MITSUBISHI

SERVICE MANUAL

COLOR MONITOR **Diamond Plus 74SB**

MODELS   DPLUS 74SB -BK(A)/(B)

NEC-MITSUBISHI ELECTRIC VISUAL SYSTEMS CORPORATION

MAY 2002

⚠ WARNING

The SERVICE PERSONNEL should have the appropriate technical training, knowledge and experience necessary to:

- Be familiar with specialized test equipment, and
- Be careful to follow all safety procedures associated with high voltage CRT circuit designs to minimize danger to themselves and their coworkers.

To avoid electrical shocks, this equipment should be used with an appropriate power code and be connected only to a properly grounded AC outlet.

This equipment utilized a micro-gap power switch. Turn off the set by first pushing the front panel power switch.   Next, remove the power cord from the AC outlet.

To prevent fire or shock hazards, do not expose this unit to rain or moisture.

This symbol warns the personnel that un-insulated voltage within the unit may have sufficient magnitude to cause electric shock.

This symbol alerts the personnel that important literature concerning the operation and maintenance of this unit has been included.
Therefore, it should be read carefully in order to avoid any problems.

⚠ PRODUCT SAFETY CAUTION

1. When parts replacement is required for servicing, always use the manufacturer's specified replacement.

2. Comply with all caution and safety-related notes on the product display chassis and picture tube.

3. When replacing the component, always be certain that all the components are put back in the place.

4. When servicing display monitor unit, it is required that the provided lead dress is used in the high voltage circuit area.

5. It is also recommended that shatter proof goggles are worn, when removing installing and handling the picture tube. People not equipped with the proper precautionary measures mentioned should keep the picture tube away from body while handling.

6. As for a connector, pick and extract housing with fingers properly since a disconnection and improper contacts may occur, when wires of the connector are led.

7. Use a proper screwdriver.   If you use screwdriver that does not fit, you may damage the screws.

8. X-radiation precaution

   This product contains critical electrical and mechanical parts essential for X-ray protection.

   Normal anode voltage is 25.5 kV at zero beam picture tube current under AC 100-120V/220-240V input, and anode voltage must not exceed the voltages shown below under any operation condition.

   To measure anode voltage set brightness for very dim picture, and use a high impedance volt meter between chassis and anode lead and measure high voltage.

   If high voltage exceeds the specifications on the chassis schematic diagram, take the necessary corrective action.

Table   MAXIMUM ANODE VOLTAGE

beam current	at 0 mA	at 0.6 mA	at 1.2 mA
A/B Ver.	31.0 kV	30.5 kV	30.5 kV

9. When you degauss the set with an external degaussing coil, you must keep strictly item " * Notes about degaussing method " of ADJUSTMENT Procedures.

CONTENTS

User's Manual

1. A Version

MITSUBISHI

USER'S MANUAL

17"

Diamond Plus 74SB

16" Viewable Image Size

www.mitsubishidisplay.com

Index

Canadian Department of Communications Compliance Statement

DOC: This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

C-UL: Bears the C-UL Mark and is in compliance with Canadian Safety Regulations according to C.S.A. C22.2 No. 950.

FCC Information

1. Use the attached specified cables with the Diamond Plus 74[SB] color monitor so as not to interfere with radio and television reception.
   (1) Please use the supplied power cord or equivalent to ensure FCC compliance.
   (2) Shielded captive type signal cable.
      Use of other cables and adapters may cause intereference with radio and television reception.
2. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
   • Reorient or relocate the receiving antenna.
   • Increase the separation between the equipment and receiver.
   • Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
   • Consult your dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

If necessary, the user should contact the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, D.C., 20402, Stock No. 004-000-00345-4.

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Contents

Your new Diamond Plus 74^{SB} monitor box* should contain the following:

• Diamond Plus 74^{SB} Monitor with tilt/swivel base
• Power Cord
• Captive Signal Cable
• User's Manual

Captive Signal Cable

MITSUBISHI

USER'S MANUAL

17"
Diamond Plus 74^{SB}
16" Viewable Image Size
www.mitsubishidisplay.com
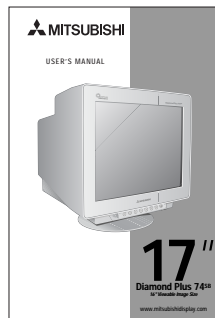
User's Manual
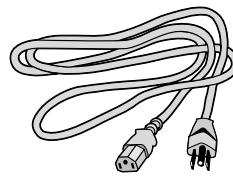
Power Cord

Remember to save your original box and packing material to transport or ship the monitor.

2

Quick Start

To attach the Diamond Plus monitor to your system, follow these instructions:

1. Turn off the power to your computer.

2. If necessary, install the display card into your system. For more information, refer to the display card manual.

3. For the PC: Connect the 15-pin mini D-SUB of the captive signal cable to the connector of the display card in your system **(Figure A.1).** Tighten all screws.

   For the Mac: Connect the Diamond Plus Macintosh cable adapter (not in-cluded) to the monitor connector on the Macintosh **(Figure B.1).** Attach the 15-pin mini D-SUB end of the captive signal cable to the Diamond Plus Macintosh cable adapter on the computer **(Figure B.1).** Tighten all screws.

**NOTE: To obtain the Diamond Plus 74^{SB} Macintosh cable adapter, call
          NEC-Mitsubishi Electronics Display of America, Inc. at (800) 632-4662.**

4. For download information on the Windows® 95/98/Me/2000/XP INF file for your Diamond Plus monitor, refer to the **References** section of this User's Manual.

5. Connect one end of the power cord to the Dimond Plus monitor and the other end to the power outlet **(Figure C.1).**

6. Turn on the monitor **(Figure D.1)** and the computer.

NOTE: If you have any problems, please refer to the **Troubleshooting** section of this User's Manual.

Figure A.1

Figure B.1

15-pin
mini
D-SUB

Captive Signal Cable

Mac Adapter
(Not Included)

Captive Signal Cable

3

Quick Start *—continued*

Power Outlet

Power
Cord

Figure C.1

MITSUBISHI

Power Button

Figure D.1

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Controls

OSM™ (On-Screen Manager) control buttons on the front of the monitor function as follows:

	Main Menu	**Sub-Menu**
EXIT	Exits the OSM menu.	Exits to the OSM controls main menu.
CONTROL ◄/►	Moves the highlighted area left/right to select one of the sub-menus.	Moves the highlighted area left/right to select one of the controls.
CONTROL –/+	Has no function.	Moves the bar in the – or + direction to decrease or increase the adjustment.
SELECT/ SBMODE	Enters sub-menu.	Has no function.
RESET	Resets all the controls within the highlighted menu to the factory setting.	Resets the highlighted control to the factory setting.

NOTE: When **RESET** is pressed in the main and sub-menu, a warning window will appear allowing you to cancel the reset function.

NOTE: In SB MODE (SuperBright Mode), ON and OFF is functional when the OSM is not displayed.

☼ ◑ Brightness/Contrast Controls

Brightness: Adjusts the overall image and background screen brightness.

Contrast: Adjusts the image brightness in relation to the background.

Degauss: Eliminates the buildup of stray magnetic fields which alter the correct scan of the electron beams and affect the purity of the screen colors, focus and convergence. When activated, your screen image will jump and waver a bit as the screen is demagnetized.

Caution: Please allow a minimum of 20 minutes to elapse between uses of the Degauss Control.

⊞ ✛ Size and Position Controls

Left/Right: Moves the image horizontally (left or right).

Down/Up: Moves the image vertically (up or down).

Narrow/Wide: Decreases or increases the horizontal size of the image.

Short/Tall: Decreases or increases the vertical size of the image.

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Controls –*continued*

ⓇⒼⒷ Color Control/AccuColor® Control System

Color presets selects the desired color setting. The bar is replaced by the color setting choice. Each color setting is adjusted at the factory to the stated Kelvin. If a setting is adjusted, the name of the setting will change from Kelvin to Custom except sRGB mode.

