34	RGB X-HATCH	Convergence	R,G,B Convergence	84	CHARAC / CX-7R	Res./converge	7*9 "CX" (reverse)
35	CG1	Convergence	R,G,B Convergence	85	TEXT 5*7	Res./converge	5*7 text
36				86	TEXT 7*9	Res./converge	7*9 text
37				87			
38				88			
39				89			
40				90			
41	WHITE	Luminance/gray	Full brightness	91	DIAGNOSTIC	system self-diagnostics	
42	5-MOSAIC	Luminance/gray	5 bright squares	92	DIAGNOSTIC	system self-diagnostics	
43	5-DISC	Luminance/gray	5 bright circles	93	DIAGNOSTIC	system self-diagnostics	
44	CONTRAST	Luminance/gray	5% contrast	94	DIAGNOSTIC	system self-diagnostics	
45	4 GRAYS	Luminance/gray	TTL/ECL grayscale	95	DIAGNOSTIC	system self-diagnostics	
46	10 GRAYS	Luminance/gray	10 grayscale	96	DIAGNOSTIC	system self-diagnostics	
47	16 GRAYS	Luminance/gray	16 grayscale	97	DIAGNOSTIC	system self-diagnostics	
48	32 GRAYS	Luminance/gray	32 grayscale	98	DIAGNOSTIC	system self-diagnostics	
49	256 GRAYS	Luminance/gray	256 grayscale	99	DIAGNOSTIC	system self-diagnostics	
50	64 GRAYS RGBW	Luminance/gray	64 color scale	100	DIAGNOSTIC	system self-diagnostics	

PATTERN # 1 : GENERAL - 1

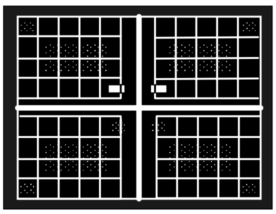


Explanation : The central big cross is used to adjust the position of central point. The crosshatch of 12 vertical squares is used to check linearity. Four corners and central six circles as well as four corners and central five blocks of density are used to test resolution. At the lower end there is an 8-color colorbar for checking the normality of R, G, B. At the upper end there are the words of Timing Name, Pattern Name and H. V. Freq. for reference. They can be used to judge if the H/V deviating connection of Yoke is upside down too. The outside frame can be used to measure size, and judge pincushion.

PATTERN # 2 : GENERAL - 1R

Explanation : It is the reverse pattern of Pattern # 1.

PATTERN # 3 : GENERAL - 2

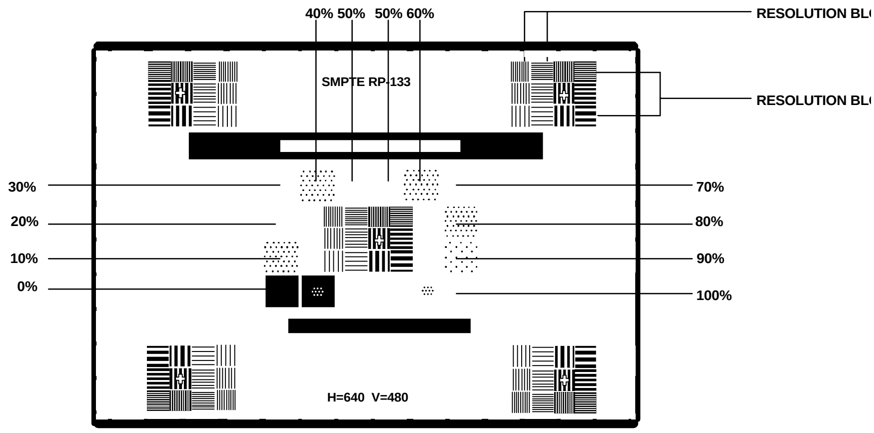


Explanation : It is similar to Pattern # 1, but has no circles and colorbar. Its crosshatch is 8 vertical grids. All figures are 50% luminance, but the density of two little pinches at the middle upper end is 100% luminance.

PATTERN # 4 : GENERAL - 2R

Explanation : It is the reverse picture of Pattern # 2.

PATTERN # 5 : SMPTE RP - 133 (a special picture)



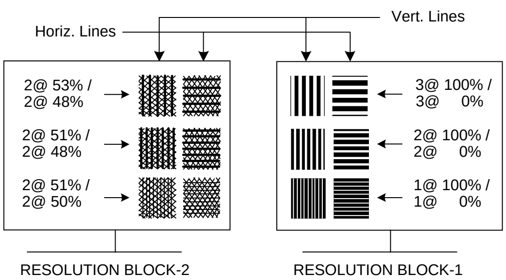
Explanation : The suggested picture of SMPTE (The Society of Motion Picture and Television Engineers) RP-133 is used as a standard pattern of general test.

① Background Color : Background color is the 50% bright grayscale (0% in TTL Mono, 33% in TTL RGBrgb).

② Text : The brightness of the text is determined by foreground color. Here is 100%. At the upper end of the picture there is a pattern name while at the lower end the number of H/V displayed pixels.

③ Lines : The white crosshatch line is 2-pixel thick. Its brightness is 75% (100% in TTL), and its grid the square of 10 vertical grids. There is a frame of 0.5% thickness about 1% distant from the border of the picture representing that the grid cannot be used to test linearity.

④ Resolution Block - 1 : There is a block at four corners and the center respectively.
Resolution Block - 2 : There is a block at four corners and the center respectively. Block-2 does not exist in TTL.

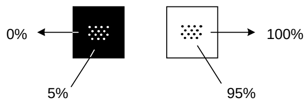


⑤ Colorbar : There is a colorbar at the upper and lower ends respectively. The order from left to right is B, R, B+R, G, G+B, G+R. The colorbar at the lower end is brighter than that at the upper end. This colorbar does not exist in O/P = TTL Mono + 1, and Mono.