Red, Green, Blue: AccuColor Control System decreases or increases the monitor's red, green or blue color guns depending upon which is selected. The change in color will appear on screen and the direction (decrease or increase) will be shown by the bars.

sRGB mode: sRGB mode provides the suitable color managed picture image. You can not change Red, Green and Blue colors, brightness and contrast individually.

Color Temperature Adjustment: Adjusts the color temperature of the screen image.

▱▱ Geometry Controls

Geometry Controls Menu

The **Geometry** controls allow you to adjust the curvature or angle of the sides of your display.

Sides In/Out (pincushion): Decreases or increases the curvature of the sides either inward or outward.

Sides Left/Right (pincushion balance): Decreases or increases the curvature of the sides either to the left or right.

Sides Tilt (parallelogram): Decreases or increases the tilt of the sides either to the left or right.

Sides Align (trapezoidal): Decreases or increases the bottom of the screen to be the same as the top.

Rotate (raster rotation): Rotates the entire display clockwise or counterclockwise.

⚒ Tools 1

Moiré Canceler: Moiré is a wavy pattern which can sometimes appear on the screen. The pattern is repetitive and superimposed as rippled images. When running certain applications, the wavy pattern is more evident than in others. To reduce moiré, adjust the level by using –/+ CONTROL buttons.

⚒ Tools 2

Language: OSM controls menus are available in 6 languages.

OSM Position: You can choose where you would like the OSM controls menu to appear on your screen. Selecting OSM Position allows you to manually adjust the OSM controls menu position from among Center, Top left, Top right, Bottom left and Bottom right.

OSM Turn Off: The OSM controls menu will stay on as long as it is in use. In the OSM Turn Off sub-menu, you can select how long the monitor waits after the last touch of a button for the OSM controls menu to disappear. The preset choices are 5 thru 120 seconds.

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Controls *–continued*

OSM Lock Out: This control completely locks out access to all OSM controls functions except Brightness and Contrast. When attempting to activate OSM controls while in the lock out mode, a screen will appear indicating that OSM controls are locked out. To activate the OSM Lock Out function, press SELECT and hold + down simultaneously. To deactivate the OSM Lock Out, press SELECT and hold + down simultaneously.

IPM™ System Off Mode: Enable: The IPM System works normally and all stages of energy savings are utilized.

Disable: The Off Mode of the IPM System is not used.

NOTE: For standard systems and graphics boards, keep the factory setting at ENABLE.

Factory Preset: Selecting Factory Preset allows you a reset most OSM™ control settings back to the factory settings. A warning statement will appear to confirm that you do want to reset ALL settings. Individual settings can be reset by high-lighting the control to be reset and pressing the **RESET** button.

ℹ Information

Display Mode: Indicates the current mode and frequency setting of the monitor.

Monitor Info: Indicates the model and serial numbers of your monitor.

Refresh Notifier: A message will advise you if the refresh rate of the signal being applied to the monitor by the computer is too low. For further information, please refer to your display card or system manual.

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Recommended Use

Safety Precautions and Maintenance

FOR OPTIMUM PERFORMANCE, PLEASE NOTE THE FOLLOWING WHEN SETTING UP AND USING THE DIAMOND PLUS COLOR MONITOR:

- **DO NOT OPEN THE MONITOR.** There are no user serviceable parts inside and opening or removing covers may expose you to dangerous shock hazards or other risks. Refer all servicing to qualified service personnel.
- Do not spill any liquids into the cabinet or use your monitor near water.
- Do not insert objects of any kind into the cabinet slots, as they may touch dangerous voltage points, which can be harmful or fatal or may cause electric shock, fire or equipment failure.
- Do not place any heavy objects on the power cord. Damage to the cord may cause shock or fire.
- Do not place this product on a sloping or unstable cart, stand or table, as the monitor may fall, causing serious damage to the monitor.
- Keep the monitor away from high capacity transformers, electric motors and other devices such as external speakers or fans, which may create strong magnetic fields.
- If possible, position the monitor so that it is facing the east to minimize the effects of the earth's magnetic field.
- Changing the direction of the monitor while it is powered on may cause image discoloration. To correct this, turn the monitor off for 20 minutes before powering it back on.
- When operating the Diamond Plus 74^{SB} with its AC 220-240V worldwide power supply, use a power supply cord that matches the power supply voltage of the AC power outlet being used. The power supply cord you use must have been approved by and comply with the safety standards of your country. (Type H05VV-F should be used except in UK)
- In UK, use a BS-approved power cord with molded plug having a black (5A) fuse installed for use with this monitor. If a power cord is not supplied with this monitor, please contact your supplier.

Cleaning Your Monitor

A special coating is provided on the glass (CRT) surface of this monitor to reduce a reflection and static electricity on the glass surface. Due to the delicate coating on the glass surface, use a lint-free, non-abrasive cloth (cotton or equivalent) and a non-alcohol, neutral, non-abrasive cleaning solution to minimize dust. If the screen requires more than a light cleaning, apply a soft neutral detergent and water directly to a soft cloth and use it upon wringing water, to clean the glass surface. Clean your monitor regularly.

CAUTION: The following agents will cause damage to the CRT when cleaning the glass surface: Benzene, thinner, acid/alkaline detergent, alcohol detergent, detergent with abrasive powder, detergent with anti-static agent, detergent for cleaning.

Immediately unplug your monitor from the wall outlet and refer servicing to qualified service personnel under the following conditions:
- When the power supply cord or plug is damaged.
- If liquid has been spilled, or objects have fallen into the monitor.
- If the monitor has been exposed to rain or water.
- If the monitor has been dropped or the cabinet damaged.
- If the monitor does not operate normally by following operating instructions.

CAUTION

- Allow adequate ventilation around the monitor so that heat can properly dissipate. Do not block ventilated openings or place the monitor near a radiator or other heat sources. Do not put anything on top of monitor.
- The power cable connector is the primary means of detaching the system from the power supply. The monitor should be installed close to a power outlet which is easily accessible.
- Handle with care when transporting. Save packaging for transporting.

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Recommended Use *–continued*

⚠️ CORRECT PLACEMENT AND ADJUSTMENT OF THE MONITOR CAN REDUCE EYE, SHOULDER AND NECK FATIGUE. CHECK THE FOLLOWING WHEN YOU POSITION THE MONITOR: ⚠️

- Adjust the monitor height so that the top of the screen is at or slightly below eye level. Your eyes should look slightly downward when viewing the middle of the screen.
- Position your monitor no closer than 16 inches and no further away than 24 inches from your eyes. The optimal distance is 20 inches.
- Rest your eyes periodically by focusing on an object at least 20 feet away. Blink often.
- Position the monitor at a 90° angle to windows and other light sources to minimize glare and reflections. Adjust the monitor tilt so that ceiling lights do not reflect on your screen.
- If reflected light makes it hard for you to see your screen, use an anti-glare filter.
- Clean your monitor regularly. Use a lint-free, non-abrasive cloth and a non-alcohol, neutral, non-abrasive cleaning solution or glass cleaner to minimize dust.
- Adjust the monitor's brightness and contrast controls to enhance readability.
- Use a document holder placed close to the screen.
- Position whatever you are looking at most of the time (the screen or reference material) directly in front of you to minimize turning your head while you are typing.
- Get regular eye checkups.

Ergonomics
To realize the maximum ergonomics benefits, we recommend the following:
- Adjust the Brightness until the background raster disappears
- Do not position the Contrast control to its maximum setting
- Use the preset Size and Position controls with standard signals
- Use the preset Color Setting and Sides Left/Right controls
- Use non-interlaced signals with a vertical refresh rate between 75-120Hz
- Do not use primary color blue on a dark background, as it is difficult to see and may produce eye fatigue due to insufficient contrast

For more detailed information on setting up a healthy work environment, call NEC - Mitsubishi Electronics Display of America at (888) NEC-MITS, FastFacts™ information at (800) 366-0476 and request document #900108 or write the American National Standard for Human Factors Engineering of Visual Display Terminal Workstations – ANSI-HFS Standard No. 100-1988 – The Human Factors Society, Inc. P.O. Box 1369, Santa Monica, California 90406.

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Specifications

Monitor Specifications		Diamond Plus 74^{SB} Monitor	Notes
Picture Tube	Diagonal: Viewable Image Size: Radius:	17 inch 16 inch 50,000 mm	90° deflection, 0.25 mm grille pitch, medium short persistence phosphor, aperture grille CRT, multi-layered, anti-static screen coating, dark-tint screen and OptiClear® screen.
Input Signal	Video: Sync:	ANALOG 0.7 Vp-p/75 Ohms Separate sync. TTL Level Horizontal sync. Positive/Negative Vertical sync. Positive/Negative Composite sync. (Positive/Negative) (TTL Level)	
Display Colors	Analog input:	Unlimited number of Colors	Depends on display card used.
Synchronization Range	Horizontal: Vertical:	30 kHz to 70 kHz 50 Hz to 120 Hz	Automatically Automatically
Resolutions Supported Resolution based on horizontal and vertical frequencies only		640 x 480 @ 60 to 120 Hz 800 x 600 @ 50 to 110 Hz 832 x 624 @ 50 to 106 Hz 1024 x 768 @ 50 to 87 Hz .... 1152 x 864 @ 50 to 77 Hz 1280 x 1024 @ 50 to 66 Hz	Some systems may not support all modes listed. NEC-Mitsubishi Electronics Display cites recommended resolution at 85 Hz for optimal display performance.
Active Display Area (Factory Setting)	Horizontal: Vertical:	315 mm/12.4 inches 236 mm/9.3 inches	Dependent upon signal timing used, and does not include border area.
Active Display Area (Full Scan)		325 mm/12.8 inches 244 mm/9.6 inches	Dependent upon signal timing used, and does not include border area.
Power Supply		AC 100 – 240 V, 50-60 Hz	
Current Rating		1.5A @ 100-240 V	
Dimensions		397 mm (W) x 392 mm (H) x 415.5 mm (D) 15.6 inches (W) x 15.4 inches (H) x 16.4 inches (D)	
Weight		16.8 kg 37.0 lbs	
Environmental Considerations	Operating Temperature: Humidity: Feet: Storage Temperature: Humidity: Feet:	+5°C to +35°C / +50°F to +90°F 10% to 90% 0 to 10,000 Feet -20°C to +60°C / -4°F to +140°F 10% to 90% 0 to 50,000 Feet	

NOTE: Technical specifications are subject to change without notice.

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Features

SuperBright™ Diamondtron® CRT: This patented flat aperture grille CRT delivers an exceptional viewing experience with unprecedented brightness and contrast and a virtually flat image that reduces distortion and glare so that what you see on-screen is what you get on your printed output. The state-of-the-art Mitsubishi PX-DBF™ electron gun and tight 0.25mm grille pitch delivers precise focus for crisp, clear text and images.

SuperBright™ Mode: With the simple touch of a button, the brightness level of the Diamondtron CRT doubles. This function enhances the crispness of images for clarity-conscious applications such as graphics, animation and video

OptiClear® Screen Surface: Further reduces reflection and glare and increases contrast without sacrificing focus level, clarity or brightness.

Dual Dynamic Beam Focus: Provides precise, continuous focus adjustments of the electron beams and optimum image quality, even to the far edges of the screen.

AccuColor® Control System with sRGB: Allows you to change between five color settings on your display to match your personal preference. The sRGB-enabled color matching setting found within AccuColor helps achieve a consistent color environment with other sRGB-enabled hardware and software applications.

On Screen Manager (OSM™) Controls: Allows you to quickly and easily adjust all elements of your screen image via simple to use on-screen menus.

ErgoDesign® Features: Enhances human ergonomics to improve the working environment, protect the health of the user and save money. Examples include OSM controls for quick and easy image adjustments, tilt/swivel base for preferred angle of vision, space-conscious cabinet design and compliance with MPRII guidelines for lower emissions.

Plug and Play: The Microsoft® solution with the Windows® 95/98/Me/2000/XP operating system facilitates setup and installation by allowing the monitor to send its capabilities (such as screen size and resolutions supported) directly to your computer, automatically optimizing display performance.

Intelligent Power Manager (IPM™) System: Provides innovative power-saving methods that allow the monitor to shift to a lower power consumption level when on but not in use, saving two-thirds of your monitor energy costs, reducing emissions and lowering the air conditioning costs of the workplace.

Reduced Magnetic Field™ Technology: Reduces magnetic and alternating electric field emissions and static electricity, addressing ergonomic concerns regarding potential risks from extended computer monitor use.

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Features *–continued*

Multiple Frequency Technology: Automatically adjusts monitor to the display card's scanning frequency, thus displaying the resolution required.

FullScan™ Capability: Allows you to use the entire screen area in most resolutions, significantly expanding image size.

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Troubleshooting

No picture
- Display card should be completely seated in its slot.
- Power Button and computer power switch should be in the ON position.
- Signal cable should be completely connected to display card/computer.
- Check connector for bent or pushed-in pins.

Image is scrolling or unstable
- Signal cable should be completely attached to the computer.
- Check pin assignments and signal timings of the monitor and your display card with respect to recommended timings and pin assignments.
- If the Macintosh cable adapter is used, check for proper connection or make sure the display card is Macintosh compatible and that the card is properly seated in the computer.

LED on monitor is not lit *(no green, orange color can be seen)*
- Power Switch should be in the ON position and power cord should be connected.

LED on monitor is flashing and/or dissapears
- Contact Customer Service at (800) 462-4662.

Picture is fuzzy or color looks blotchy
- Adjust Brightness and Contrast Controls or adjust the Moiré Canceler control.
- Access the Degauss Control through OSM™ controls. Activate the Degauss Control. CAUTION: A minimum interval of 20 minutes should elapse before the Deguass Control is used a second time when not switching between modes.

Picture bounces or a wavy pattern is present in the picture
- Move electrical devices that may be causing electrical interference away from the monitor.
- See inside cover of User's Manual for FCC information.

Edges of the display image are not square
- Use the OSM Geometry Controls to straighten the edges.
- If possible, position the front of the monitor facing east.

Display image is not centered, too small, or too large
- Use the OSM Size and Position Controls to adjust the image.

Thin lines appear on your screen
- Thin lines are normal for an aperture grille CRT and are not a malfunction. These are shadows from the damper wires used to stabilize the aperture grille and are most noticeable when the screen's background is light (usually white).

Black vertical lines are visible on the screen
- Thin vertical black lines on one or both sides of the screen. This minor condition is caused by grille element overlap which can occur during shipping.
- Position an open white window over the affected area of the screen and maximize the brightness and contrast controls. This will cause localized heating of the overlap which will clear in a few minutes. Be sure to readjust the brightness and contrast controls back to the normal viewing level after this procedure.

13

References

- **BBS**   **(978) 742-8706**

NEC-Mitsubishi Electronics Display of America Remote Bulletin Board System is an electronic service accessible with your system and a modem. Communication parameters are: 300/1200/2400/9600/14.4k/28.8k/33.6k bps, no parity, 8-data bits, 1 stop bit

- **Customer Service/**
  Technical Support   **(800) 632-4662**
      Fax   **(978) 742-7049**

- **Electronic Channels:**

Internet e-mail:	tech-support@necmitsubishi.com
Internet ftp site:	ftp.necmitsubishi.com
World Wide Web:	http://www.necmitsubishi.com
Product Registration:	http://www.necmitsubishi.com/productregistration
European Operations:	http://www.nec-monitors.com
Windows® 95/98/Me/2000/XP INF File:	http://support.necmitsubishi.com/software.htm

- **FastFacts™ Information**   **(800) 366-0476**

INFORMATION	DESCRIPTION	DOCUMENT #
Glossary	Definition of terms related to functions, features and installation of the DP monitor	900203
More Information	Names and addresses of other groups involved in standards and features of the DP monitor	900204
Macintosh Connection	Detailed information on connecting the DP monitor to a Macintosh	153006
Healthy Work Environment	Detailed information on setting up a healthy work environment	900108

- **Literature & Sales Info**   **(800) NEC-INFO [(800) 632-4636]**
- **Mitsubishi Fulfillment**   **(800) 632-4662**
                                [For software & accessories]
- **TeleSales**   **(800) 284-4484**

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Limited Warranty

NEC-Mitsubishi Electronics Display of America, Inc. (hereinafter "NMD-A") warrants this Product to be free from defects in material and workmanship and, subject to the conditions set forth below, agrees to repair or replace (at NMD-A's sole option) any part of the enclosed unit which proves defective for a period of three (3) years from the date of first consumer purchase. Spare parts are warranted for ninety (90) days. Replacement parts or unit may be new or refurbished and will meet specifications of the original parts or unit.