⑥ The Contrast of Black & White : There is a small white horizontal bar of 95% in the center of black horizontal bar of 5% at the upper colorbar (100% and 0% in TTL output). There is a small black horizontal bar of 5% in the center of white horizontal bar of 95% (0% and 100% in TTL output) at the lower colorbar.

⑦ Grayscale : There are some blocks of different brightness surrounding the center. This part does not exist in TTL output.

⑧ Sensitivity of Grayscale : The two blocks at the middle lower end are shown below. They do not exist in TTL output.



PATTERN # 6 : DEMO-1 (a special picture)

Explanation : It is a dynamic picture for display.

PATTERN # 7 : DEMO-2 (a special picture)

Explanation : It is a dynamic picture for display.

PATTERN # 8 : DEMO-3 (a special picture)

Explanation : It is a dynamic picture for display.

PATTERN # 9 : DEMO-4 (a special picture)

Explanation : It is a dynamic picture for display.

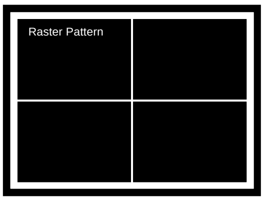
PATTERN # 10 : DEMO-5 (a special picture)

Explanation : It is a dynamic picture for display.

PATTERN # 11 : BLACK

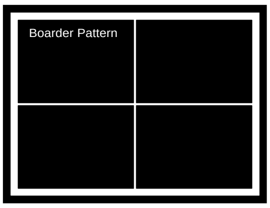
Explanation : The picture is all black. Pattern name is displayed at the left upper corner.

PATTERN # 12 : RASTER (a special picture)



Explanation : All the parts of raster outside the display area have become the brightest. The color of the central cross inside the display area, and the color of the frame is foreground color. It is used to observe the real position of raster. It is not necessary to adjust the button of luminance inside or outside the monitor. It can be also used to adjust raster, and the superimposing of the central point of the picture and that of CRT.

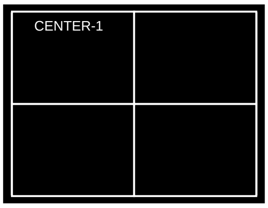
PATTERN # 13 : BORDER (a special picture)



Explanation : The display area means the frame and the central cross. On its outer rim there is an Hborder at the left and right sides respectively, and a Vborder at the upper and lower sides respectively. The color is the same as foreground color.

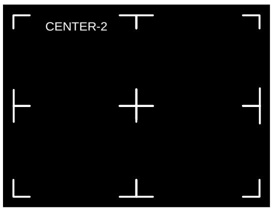
Note : Only in this pattern can two parameters, Hborder and Vborder be used. There is no effect of border in other patterns.

PATTERN # 14 : CENTER - 1



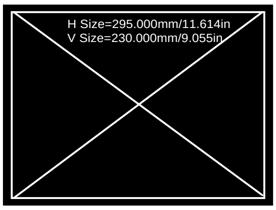
Explanation : The frame and the central cross are used to adjust the central point and pincushion.

PATTERN # 15 : CENTER - 2



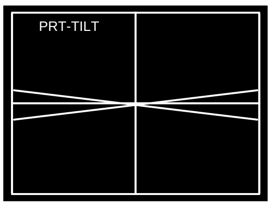
Explanation : Four corners, the central point of four sides and the central marker of the picture are used to adjust the central point.

PATTERN # 16 : SIZE



Explanation : The outer lines of four corners and the two diagonal lines are used to adjust the trapezoid distortion and display size. On the picture the values of Hsize and Vsize set in Timing Format are displayed for reference.

PATTERN # 17 : PRE - TILT



Explanation : The symbol “×” of the central point is used to adjust pre-tilt. If its extent does not meet the actual need, you can change the contents of window size in its icon (marker # 7).

PATTERN # 18 : USER-1

PATTERN # 19 : USER-2

Explanation : It is a picture of windows.

PATTERN # 21 : R PURITY

Explanation : The picture is all red (Red = Color Pen # 10) for the check of purity.

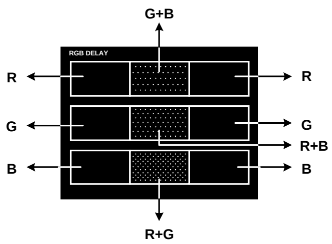
PATTERN # 22 : G PURITY

Explanation : The picture is all green (Green = Color Pen # 12) for the check of purity.

PATTERN # 23 : B PURITY

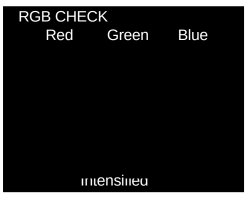
Explanation : The picture is all blue (Blue = Color Pen # 9) for the check of purity.

PATTERN # 24 : RGB DELAY



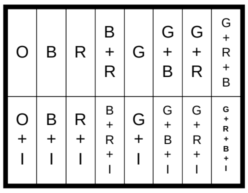
Explanation : On the picture there are complementary colors in the middle of R, G, B color bars. If there is delay in R, G, B, the bordering lines of some color bars will become white.

PATTERN # 26 : RGB CHECK



Explanation : There are three color bars of R, G, B from left to right at the upper side, and three brighter color bars of R, G, B from left to right at the lower side. The picture is used to check if the connection order of the input of R, G, B is normal, and if the circuit works well.

PATTERN # 27 : 16 COLORS



Explanation : The standard 16-color bar is used for the comparison and contrast of colors. I means to intensify; that is to say, to make a color brighter.

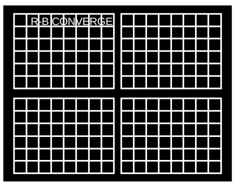
PATTERN # 28 : EGA 64 COLORS

Explanation : This picture of 64 colors is for EGA monitor. Only when output is TTL RGB rgb can this picture be meaningful. For the detailed positions of colors refer to the explanation of Type = 64 colors in Colorbar Icon.