This warranty gives you specific legal rights and you may also have other rights, which vary from state to state. This warranty is limited to the original purchaser of the Product and is not transferable. This warranty covers only NMD-A-supplied components. Service required as a result of third party components is not covered under this warranty. In order to be covered under this warranty, the Product must have been purchased in the U.S.A. or Canada by the original purchaser. This warranty only covers Product distribution in the U.S.A. or Canada by NMD-A No warranty service is provided outside of the U.S.A. or Canada. Proof of Purchase will be required by NMD-A to substantiate date of purchase. Such proof of purchase must be an original bill of sale or receipt containing name and address of seller, purchaser, and the serial number of the product.

It shall be your obligation and expense to have the Product shipped, freight prepaid, or delivered to the authorized reseller from whom it was purchased or other facility authorized by NMD-A to render the services provided hereunder in either the original package or a similar package affording an equal degree of protection. All Products returned to NMD-A for service MUST have prior approval, which may be obtained by calling 1-800-632-4662. The Product shall not have been previously altered, repaired, or serviced by anyone other than a service facility authorized by NMD-A to render such service, the serial number of the product shall not have been altered or removed. In order to be covered by this warranty the Product shall not have been subjected to displaying of fixed images for long periods of time resulting in image persistence (afterimage effects), accident, misuse or abuse or operated contrary to the instructions contained in the User's Manual. Any such conditions will void this warranty.

NMD-A SHALL NOT BE LIABLE FOR DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, OR OTHER TYPES OF DAMAGES RESULTING FROM THE USE OF ANY NMD-A PRODUCT OTHER THAN THE LIABILITY STATED ABOVE. THESE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SOME STATES DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES OR THE LIMITATION OR EXCLUSION OF LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAM-AGES SO THE ABOVE EXCLUSIONS OR LIMITATIONS MAY NOT APPLY TO YOU.

This Product is warranted in accordance with the terms of this limited warranty. Consumers are cautioned that Product performance is affected by system configuration, software, the application, customer data, and operator control of the system, among other factors. While NMD-A Products are considered to be compatible with many systems, specific functional implementation by the customers of the Product may vary. Therefore, suitability of a Product for a specific purpose or application must be determined by consumer and is not warranted by NMD-A.

For the name of your nearest authorized NEC-Mitsubishi Electronics Display of America service facility, contact NEC-Mitsubishi Electronics Display of America at 1-800-632-4662.

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TCO'95

Diamond Plus 74^{SB} Black Model

Congratulations! You have just purchased a TCO'95 approved and labeled product! Your choice has provided you with a product developed for professional use. Your purchase has also contributed to reducing the burden on the environment and also, to the further development of environmentally adapted electronics products.

Why do we have environmentally labelled computers?

In many countries, environmental labelling has become an established method for encouraging the adaptation of goods and services to the environment. The main problem, as far as computers and other electronics equipment are concerned, is that environmentally harmful substances are used both in the products and during the manufacturing. Since it has not been possible for the majority of electronics equipment to be recycled in a satisfactory way, most of these potentially damaging substances sooner or later enter Nature.

There are also other characteristics of a computer, such as energy consumption levels, that are important from the viewpoints of both the work (Internal) and natural (external) environments. Since all methods of conventional electricity generation have a negative effect on the environment (acidic and climate-influencing emissions, radioactive waste, etc.), it is vital to conserve energy. Electronics equipment in offices consume an enormous amount of energy since they are often left running continuously.

What does labelling involve?

This product meets the requirements for the TCO'95 scheme which provides for international and environmental labelling of personal computers. The labelling scheme was developed as a joint effort by the TCO (The Swedish Confederation of Professional Employees), Naturskyddsforeningen (The Swedish Society for Nature Conservation) and NUTEK (The National Board for Industrial and Technical Development in Sweden).

The requirements cover a wide range of issues: environment, ergonomics, usability, emission of electrical and magnetic fields, energy consumption and electrical and fire safety.

The environmental demands concern restrictions on the presence and use of heavy metals, brominated and chlorinated flame retardants, CFCs (freons) and chlorinated solvents, among other things. The product must be prepared for recycling and the manufacturer is obliged to have an environmental plan which must be adhered to in each country where the company implements its operational policy. The energy requirements include a demand that the computer and/or display, after a certain period of inactivity, shall reduce its power consumption to a lower level in one or more stages. The length of time to reactivate the computer shall be reasonable for the user.

Labelled products must meet strict environmental demands, for example, in respect of the reduction of electric and magnetic fields, physical and visual ergonomics and good usability.

TCO'95 is a co-operative project between TCO (The Swedish Confederation of Professional Employees), Naturskyddsforeningen (The Swedish Society for Nature Conservation) and NUTEK (The National Board for Industrial and Technical Development in Sweden).

Environmental Requirements

Brominated flame retardants

Brominated flame retardants are present in printed circuit boards, cables, wires, casings and housings. In turn, they delay the spread of fire. Up to thirty percent of the plastic in a computer casing can consist of flame retardant substances. These are related to another group of environmental

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TCO'95 —*continued*

toxins, PCBs, which are suspected to give rise to similar harm, including reproductive damage in fisheating birds and mammals, due to the bio-accumulative* processes. Flame retardants have been found in human blood and researchers fear that disturbances in foetus development may occur.
TCO'95 demand requires that plastic components weighing more than 25 grams must not contain organically bound chlorine and bromine.

Lead**
Lead can be found in picture tubes, display screens, solders and capacitors. Lead damages the nervous system and in higher doses, causes lead poisoning.
TCO'95 requirement permits the inclusion of lead since no replacement has yet been developed.

Cadmium**
Cadmium is present in rechargeable batteries and in the colourgenerating layers of certain computer displays. Cadmium damages the nervous system and is toxic in high doses.
TCO'95 requirement states that batteries may not contain more than 25 ppm (parts per million) of cadmium. The colourgenerating layers of display screens must not contain any cadmium.

Mercury**
Mercury is sometimes found in batteries, relays and switches, Mercury damages the nervous system and is toxic in high doses.
TCO'95 requirement states that batteries may not contain more than 25 ppm (parts per million) of mercury. It also demands that no mercury is present in any of the electrical or electronics components concerned with the display unit. Mercury is, for the time being, permitted in the back light system of flat panel monitors as there today is no commercially available alternative. TCO aims on removing this exception when a mercury free alternative is available.

CFCs (freons)
CFCs (freons) are sometimes used for washing printed circuit boards and in the manufacturing of expanded foam for packaging. CFCs break down ozone and thereby damage the ozone layer in the stratosphere, causing increased reception on Earth of ultraviolet light with consequent increased risks of skin cancer (malignant melanoma).
The relevant TCO'95 requirement; Neither CFCs nor HCFCs may be used during the manufacturing of the product or its packaging.

*Bio-accumulative is defined as substances which accumulate within living organisms.
**Lead, Cadmium and Mercury are heavy metals which are Bio-accumulative.

To obtain complete information on the environmental criteria document, order from:

    TCO Development Unit
    SE-114 94 Stockholm
    SWEDEN
    FAX Number: +46 8 782 92 07
    E-mail (Internet): development@tco.se

You may also obtain current information on TCO'95 approved and labelled products by visiting their website at: http://www.tco-info.com/

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Declaration of the Manufacturer

We hereby certify that the color monitor Diamond Plus 74^{SB} is in compliance with Council Directive 73/23/EEC:
- EN 60950

Council Directive 89/336/EEC:
EN 55022
- EN 61000-3-2
- EN 61000-3-3
- EN 55024

and marked with

ϵ

NEC-Mitsubishi Electric Visual Systems Corporation
686-1, Nishioi Oi-Machi
Ashigarakami-gun
Kanagawa 258-8533, Japan

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Mitsubishi Diamond Plus74ˢᴮ

PROPRIETARY NOTICE AND LIABILITY DISCLAIMER

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The NEC-Mitsubishi Electronics Display of America product(s) discussed in this document are warranted in accordance with the terms of the Limited Warranty Statement accompanying each product. However, actual performance of each such product is dependent upon factors such as system configuration, customer data and operator control. Since implementation by customers of each product may vary, the suitability of specific product configurations and applications must be determined by the customer and is not warranted by NEC-Mitsubishi Electronics Display of America.