PATTERN # 29 : 256 COLORS

Explanation : This picture of 256 colors is for Analog monitor. For the detailed positions of colors refer to the explanation of Type = 256 colors in Colorbar Icon.

PATTERN # 31 : R - B CONVERGE



Explanation : The crosshatch of magenta (R+B) is used to check the convergence of CRT upon R & B.

PATTERN # 32 : R - G CONVERGE

Explanation : It is the same as pattern # 31 except that the color is yellow (R+G).

PATTERN # 33 : B - G CONVERGE

Explanation : It is the same as pattern # 31 except that the color is cyan (G+B).

PATTERN # 34 : RGB X-HATCH (a special picture)

Explanation : It is the crosshatch pattern of some grid lines, but the colors of lines are R, G, B appearing by turns. The picture is also used to check the convergence of R, G, B.

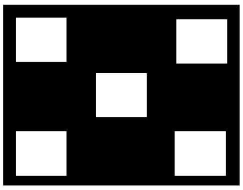
PATTERN # 35 : CG1 (a special picture)

Explanation : It is the same as pattern # 34.

PATTERN # 41 : WHITE

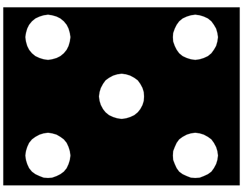
Explanation : The picture is all bright (a highlighted pattern name at the left upper corner). It is used to adjust luminance and white balance.

PATTERN # 42 : 5 - MOSAIC



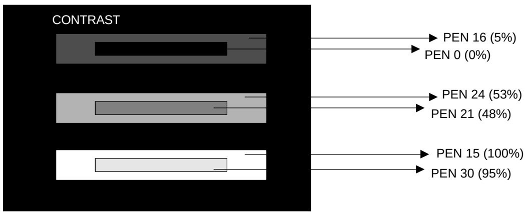
Explanation : The five independent, bright squares are used to adjust luminance.

PATTERN # 43 : 5 - DISC



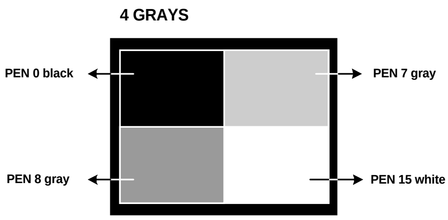
Explanation : The five independent, bright circles are used to adjust luminance.

PATTERN # 44 : CONTRAST



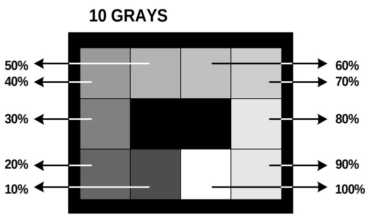
Explanation : These are three horizontal bars of different luminance. The central luminance is all reduced 5% in order to check if the contrast can be distinguished.

PATTERN # 45 : 4 GRAYS



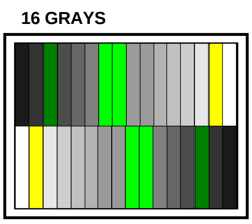
Explanation : The picture is for TTL output signal to check the contrast of black and white.

PATTERN # 46 : 10 GRAYS



Explanation : From 0% to 100%, the grayscale is raised one scale every 10% for the adjustment of contrast. The middle is black (0%).

PATTERN # 47 : 16 GRAYS



Explanation : At the upper side there are 16 grayscales from left to right. One is brighter than the other. At the lower side the arrangement is from right to left.
Note : The weakest luminance is 60/1023, and the strongest 1023/1023. The difference of every scale is 64/1023.

PATTERN # 48 : 32 GRAYS

Explanation : It is the same as pattern # 47, but 16 grayscales become 32 grayscales. The weakest luminance is 28/1023, and strongest 1023/1023. The difference of every scale is 32/1023.

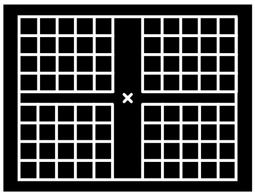
PATTERN # 49 : 256 GRAYS

Explanation : It is the same as pattern # 47, but the upper and lower rows become 255 grayscales. The weakest brightness is 0/1023, and strongest 1023/1023. The difference of every scale is 4/1023.

PATTERN # 50 : 64 GRAYS RGBW

Explanation : The color scales of R, G, B, W are arranged at the upper and lower rows. Each color has 64 scales, and the difference of every scale is 16/1023.

PATTERN # 51 : X - HATCH - V8



Explanation : It is a crosshatch pattern of 8 vertical grids. The remainders are placed in the center. The number of horizontal grids is automatically calculated by the system, and this makes all grids become squares except the remainders. Besides, there is a symbol of "×" in the central point too.

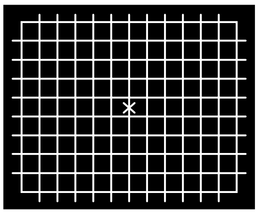
PATTERN # 52 : X - HATCH - V10

Explanation : It is the same as the above one except 10 vertical grids.

PATTERN # 53 : X - HATCH - V12

Explanation : It is the same as the above one except 12 vertical grids.

PATTERN # 54 : X - HATCH - V9E

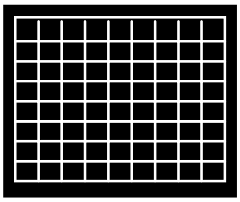


Explanation : It is the same as the above one except 9 vertical grids and remainders on two sides.

PATTERN # 55 : X - HATCH - V12E

Explanation : It is the same as the above one except 12 vertical grids and remainders on two sides.

PATTERN # 56 : LINEARITY / 8



Explanation : The picture seems like a crosshatch of 10 horizontal grids and 8 vertical grids. If there are remainders, the lighted part will be placed on the right and lower sides. If there are no remainders, the line of the frame is 1-pixel wide, and the line of internal grids is 2-pixel wide. The grids are drawn repeatedly by the use of rectangles, so they are suitable for the adjustment of ATE.