To allow for design and specification improvements, the information in this document is subject to change at any time without notice. Reproduction of this document or portions thereof without prior approval of NEC-Mitsubishi Electronics Display of America is prohibited.

DECLARATION OF CONFORMITY

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions. (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

U.S. Responsible Party: Address:	NEC-Mitsubishi Electronics Display of America, Inc. 1250 N. Arlington Heights Road Itasca, Illinois 60143
Tel. No.:	(630) 467-3000

Type of Product:	Computer Monitor
Equipment Classification:	Class B Peripheral
Models:	N1702

FC

We hereby declare that the equipment specified above
conforms to the technical standards as specified in the FCC Rules.

Windows is a registered trademark of Microsoft Corporation. ENERGY STAR is a U.S. registered trademark.
All other brands and product names are trademarks or registered trademarks of their respective owners.

As an ENERGY STAR® Partner, NEC-Mitsubishi Electronics Display of America, Inc. has determined that this product meets the ENERGY STAR guidelines for energy efficiency. The ENERGY STAR emblem does not represent EPA endorsement of any product or service.

▲ MITSUBISHI

2. B Version

MITSUBISHI

USER'S MANUAL

SuperBright
Diamondtron

Diamond Plus 74SB

MITSUBISHI

Diamond Plus 74SB

www.nec-mitsubishi.com

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Declaration of the Manufacturer

We hereby certify that the colour monitor
Diamond Plus 74^{SB} is in compliance with
Council Directive 73/23/EEC:
– EN 60950
Council Directive 89/336/EEC:
EN 55022
– EN 61000-3-2
– EN 61000-3-3
– EN 55024
and marked with

$$C\,E$$

NEC-Mitsubishi Electric Visual
Systems Corporation
686-1, Nishioi Oi-Machi
Ashigarakami-gun
Kanagawa 258-8533, Japan

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ENERGYSTAR Product

As an ENERGYSTAR Partner, NEC-Mitsubishi Electronics Display of America, Inc. has determined that this product meets the ENERGYSTAR guidelines for energy efficiency. The ENERGYSTAR emblem does not represent EPA endorsement of any product or service.

WARNING

TO PREVENT FIRE OR SHOCK HAZARDS, DO NOT EXPOSE THIS UNIT TO RAIN OR MOISTURE. ALSO, DO NOT USE THIS UNIT'S POLARIZED PLUG WITH AN EXTENSION CORD RECEPTACLE OR OTHER OUTLETS UNLESS THE PRONGS CAN BE FULLY INSERTED.
EFRAIN FROM OPENING THE CABINET AS THERE ARE HIGH VOLTAGE COMPONENTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

CAUTION

RISK OF ELECTRIC SHOCK • DO NOT OPEN

CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER (OR BACK). NO USER SERVICE-ABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

This symbol warns user that uninsulated voltage within the unit may have sufficient magnitude to cause electric shock. Therefore, it is dangerous to make any kind of contact with any part inside this unit.

This symbol alerts the user that important literature concerning the operation and maintenance of this unit has been included. Therefore, it should be read carefully in order to avoid any problems.

Canadian Department of Communications Compliance Statement

DOC: This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

C-UL: Bears the C-UL Mark and is in compliance with Canadian Safety Regulations according to C.S.A. C22.2 No. 950.

FCC Information

1. Use the attached specified cables with the Diamond Plus 74^{SB} colour monitor so as not to interfere with radio and television reception.

   (1) Please use the supplied power cord or equivalent to ensure FCC compliance.

   (2) Shielded captive type signal cable.
      Use of other cables and adapters may cause intereference with radio and television reception.

2. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

   • Reorient or relocate the receiving antenna.

   • Increase the separation between the equipment and receiver.

   • Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

   • Consult your dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

If necessary, the user should contact the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, D.C., 20402, Stock No. 004-000-00345-4.

Diamond Plus 74^{SB}   **3**

Contents

Your new Diamond Plus 74^{SB} monitor box* should contain the following:

- Diamond Plus 74^{SB} Monitor with tilt/swivel base
- Power Cord
- Captive Signal Cable
- User's Manual
- CD ROM with Setup Software, complete User's Manual and other helpful files.
  To see the User's Manual, Acrobat Reader 4.0 must be installed on your PC.

Captive Signal Cable
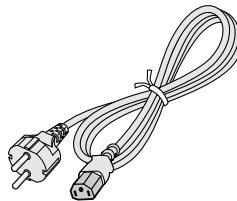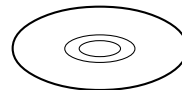
User's Manual   Power Cord   CD-ROM

Remember to save your original box and packing material to transport or ship the monitor.

Quick Start

To attach the Diamond Plus 74[SB] monitor to your system, follow these instructions:

1. Turn off the power to your computer.
2. If necessary, install the display card into your system. For more information, refer to the display card manual.
3. For the PC: Connect the 15-pin mini D-SUB of the captive signal cable to the connector of the display card in your system **(Figure A.1).** Tighten all screws.

   For the Mac: Connect the Diamond Plus 74[SB] Macintosh cable adapter (not included) to the monitor connector on the Macintosh **(Figure B.1).** Attach the 15-pin mini D-SUB end of the captive signal cable to the Diamond Plus 74[SB] Macintosh cable adapter on the computer **(Figure B.1).** Tighten all screws.
4. Connect one end of the power cord to the Diamond Plus 74[SB] monitor and the other end to the power outlet **(Figure C.1).**
5. Turn on the monitor **(Figure D.1)** and the computer.

NOTE: If you have any problems, please refer to the **Troubleshooting** section of this User's Manual.

Figure A.1   Figure B.1

15-pin
mini
D-SUB

Mac Adapter
(Not Included)

Captive Signal Cable   Captive Signal Cable

Quick Start *– continued*

Power Outlet

Power
Cord

Figure C.1

MITSUBISHI

Power Button
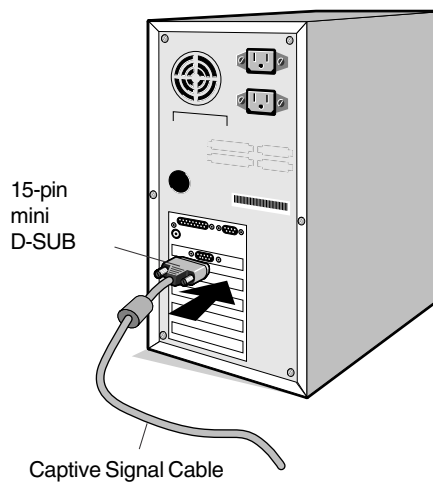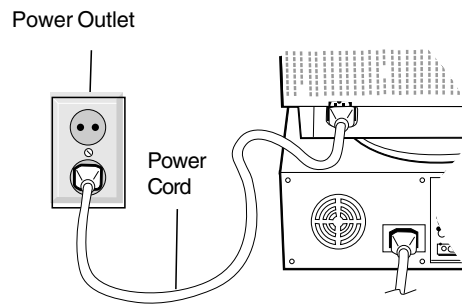
Figure D.1

Controls

OSM (On-Screen Manager) control buttons on the front of the monitor function as follows:

	Main Menu	Sub-Menu
EXIT	Exits the OSM menu.	Exits to the OSM controls main menu.
CONTROL ◀/▶	Moves the highlighted area left/right to select one of the sub-menus.	Moves the highlighted area left/right to select one of the controls.
CONTROL –/+	Has no function.	Moves the bar in the – or + direction to decrease or increase the adjustment.
SELECT/ SBMODE	Without OSD, switches SuperBright Mode ON/OFF With OSD, enters sub menu	Has no function.
RESET	Resets all the controls within the highlighted menu to the factory setting.	Resets the highlighted control to the factory setting.