PATTERN # 57 : LINEARITY / 9

Explanation : It is the same as pattern # 56, but has 12 horizontal grids and 9 vertical grids.

PATTERN # 58 : LINEARITY / 10

Explanation : It is the same as pattern # 56, but has 13 horizontal grids and 10 vertical grids.

PATTERN # 59 : LINEARITY / 12

Explanation : It is the same as pattern # 56, but has 16 horizontal grids and 12 vertical grids.

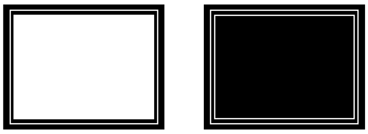
PATTERN # 60 : X - HATCH / 1612

Explanation : It is a crosshatch pattern of 16 horizontal grids and 12 vertical grids. The remainders are placed in the center. There is a symbol of "×" in the central point.

PATTERN # 61 : H.V. - STATIC

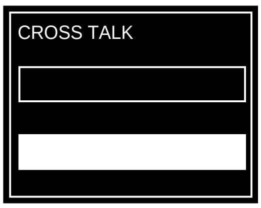
Explanation : The picture of three bright horizontal bars and three dark ones is used to check the stability of high voltage during the change of load. If the high voltage is not stable, the lower ends of the bright bars will protrude to either side. They will not draw back until they touch the dark bars.

PATTERN # 62 : H.V. - BLINK



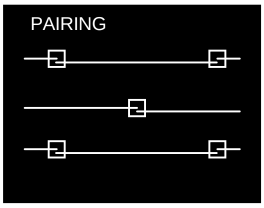
Explanation : The two pictures appear by turns. They are used to test the stability of high voltage under the different load. If the high voltage is not stable, the size of these two pictures will not be the same. The corresponding change of high voltage can be measured through the change of boundary lines.

PATTERN # 63 : CROSSTALK



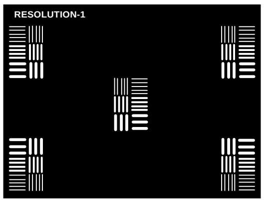
Explanation : The high and low frequency (the interlaced, dense lines of brightness and darkness at the upper side as well as the bright bar at the lower side) can be used to check if the horizontal deviating circuit of a monitor is affected by video. If it is affected, the frame at the either side of video in high (or low) frequency will be staggered with other parts of the frame, and the either side will be staggered toward the same direction.

PATTERN # 64 : PARING



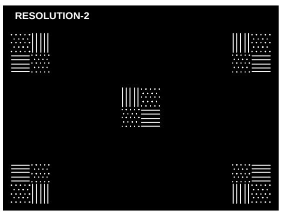
Explanation : There are four consecutive lines on vertical direction inside the square. In Interlace Mode, the four lines belong to two different fields, and should be divided from equal distance (can be seen with a magnifier).

PATTERN # 66 : RESOLUTION - 1



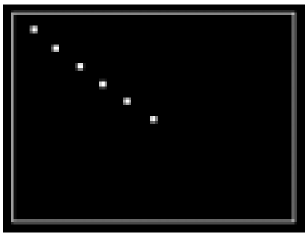
Explanation : There are six areas of horizontal and straight lines with different density in the four corners and the center of the picture respectively. They are 1-pixel ON / 1-pixel OFF, 2-pixel ON / 2-pixel OFF, 3-pixel ON / 3-pixel OFF separately, and used to check resolution.

PATTERN # 67 : RESOLUTION - 2



Explanation : There are all kinds of dense dots, horizontal and straight lines (all 1-pixel ON/ 1-pixel OFF) in the four corners and the center of the picture. They are used to check resolution.

PATTERN # 68 : MOTION-1 (a dynamic picture)



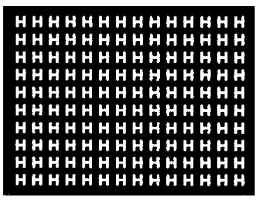
Explanation : This is applied to the inspection of phosphor persistence. The parameter, Speed On, can be used to choose the speed of movement. The larger the value is the faster the speed is. The parameter, Speed Off, can be used to determine the size of a small square. The larger the value is the smaller the size is. The first parameter of Blink Draw is used to determine the amount of small squares. Its value plus one is the amount of small squares. The second parameter of Blink Draw has the following meanings:

0 : It means clockwise direction, and the path is a rectangle.
1 : It means counterclockwise direction, and the path is a rectangle.
2 : It means oblique direction, and the path is a straight line.
3 : It means clockwise direction, and the path is a circle.
4 : It means counterclockwise direction, and the path is a circle.

PATTERN # 69 : PICTURE-1 (a natural picture)

Explanation : The parameter, Foreground Color, means to choose which set of natural pictures. 0 means the natural picture stored in flash memory. 21 ~ 84 means the natural pictures stored on memory card. The first two parameters of Blink Draw are used to change the positions of natural pictures. The first parameter determines the horizontal position. The second parameter determines the vertical position. They are expressed in ratio; that is, the ratio of input values divided by 20. For example, the value of the first parameter is five, and that of the second is four, so their starting points of natural pictures are at 5/20 (=1/4) of the horizontal direction and 4/20 (=1/5) of the vertical one separately.

PATTERN # 71 : CHARAC / H - 5



Explanation : The picture is all composed of “H”. The font type is 5×7.

PATTERN # 72 : CHARAC / H - 5R

Explanation : It is the reverse pattern of pattern # 71.

PATTERN # 73 : CHARAC / CX - 5

Explanation : The picture is all composed of "区". The font type is 5×7.

PATTERN # 74 : CHARAC / CX - 5R

Explanation : It is the reverse pattern of pattern # 73.

PATTERN # 75 : CHARAC / ME

Explanation : The picture is all composed of "ME". The font type is 11×11.

PATTERN # 76 : CHARAC / ME - R

Explanation : It is the reverse pattern of pattern # 75.

PATTERN # 77 : ROOT WEAVE

Explanation : The picture is all composed of "root". It is used to check moire.

PATTERN # 78 : CHARAC / 16×15

Explanation : The picture is all composed of "惠" (Hui). The font type is 16×15.

PATTERN # 79 : CHARAC / 24×24

Explanation : The picture is all composed of "鷹" (Ying). The font type is 24×24.

PATTERN # 80 : CHARAC / @

Explanation : The picture is all composed of “@”. The font type is 5×7.

PATTERN # 81 : CHARAC / H - 7

Explanation : The picture is all composed of “H”. The font type is 7×9.

PATTERN # 82 : CHARAC / H - 7R

Explanation : It is the reverse pattern of pattern # 81.

PATTERN # 83 : CHARAC / CX - 7

Explanation : The picture is all compoed of “⊠ ”. The font type is 7×9.

PATTERN # 84 : CHARAC / CX - 7R

Explanation : It is the reverse pattern of pattern # 83.

PATTERN # 85 : TEXT 5×7

Explanation : The picture is an article. The font type of each letter is 5×7 (Character # 32 ~ 127).

PATTERN # 86 : TEXT 7×9

Explanation : The picture is an article. The font type of each letter is 7×9 (Character # 160 ~ 255). It is the type of proportional spacing.

PATTERN # 91 ~ 100

Explanation : The pattern is for diagnosis.

APPENDIX C

CHARACTER FONTS

CODE No. #	No. OF CHARACTERS	STORAGE DEVICE	READ / WRITE	MAX FONT SIZE	REMARKS
1 ~ 31	31	FLASH	READ	8∗16	
32 ~ 127	96	FLASH	READ	5∗7	(STORE SIZE 5∗9)
128 ~ 159	32	FLASH	READ	8∗16	
160 ~ 255	96	FLASH	READ	7∗9	(PROPORTIONAL WIDTH STORE SIZE A∗12)
256 ~ 351	96	FLASH	READ	7∗9	(PC FONT,STORE SIZE A∗13)
352 ~ 383	32	FLASH	READ	16∗16	
384 ~ 415	32	FLASH	READ	24∗24	
416 ~ 431	16	FLASH	READ	32∗32	RESERVED
432 ~ 435	4	FLASH	READ	64∗64	RESERVED
436 ~ 499	-	-	-	-	
500 ~ 549	50	NVRAM	READ/WRITE	8∗8	
550 ~ 599	50	NVRAM	READ/WRITE	16∗16	
600 ~ 609	10	NVRAM	READ/WRITE	32∗32	
610 ~ 611	2	NVRAM	READ/WRITE	64∗64	
700 ~ 749	50	MEMORY CARD	READ/WRITE	8∗8	
750 ~ 799	50	MEMORY CARD	READ/WRITE	16∗16	
800 ~ 809	10	MEMORY CARD	READ/WRITE	32∗32	
810 ~ 811	2	MEMORY CARD	READ/WRITE	64∗64	
812 ~ 861	50	MEMORY CARD	READ/WRITE	8∗8	
862 ~ 911	50	MEMORY CARD	READ/WRITE	16∗16	
912 ~ 921	10	MEMORY CARD	READ/WRITE	32∗32	
922 ~ 923	2	MEMORY CARD	READ/WRITE	64∗64	
924 ~ 999	76	MEMORY CARD	READ/WRITE	32∗32	