NOTE: When **RESET** is pressed in the main and sub-menu, a warning window will appear allowing you to cancel the reset function.

NOTE: In SB MODE (SuperBright Mode), ON and OFF is functional when the OSM is not displayed.

☼ ◖ Brightness/Contrast Controls

Brightness: Adjusts the overall image and background screen brightness.

Contrast: Adjusts the image brightness in relation to the background.

Degauss: Eliminates the buildup of stray magnetic fields which alter the correct scan of the electron beams and affect the purity of the screen colours, focus and convergence. When activated, your screen image will jump and waver a bit as the screen is demagnetized.

Caution: Please allow a minimum of 20 minutes to elapse between uses of the Degauss Control.

⊞◆ Size and Position Controls

Left/Right: Moves the image horizontally (left or right).

Down/Up: Moves the image vertically (up or down).

Narrow/Wide: Decreases or increases the horizontal size of the image.

Short/Tall: Decreases or increases the vertical size of the image.

Diamond Plus 74^{SB} **7**

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Controls *– continued*

ⓇⒼⒷ Color Control System

Colour presets selects the desired colour setting. The bar is replaced by the colour setting choice. Each colour setting is adjusted at the factory to the stated Kelvin. If a setting is adjusted, the name of the setting will change from Kelvin to Custom except sRGB mode.

Red, Green, Blue: Color Control System decreases or increases the monitor's red, green or blue colour guns depending upon which is selected. The change in colour will appear on screen and the direction (decrease or increase) will be shown by the bars.

sRGB mode: sRGB mode provides the suitable colour managed picture image. You can not change Red, Green and Blue colours, brightness and contrast individually.

Colour Temperature Adjustment: Adjusts the colour temperature of the screen image.

Geometry Controls

Geometry Controls Menu

The **Geometry** controls allow you to adjust the curvature or angle of the sides of your display.

Sides In/Out (pincushion): Decreases or increases the curvature of the sides either inward or outward.

Sides Left/Right (pincushion balance): Decreases or increases the curvature of the sides either to the left or right.

Sides Tilt (parallelogram): Decreases or increases the tilt of the sides either to the left or right.

Sides Align (trapezoidal): Decreases or increases the bottom of the screen to be the same as the top.

Rotate (raster rotation): Rotates the entire display clockwise or counterclockwise.

Tools 1

Moiré Canceler: Moiré is a wavy pattern which can sometimes appear on the screen. The pattern is repetitive and superimposed as rippled images. When running certain applications, the wavy pattern is more evident than in others. To reduce moiré, adjust the level by using –/+ CONTROL buttons.

Tools 2

Language: OSM controls menus are available in 6 languages.

OSM Position: You can choose where you would like the OSM controls menu to appear on your screen. Selecting OSM Position allows you to manually adjust the OSM controls menu position from among Center, Top left, Top right, Bottom left and Bottom right.

OSM Turn Off: The OSM controls menu will stay on as long as it is in use. In the OSM Turn Off sub-menu, you can select how long the monitor waits after the last touch of a button for the OSM controls menu to disappear. The preset choices are 5 thru 120 seconds.

Controls *– continued*

OSM Lock Out: This control completely locks out access to all OSM controls functions except Brightness and Contrast. When attempting to activate OSM controls while in the lock out mode, a screen will appear indicating that OSM controls are locked out. To activate the OSM Lock Out function, press SELECT and hold + down simultaneously. To deactivate the OSM Lock Out, press SELECT and hold + down simultaneously.

IPM System Off Mode:	Enable:	The IPM System works normally and all stages of energy savings are utilized.
	Disable:	The Off Mode of the IPM System is not used.

NOTE: For standard systems and graphics boards, keep the factory setting at ENABLE.

Factory Preset: Selecting Factory Preset allows you a reset most OSM control settings back to the factory settings. A warning statement will appear to confirm that you do want to reset ALL settings. Individual settings can be reset by highlighting the control to be reset and pressing the **RESET** button.

ℹ Information

Display Mode: Indicates the current mode and frequency setting of the monitor.

Monitor Info: Indicates the model and serial numbers of your monitor.

Refresh Notifier: A message will advise you if the refresh rate of the signal being applied to the monitor by the computer is too low. For further information, please refer to your display card or system manual.

Recommended Use

Safety Precautions and Maintenance

FOR OPTIMUM PERFORMANCE, PLEASE NOTE THE FOLLOWING WHEN SETTING UP AND USING THE DIAMOND PLUS 74ᔆᔆ COLOUR MONITOR:

- DO NOT OPEN THE MONITOR. There are no user serviceable parts inside and opening or removing covers may expose you to dangerous shock hazards or other risks. Refer all servicing to qualified service personnel.
- Do not spill any liquids into the cabinet or use your monitor near water.
- Do not insert objects of any kind into the cabinet slots, as they may touch dangerous voltage points, which can be harmful or fatal or may cause electric shock, fire or equipment failure.
- Do not place any heavy objects on the power cord. Damage to the cord may cause shock or fire.
- Do not place this product on a sloping or unstable cart, stand or table, as the monitor may fall, causing serious damage to the monitor.
- Keep the monitor away from high capacity transformers, electric motors and other devices such as external speakers or fans, which may create strong magnetic fields.
- If possible, position the monitor so that it is facing the east to minimize the effects of the earth's magnetic field.
- Changing the direction of the monitor while it is powered on may cause image discolouration. To correct this, turn the monitor off for 20 minutes before powering it back on.
- When operating the Diamond Plus 74ˢᴮ with its AC 220 - 240 V worldwide power supply, use a power supply cord that matches the power supply voltage of the AC power outlet being used. The power supply cord you use must have been approved by and comply with the safety standards of your country. (Type H05VV-F should be used except in UK)
- In UK, use a BS-approved power cord with molded plug having a black (5A) fuse installed for use with this monitor. If a power cord is not supplied with this monitor, please contact your supplier.

Cleaning Your Monitor

A special coating is provided on the glass (CRT) surface of this monitor to reduce a reflection and static electricity on the glass surface. Due to the delicate coating on the glass surface, use a lint-free, non-abrasive cloth (cotton or equivalent) and a non-alcohol, neutral, non-abrasive cleaning solution to minimize dust. If the screen requires more than a light cleaning, apply a soft neutral detergent and water directly to a soft cloth and use it upon wringing water, to clean the glass surface. Clean your monitor regularly.

CAUTION: The following agents will cause damage to the CRT when cleaning the glass surface:
Benzene, thinner, acid/alkaline detergent, alcohol detergent, detergent with abrasive powder, detergent with anti-static agent, detergent for cleaning.

Immediately unplug your monitor from the wall outlet and refer servicing to qualified service personnel under the following conditions:

- When the power supply cord or plug is damaged.
- If liquid has been spilled, or objects have fallen into the monitor.
- If the monitor has been exposed to rain or water.
- If the monitor has been dropped or the cabinet damaged.
- If the monitor does not operate normally by following operating instructions.

CAUTION

- Allow adequate ventilation around the monitor so that heat can properly dissipate. Do not block ventilated openings or place the monitor near a radiator or other heat sources. Do not put anything on top of monitor.
- The power cable connector is the primary means of detaching the system from the power supply. The monitor should be installed close to a power outlet which is easily accessible.
- Handle with care when transporting. Save packaging for transporting.

Recommended Use – *continued*

CORRECT PLACEMENT AND ADJUSTMENT OF THE MONITOR CAN REDUCE EYE, SHOULDER AND NECK FATIGUE. CHECK THE FOLLOWING WHEN YOU POSITION THE MONITOR:

- Adjust the monitor height so that the top of the screen is at or slightly below eye level. Your eyes should look slightly downward when viewing the middle of the screen.
- Position your monitor no closer than 40 cm and no further away than 60 cm from your eyes. The optimal distance is 50 cm.
- Rest your eyes periodically by focusing on an object at least 6 meter away. Blink often.
- Position the monitor at a 90° angle to windows and other light sources to minimize glare and reflections. Adjust the monitor tilt so that ceiling lights do not reflect on your screen.
- If reflected light makes it hard for you to see your screen, use an anti-glare filter.
- Clean your monitor regularly. Use a lint-free, non-abrasive cloth and a non-alcohol, neutral, non-abrasive cleaning solution or glass cleaner to minimize dust.
- Adjust the monitor's brightness and contrast controls to enhance readability.
- Use a document holder placed close to the screen.
- Position whatever you are looking at most of the time (the screen or reference material) directly in front of you to minimize turning your head while you are typing.
- Get regular eye checkups.

Ergonomics

To realize the maximum ergonomics benefits, we recommend the following:

- Adjust the Brightness until the background raster disappears
- Do not position the Contrast control to its maximum setting
- Use the preset Size and Position controls with standard signals
- Use the preset Colour Setting and Sides Left/Right controls
- Use non-interlaced signals with a vertical refresh rate between 75 - 120 Hz
- Do not use primary colour blue on a dark background, as it is difficult to see and may produce eye fatigue due to insufficient contrast

Specifications

Monitor Specifications		Diamond Plus 74^{SB} Monitor	Notes
Picture Tube	Diagonal:	43 cm/17 inch	90° deflection, 0.25 mm grille pitch, medium short persistence phosphor, aperture grille CRT, multi-layered, anti-static screen coating, dark-tint screen and OptiClear screen.
	Viewable Image Size:	406 mm/16 inch	
Input Signal	Video: Sync:	ANALOG 0.7 Vp-p/75 Ohms Separate sync. TTL Level Horizontal sync. Positive/Negative Vertical sync. Positive/Negative Composite sync. (Positive/Negative) (TTL Level)	
Display Colours	Analog input:	Unlimited number of Colours	Depends on display card used.
Synchronization	Horizontal:	30 kHz to 70 kHz	Automatically
Range	Vertical:	50 Hz to 120 Hz	Automatically
Resolutions Supported Resolution based on horizontal and vertical frequencies only		640 x 480 @ 60 to 120 Hz 800 x 600 @ 50 to 110 Hz 832 x 624 @ 50 to 106 Hz 1024 x 768 @ 50 to 87 Hz .... 1152 x 864 @ 50 to 77 Hz 1280 x 1024 @ 50 to 66 Hz	Some systems may not support all modes listed. NEC-Mitsubishi Electronics Display cites recommended resolution at 85 Hz for optimal display performance
Active Display Area (Factory Setting)	Horizontal: Vertical:	315 mm/12.4 inches 236 mm/9.3 inches	Dependent upon signal timing used, and does not include border area.
Active Display Area (Full Scan)		325 mm/12.8 inches 244 mm/9.6 inches	Dependent upon signal timing used, and does not include border area.
Power Supply		AC 100 - 240 V, 50 - 60 Hz	
Current Rating		1.5A @ 100 - 240 V	
Dimensions		397 mm (W) x 392 mm (H) x 415.5 mm (D) 15.6 inches (W) x 15.4 inches (H) x 16.4 inches (D)	
Weight		16.8 kg 37.0 lbs	
Environmental Considerations			
	Operating Temperature:	+5 °C to +35 °C	
	Humidity:	10 % to 90 %	
	Feet:	0 to 3,000	
	Storage Temperature:	-20 °C to +60 °C	
	Humidity:	10 % to 90 %	
	Feet:	0 to 15,000 Feet	

NOTE: Technical specifications are subject to change without notice.

Features

SuperBright Diamondtron CRT: This patented flat aperture grille CRT delivers an exceptional viewing experience with unprecedented brightness and contrast and a virtually flat image that reduces distortion and glare so that what you see on-screen is what you get on your printed output. The state-of-the-art Mitsubishi PX-DBF electron gun and tight 0.25 mm grille pitch delivers precise focus for crisp, clear text and images.

SuperBright Mode: With the simple touch of a button, the brightness level of the Diamondtron CRT doubles. This function enhances the crispness of images for clarity-conscious applications such as graphics, animation and video

OptiClear Screen Surface: Further reduces reflection and glare and increases contrast without sacrificing focus level, clarity or brightness.

Dual Dynamic Beam Focus: Provides precise, continuous focus adjustments of the electron beams and optimum image quality, even to the far edges of the screen.

Color Control System with sRGB: Allows you to change between five colour settings on your display to match your personal preference. The sRGB-enabled colour matching setting found within Color Control helps achieve a consistent colour environment with other sRGB-enabled hardware and software applications.

On Screen Manager (OSM) Controls: Allows you to quickly and easily adjust all elements of your screen image via simple to use on-screen menus.

ErgoDesign Features: Enhances human ergonomics to improve the working environment, protect the health of the user and save money. Examples include OSM controls for quick and easy image adjustments, tilt/swivel base for preferred angle of vision, space-conscious cabinet design and compliance with MPRII guidelines for lower emissions.

Plug and Play: The Microsoft solution with the Windows 95/98/Me/2000/XP operating system facilitates setup and installation by allowing the monitor to send its capabilities (such as screen size and resolutions supported) directly to your computer, automatically optimizing display performance.

Intelligent Power Manager (IPM) System: Provides innovative power-saving methods that allow the monitor to shift to a lower power consumption level when on but not in use, saving two-thirds of your monitor energy costs, reducing emissions and lowering the air conditioning costs of the workplace.

Reduced Magnetic Field Technology: Reduces magnetic and alternating electric field emissions and static electricity, addressing ergonomic concerns regarding potential risks from extended computer monitor use.

Multiple Frequency Technology: Automatically adjusts monitor to the display card's scanning frequency, thus displaying the resolution required.

FullScan Capability: Allows you to use the entire screen area in most resolutions, significantly expanding image size.

Diamond Plus 74^{SB} **13**

Troubleshooting

No picture
- Display card should be completely seated in its slot.
- Power Button and computer power switch should be in the ON position.
- Signal cable should be completely connected to display card/computer.
- Check connector for bent or pushed-in pins.

Image is scrolling or unstable
- Signal cable should be completely attached to the computer.
- Check pin assignments and signal timings of the monitor and your display card with respect to recommended timings and pin assignments.
- If the Macintosh cable adapter is used, check for proper connection or make sure the display card is Macintosh compatible and that the card is properly seated in the computer.

LED on monitor is not lit *(no green, orange colour can be seen)*
- Power Switch should be in the ON position and power cord should be connected.

Picture is fuzzy or colour looks blotchy
- Adjust Brightness and Contrast Controls or adjust the Moiré Canceler control.
- Access the Degauss Control through OSM controls. Activate the Degauss Control.
  CAUTION: A minimum interval of 20 minutes should elapse before the Deguass Control is used a second time when not switching between modes.

Picture bounces or a wavy pattern is present in the picture
- Move electrical devices that may be causing electrical interference away from the monitor.
- See inside cover of User's Manual for FCC information.

Edges of the display image are not square
- Use the OSM Geometry Controls to straighten the edges.
- If possible, position the front of the monitor facing east.

Display image is not centered, too small, or too large
- Use the OSM Size and Position Controls to adjust the image.

Thin lines appear on your screen
- Thin lines are normal for an aperture grille CRT and are not a malfunction.
  These are shadows from the damper wires used to stabilize the aperture grille and are most noticeable when the screen's background is light (usually white).

Black vertical lines are visible on the screen
- Thin vertical black lines on one or both sides of the screen. This minor condition is caused by grille element overlap which can occur during shipping.
- Position an open white window over the affected area of the screen and maximize the brightness and contrast controls. This will cause localized heating of the overlap which will clear in a few minutes. Be sure to readjust the brightness and contrast controls back to the normal viewing level after this procedure.

TCO'99

Diamond Plus 74^{SB}

Congratulations! You have just purchased a TCO'99 approved and labeled product! Your choice has provided you with a product developed for professional use. Your purchase has also contributed to reducing the burden on the environment and also to the further development of environmentally adapted electronics products.