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APPENDIX D

ANALOG-COLOR: NORMAL PEN FORM

PEN	R	G	B	PEN	R	G	B	PEN	R	G	B	PEN	R	G	B
0	0	0	0	64	28	0	0	128	0	28	0	192	28	28	0
1	0	0	674	65	60	0	0	129	0	60	0	193	60	60	0
2	674	0	0	66	92	0	0	130	0	92	0	194	92	92	0
3	674	0	674	67	124	0	0	131	0	124	0	195	124	124	0
4	0	674	0	68	156	0	0	132	0	156	0	196	156	156	0
5	0	674	674	69	189	0	0	133	0	189	0	197	189	189	0
6	674	674	0	70	221	0	0	134	0	221	0	198	221	221	0
7	674	674	674	71	253	0	0	135	0	253	0	199	253	253	0
8	514	514	514	72	285	0	0	136	0	285	0	200	285	285	0
9	0	0	1023	73	317	0	0	137	0	317	0	201	317	317	0
10	1023	0	0	74	349	0	0	138	0	349	0	202	349	349	0
11	1023	0	1023	75	381	0	0	139	0	381	0	203	381	381	0
12	0	1023	0	76	413	0	0	140	0	413	0	204	413	413	0
13	0	1023	1023	77	445	0	0	141	0	445	0	205	445	445	0
14	1023	1023	0	78	477	0	0	142	0	477	0	206	477	477	0
15	1023	1023	1023	79	509	0	0	143	0	509	0	207	509	509	0
16	51	51	51	80	542	0	0	144	0	542	0	208	542	542	0
17	102	102	102	81	574	0	0	145	0	574	0	209	574	574	0
18	205	205	205	82	606	0	0	146	0	606	0	210	606	606	0
19	307	307	307	83	638	0	0	147	0	638	0	211	638	638	0
20	409	409	409	84	670	0	0	148	0	670	0	212	670	670	0
21	491	491	491	85	702	0	0	149	0	702	0	213	702	702	0
22	512	512	512	86	734	0	0	150	0	734	0	214	734	734	0
23	522	522	522	87	766	0	0	151	0	766	0	215	766	766	0
24	542	542	542	88	798	0	0	152	0	798	0	216	798	798	0
25	614	614	614	89	830	0	0	153	0	830	0	217	830	830	0
26	716	716	716	90	863	0	0	154	0	863	0	218	863	863	0
27	767	767	767	91	895	0	0	155	0	895	0	219	895	895	0
28	818	818	818	92	927	0	0	156	0	927	0	220	927	927	0
29	921	921	921	93	959	0	0	157	0	959	0	221	959	959	0
30	972	972	972	94	991	0	0	158	0	991	0	222	991	991	0
31	124	124	124	95	1023	0	0	159	0	1023	0	223	1023	1023	0
32	0	0	28	96	28	0	28	160	0	28	28	224	28	28	28
33	0	0	60	97	60	0	60	161	0	60	60	225	60	60	60
34	0	0	92	98	92	0	92	162	0	92	92	226	92	92	92
35	0	0	124	99	124	0	124	163	0	124	124	227	124	124	124
36	0	0	156	100	156	0	156	164	0	156	156	228	156	156	156
37	0	0	189	101	189	0	189	165	0	189	189	229	189	189	189
38	0	0	221	102	221	0	221	166	0	221	221	230	221	221	221
39	0	0	253	103	253	0	253	167	0	253	253	231	253	253	253
40	0	0	285	104	285	0	285	168	0	285	285	232	285	285	285
41	0	0	317	105	317	0	317	169	0	317	317	233	317	317	317
42	0	0	349	106	349	0	349	170	0	349	349	234	349	349	349
43	0	0	381	107	381	0	381	171	0	381	381	235	381	381	381
44	0	0	413	108	413	0	413	172	0	413	413	236	413	413	413
45	0	0	445	109	445	0	445	173	0	445	445	237	445	445	445
46	0	0	477	110	477	0	477	174	0	477	477	238	477	477	477
47	0	0	509	111	509	0	509	175	0	509	509	239	509	509	509
48	0	0	542	112	542	0	542	176	0	542	542	240	542	542	542
49	0	0	574	113	574	0	574	177	0	574	574	241	574	574	574
50	0	0	606	114	606	0	606	178	0	606	606	242	606	606	606
51	0	0	638	115	638	0	638	179	0	638	638	243	638	638	638
52	0	0	670	116	670	0	670	180	0	670	670	244	670	670	670
53	0	0	702	117	702	0	702	181	0	702	702	245	702	702	702
54	0	0	734	118	734	0	734	182	0	734	734	246	734	734	734
55	0	0	766	119	766	0	766	183	0	766	766	247	766	766	766
56	0	0	798	120	798	0	798	184	0	798	798	248	798	798	798
57	0	0	830	121	830	0	830	185	0	830	830	249	830	830	830
58	0	0	863	122	863	0	863	186	0	863	863	250	863	863	863
59	0	0	895	123	895	0	895	187	0	895	895	251	895	895	895
60	0	0	927	124	927	0	927	188	0	927	927	252	927	927	927
61	0	0	959	125	959	0	959	189	0	959	959	253	959	959	959
62	0	0	991	126	991	0	991	190	0	991	991	254	991	991	991
63	0	0	1023	127	1023	0	1023	191	0	1023	1023	255	1023	1023	1023

ANALOG-MONO: NORMAL PEN FORM

PEN	R	G	B	PEN	R	G	B	PEN	R	G	B	PEN	R	G	B
0	0	0	0	64	257	257	257	128	514	514	514	192	770	770	770
1	68	68	68	65	261	261	261	129	518	518	518	193	774	774	774
2	136	136	136	66	265	265	265	130	522	522	522	194	778	778	778
3	205	205	205	67	269	269	269	131	526	526	526	195	782	782	782
4	273	273	273	68	273	273	273	132	530	530	530	196	786	786	786
5	341	341	341	69	277	277	277	133	534	534	534	197	790	790	790
6	409	409	409	70	281	281	281	134	538	538	538	198	794	794	794
7	477	477	477	71	285	285	285	135	542	542	542	199	798	798	798
8	546	546	546	72	289	289	289	136	546	546	546	200	802	802	802
9	614	614	614	73	293	293	293	137	550	550	550	201	806	806	806
10	682	682	682	74	297	297	297	138	554	554	554	202	810	810	810
11	750	750	750	75	301	301	301	139	558	558	558	203	814	814	814
12	818	818	818	76	305	305	305	140	562	562	562	204	818	818	818
13	887	887	887	77	309	309	309	141	566	566	566	205	822	822	822
14	955	955	955	78	313	313	313	142	570	570	570	206	826	826	826
15	1023	1023	1023	79	317	317	317	143	574	574	574	207	830	830	830
16	51	51	51	80	321	321	321	144	578	578	578	208	834	834	834
17	102	102	102	81	325	325	325	145	582	582	582	209	838	838	838
18	205	205	205	82	329	329	329	146	586	586	586	210	842	842	842
19	307	307	307	83	333	333	333	147	590	590	590	211	846	846	846
20	409	409	409	84	337	337	337	148	594	594	594	212	850	850	850
21	491	491	491	85	341	341	341	149	598	598	598	213	855	855	855
22	512	512	512	86	345	345	345	150	602	602	602	214	859	859	859
23	522	522	522	87	349	349	349	151	606	606	606	215	863	863	863
24	542	542	542	88	353	353	353	152	610	610	610	216	867	867	867
25	614	614	614	89	357	357	357	153	614	614	614	217	871	871	871
26	716	716	716	90	361	361	361	154	618	618	618	218	875	875	875
27	767	767	767	91	365	365	365	155	622	622	622	219	879	879	879
28	818	818	818	92	369	369	369	156	626	626	626	220	883	883	883
29	921	921	921	93	373	373	373	157	630	630	630	221	887	887	887
30	972	972	972	94	377	377	377	158	634	634	634	222	891	891	891
31	124	124	124	95	381	381	381	159	638	638	638	223	895	895	895
32	128	128	128	96	385	385	385	160	642	642	642	224	28	28	28
33	132	132	132	97	389	389	389	161	646	646	646	225	60	60	60
34	136	136	136	98	393	393	393	162	650	650	650	226	92	92	92
35	140	140	140	99	397	397	397	163	654	654	654	227	124	124	124
36	144	144	144	100	401	401	401	164	658	658	658	228	156	156	156
37	148	148	148	101	405	405	405	165	662	662	662	229	189	189	189
38	152	152	152	102	409	409	409	166	666	666	666	230	221	221	221
39	156	156	156	103	413	413	413	167	670	670	670	231	253	253	253
40	160	160	160	104	417	417	417	168	674	674	674	232	285	285	285
41	164	164	164	105	421	421	421	169	678	678	678	233	317	317	317
42	168	168	168	106	425	425	425	170	682	682	682	234	349	349	349
43	173	173	173	107	429	429	429	171	686	686	686	235	381	381	381
44	177	177	177	108	433	433	433	172	690	690	690	236	413	413	413
45	181	181	181	109	437	437	437	173	694	694	694	237	445	445	445
46	185	185	185	110	441	441	441	174	698	698	698	238	477	477	477
47	189	189	189	111	445	445	445	175	702	702	702	239	509	509	509
48	193	193	193	112	449	449	449	176	706	706	706	240	542	542	542
49	197	197	197	113	453	453	453	177	710	710	710	241	574	574	574
50	201	201	201	114	457	457	457	178	714	714	714	242	606	606	606
51	205	205	205	115	461	461	461	179	718	718	718	243	638	638	638
52	209	209	209	116	465	465	465	180	722	722	722	244	670	670	670
53	213	213	213	117	469	469	469	181	726	726	726	245	702	702	702
54	217	217	217	118	473	473	473	182	730	730	730	246	734	734	734
55	221	221	221	119	477	477	477	183	734	734	734	247	766	766	766
56	225	225	225	120	481	481	481	184	738	738	738	248	798	798	798
57	229	229	229	121	485	485	485	185	742	742	742	249	830	830	830
58	233	233	233	122	489	489	489	186	746	746	746	250	863	863	863
59	237	237	237	123	493	493	493	187	750	750	750	251	895	895	895
60	241	241	241	124	497	497	497	188	754	754	754	252	927	927	927
61	245	245	245	125	501	501	501	189	758	758	758	253	959	959	959
62	249	249	249	126	505	505	505	190	762	762	762	254	991	991	991
63	253	253	253	127	509	509	509	191	766	766	766	255	1023	1023	1023

ANALOG: GRAY PEN FORM

PEN	R	G	B	PEN	R	G	B	PEN	R	G	B	PEN	R	G	B
0	0	0	0	64	257	257	257	128	514	514	514	192	770	770	770
1	4	4	4	65	261	261	261	129	518	518	518	193	774	774	774
2	8	8	8	66	265	265	265	130	522	522	522	194	778	778	778
3	12	12	12	67	269	269	269	131	526	526	526	195	782	782	782
4	16	16	16	68	273	273	273	132	530	530	530	196	786	786	786
5	20	20	20	69	277	277	277	133	534	534	534	197	790	790	790
6	24	24	24	70	281	281	281	134	538	538	538	198	794	794	794
7	28	28	28	71	285	285	285	135	542	542	542	199	798	798	798
8	32	32	32	72	289	289	289	136	546	546	546	200	802	802	802
9	36	36	36	73	293	293	293	137	550	550	550	201	806	806	806
10	40	40	40	74	297	297	297	138	554	554	554	202	810	810	810
11	44	44	44	75	301	301	301	139	558	558	558	203	814	814	814
12	48	48	48	76	305	305	305	140	562	562	562	204	818	818	818
13	52	52	52	77	309	309	309	141	566	566	566	205	822	822	822
14	56	56	56	78	313	313	313	142	570	570	570	206	826	826	826
15	60	60	60	79	317	317	317	143	574	574	574	207	830	830	830
16	64	64	64	80	321	321	321	144	578	578	578	208	834	834	834
17	68	68	68	81	325	325	325	145	582	582	582	209	838	838	838
18	72	72	72	82	329	329	329	146	586	586	586	210	842	842	842
19	76	76	76	83	333	333	333	147	590	590	590	211	846	846	846
20	80	80	80	84	337	337	337	148	594	594	594	212	850	850	850
21	84	84	84	85	341	341	341	149	598	598	598	213	855	855	855
22	88	88	88	86	345	345	345	150	602	602	602	214	859	859	859
23	92	92	92	87	349	349	349	151	606	606	606	215	863	863	863
24	96	96	96	88	353	353	353	152	610	610	610	216	867	867	867
25	100	100	100	89	357	357	357	153	614	614	614	217	871	871	871
26	104	104	104	90	361	361	361	154	618	618	618	218	875	875	875
27	108	108	108	91	365	365	365	155	622	622	622	219	879	879	879
28	112	112	112	92	369	369	369	156	626	626	626	220	883	883	883
29	116	116	116	93	373	373	373	157	630	630	630	221	887	887	887
30	120	120	120	94	377	377	377	158	634	634	634	222	891	891	891
31	124	124	124	95	381	381	381	159	638	638	638	223	895	895	895
32	128	128	128	96	385	385	385	160	642	642	642	224	899	899	899
33	132	132	132	97	389	389	389	161	646	646	646	225	903	903	903
34	136	136	136	98	393	393	393	162	650	650	650	226	907	907	907
35	140	140	140	99	397	397	397	163	654	654	654	227	911	911	911
36	144	144	144	100	401	401	401	164	658	658	658	228	915	915	915
37	148	148	148	101	405	405	405	165	662	662	662	229	919	919	919
38	152	152	152	102	409	409	409	166	666	666	666	230	923	923	923
39	156	156	156	103	413	413	413	167	670	670	670	231	927	927	927
40	160	160	160	104	417	417	417	168	674	674	674	232	931	931	931
41	164	164	164	105	421	421	421	169	678	678	678	233	935	935	935
42	168	168	168	106	425	425	425	170	682	682	682	234	939	939	939
43	173	173	173	107	429	429	429	171	686	686	686	235	943	943	943
44	177	177	177	108	433	433	433	172	690	690	690	236	947	947	947
45	181	181	181	109	437	437	437	173	694	694	694	237	951	951	951
46	185	185	185	110	441	441	441	174	698	698	698	238	955	955	955
47	189	189	189	111	445	445	445	175	702	702	702	239	959	959	959
48	193	193	193	112	449	449	449	176	706	706	706	240	963	963	963
49	197	197	197	113	453	453	453	177	710	710	710	241	967	967	967
50	201	201	201	114	457	457	457	178	714	714	714	242	971	971	971
51	205	205	205	115	461	461	461	179	718	718	718	243	975	975	975
52	209	209	209	116	465	465	465	180	722	722	722	244	979	979	979
53	213	213	213	117	469	469	469	181	726	726	726	245	983	983	983
54	217	217	217	118	473	473	473	182	730	730	730	246	987	987	987
55	221	221	221	119	477	477	477	183	734	734	734	247	991	991	991
56	225	225	225	120	481	481	481	184	738	738	738	248	995	995	995
57	229	229	229	121	485	485	485	185	742	742	742	249	999	999	999
58	233	233	233	122	489	489	489	186	746	746	746	250	1003	1003	1003
59	237	237	237	123	493	493	493	187	750	750	750	251	1007	1007	1007
60	241	241	241	124	497	497	497	188	754	754	754	252	1011	1011	1011
61	245	245	245	125	501	501	501	189	758	758	758	253	1015	1015	1015
62	249	249	249	126	505	505	505	190	762	762	762	254	1019	1019	1019
63	253	253	253	127	509	509	509	191	766	766	766	255	1023	1023	1023

TTL-MONO PEN FORM

PEN	M BIT
0	0
1-255	1

TTL-MONO + I PEN FORM

PEN	M	I
0	0	0
1	0	1
2	1	0
3	1	1
4 - 7	0	1
8 -11	1	0
12 -15	1	1
16-255	1	1

TTL RGBI PEN FORM

PEN	(R)	(G)	(B)	(I)	REMARKS
0	0	0	0	0	BLACK
1	0	0	1	0	BLUE
2	1	0	0	0	RED
3	1	0	1	0	MAGENTA
4	0	1	0	0	GREEN
5	0	1	1	0	CYAN
6	1	1	0	0	YELLOW
7	1	1	1	0	WHITE
8	0	0	0	1	BLACK + I
9	0	0	1	1	BLUE + I
10	1	0	0	1	RED + I
11	1	0	1	1	MAGENTA + I
12	0	1	0	1	GREEN + I
13	0	1	1	1	CYAN + I
14	1	1	0	1	YELLOW + I
15-255	1	1	1	1	WHITE + I

TTL RGBrgb PEN FORM

PEN	R	G	B	r	g	b	REMARKS	PEN	R	G	B	r	g	b	REMARKS
0	0	0	0	0	0	0	BLACK 0%	32	0	1	1	1	1	1	
1	0	0	1	0	0	0	BLUE 66%	33	1	1	0	1	1	1	
2	1	0	0	0	0	0	RED 66%	34	1	1	1	0	0	1	
3	1	0	1	0	0	0	MAGENTA 66%	35	1	1	1	1	0	0	
4	0	1	0	0	0	0	GREEN 66%	36	1	1	1	1	0	1	
5	0	1	1	0	0	0	CYAN 66%	37	1	1	1	0	1	0	
6	1	1	0	0	0	0	YELLOW 66%	38	1	1	1	0	1	1	
7	1	1	1	0	0	0	WHITE 66%	39	1	1	1	1	1	0	
8	0	0	0	1	1	1	BLACK 33%	40	0	0	1	1	0	0	
9	0	0	1	0	0	1	BLUE 100%	41	0	0	1	1	0	1	
10	1	0	0	1	0	0	RED 100%	42	1	0	1	0	0	1	
11	1	0	1	1	0	1	MAGENTA 100%	43	1	0	1	0	1	1	
12	0	1	0	0	1	0	GREEN 100%	44	1	0	0	0	0	1	
13	0	1	1	0	1	1	CYAN 100%	45	1	0	0	1	0	1	
14	1	1	0	1	1	0	YELLOW 100%	46	1	0	1	1	0	0	
15	1	1	1	1	1	1	WHITE 100%	47	1	0	1	1	1	0	
16	0	0	0	0	0	1		48	0	0	1	0	1	0	
17	0	0	0	1	0	0		49	0	0	1	0	1	1	
18	0	0	0	1	0	1		50	0	1	1	0	0	1	
19	0	0	0	0	1	0		51	0	1	1	1	0	1	
20	0	0	0	0	1	1		52	0	1	0	0	0	1	
21	0	0	0	1	1	0		53	0	1	0	0	1	1	
22	0	0	1	1	1	0		54	0	1	1	0	1	0	
23	1	0	0	0	1	1		55	0	1	1	1	1	0	
24	1	0	1	0	1	0		56	1	0	0	0	1	0	
25	0	1	0	1	0	1		57	1	0	0	1	1	0	
26	0	1	1	1	0	0		58	1	1	0	1	0	0	
27	1	1	0	0	0	1		59	1	1	0	1	0	1	
28	0	0	1	1	1	1		60	0	1	0	1	0	0	
29	1	0	0	1	1	1		61	0	1	0	1	1	0	
30	1	0	1	1	1	1		62	1	1	0	0	1	0	
31	0	1	0	1	1	1		63	1	1	0	0	1	1	
								64-255	1	1	1	1	1	1	

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