Why do we have environmentally labelled computers?

In many countries, environmental labelling has become an established method for encouraging the adaptation of goods and services to the environment. The main problem, as far as computers and other electronics equipment are concerned, is that environmentally harmful substances are used both in the products and during the manufacturing. Since it has not been possible for the majority of electronics equipment to be recycled in a satisfactory way, most of these potentially damaging substances sooner or later enter Nature.

There are also other characteristics of a computer, such as energy consumption levels, that are important from the viewpoints of both the work (Internal) and natural (external) environments. Since all methods of conventional electricity generation have a negative effect on the environment (acidic and climate-influencing emissions, radioactive waste, etc.), it is vital to conserve energy. Electronics equipment in offices consume an enormous amount of energy since they are often left running continuously.

What does labelling involve?

This product meets the requirements for the TCO'99 scheme which provides for international and environmental labelling of personal computers. The labelling scheme was developed as a joint effort by the TCO (The Swedish Confederation of Professional Employees), Svenska Naturskyddsforeningen (The Swedish Society for Nature Conservation) and Statens Energimyndighet (The Swedish National Energy Administration).

The requirements cover a wide range of issues: environment, ergonomics, usability, emission of electrical and magnetic fields, energy consumption and electrical and fire safety.

The environmental demands concern restrictions on the presence and use of heavy metals, brominated and chlorinated flame retardants, CFCs (freons) and chlorinated solvents, among other things. The product must be prepared for recycling and the manufacturer is obliged to have an environmental plan which must be adhered to in each country where the company implements its operational policy. The energy requirements include a demand that the computer and/or display, after a certain period of inactivity, shall reduce its power consumption to a lower level in one or more stages. The length of time to reactivate the computer shall be reasonable for the user.

Labelled products must meet strict environmental demands, for example, in respect of the reduction of electric and magnetic fields, physical and visual ergonomics and good usability.

Environmental Requirements

Flame retardants

Flame retardants are present in printed circuit boards, cables, wires, casings and housings. In turn, they delay the spread of fire. Up to thirty percent of the plastic in a computer casing can consist of flame retardant substances. Most flame retardants contain bromine or chloride and these are related to another group of environmental toxins, PCBs, which are suspected to give rise to severe health effects, including reproductive damage in fisheating birds and mammals, due to the bioaccumulative* processes. Flame retardants have been found in human blood and researchers fear that disturbances in foetus development may occur.

TCO'99 – *continued*

TCO'99 demand requires that plastic components weighing more than 25 grams must not contain flame retardants with organically bound chlorine and bromine. Flame retardants are allowed in the printed circuit boards since no substitutes are available.

Lead**

Lead can be found in picture tubes, display screens, solders and capacitors. Lead damages the nervous system and in higher doses, causes lead poisoning.

TCO'99 requirement permits the inclusion of lead since no replacement has yet been developed.

Cadmium**

Cadmium is present in rechargeable batteries and in the colourgenerating layers of certain computer displays. Cadmium damages the nervous system and is toxic in high doses.

TCO'99 requirement states that batteries, the colourgenerating layers of display screens and the electrical or electronics components must not contain any cadmium.

Mercury**

Mercury is sometimes found in batteries, relays and switches, Mercury damages the nervous system and is toxic in high doses.

TCO'99 requirement states that batteries may not contain any Mercury. It also demands that no mercury is present in any of the electrical or electronics components associated with the display unit.

CFCs (freons)

CFCs (freons) are sometimes used for washing printed circuit boards. CFCs break down ozone and thereby damage the ozone layer in the stratosphere, causing increased reception on Earth of ultraviolet light with consequent increased risks of skin cancer (malignant melanoma).

The relevant TCO'99 requirement; Neither CFCs nor HCFCs may be used during the manufacturing and assembly of the product or its packaging.

* Bio-accumulative is defined as substances which accumulate within living organisms.

** Lead, Cadmium and Mercury are heavy metals which are Bio-accumulative.

To obtain complete information on the environmental criteria document, order from:

TCO Development Unit
SE-114 94 Stockholm
SWEDEN
FAX Number: +46 8 782 92 07
E-mail (Internet): development@tco.se

You may also obtain current information on TCO'99 approved and labelled products by visiting their website at: http://www.tco-info.com/

Serial Number Information

Refer to the serial number information shown below.

EX.) SERIAL NUMBER LABEL

Model   : DPLUS74SB
             : DPLUS74SB-BK

SERIAL NO. :

■ ■ ■ ■ ■ ■ ■ ■ ■
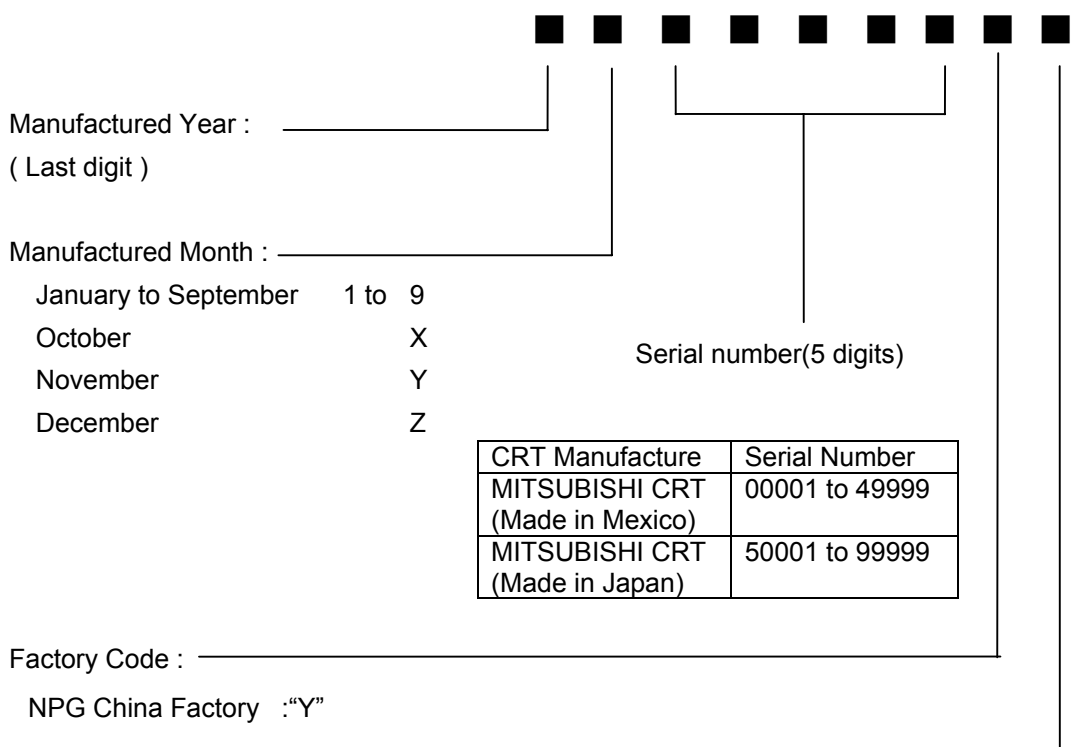
Manufactured Year :
(Last digit)

Manufactured Month :
   January to September   1 to 9
   October   X
   November   Y
   December   Z

Serial number(5 digits)

CRT Manufacture	Serial Number
MITSUBISHI CRT (Made in Mexico)	00001 to 49999
MITSUBISHI CRT (Made in Japan)	50001 to 99999

Factory Code :
   NPG China Factory   :"Y"

Destination Code :
USA   : "A"
Europe   : "B"

DISASSEMBLY

- Before you disassemble the set, turn off power and pull out the power plug.

- Use the appropriate screwdrivers that first the screws. If you use screwdriver that does not fit, you may break the screws.

- Assembly is the opposite process of Disassembly.

- Carefully discharge the CRT anode potential by grounding to coating dag before removing Anode Cap.

Revolving Stand ASSY

1. Turn the monitor CRT face down on a clean static free surface to prevent scratching CRT face.

2. Remove with pulling up a Hooks and lifting a Revolving stand Assy to the upside.

HOOK

Revolving stand Assy
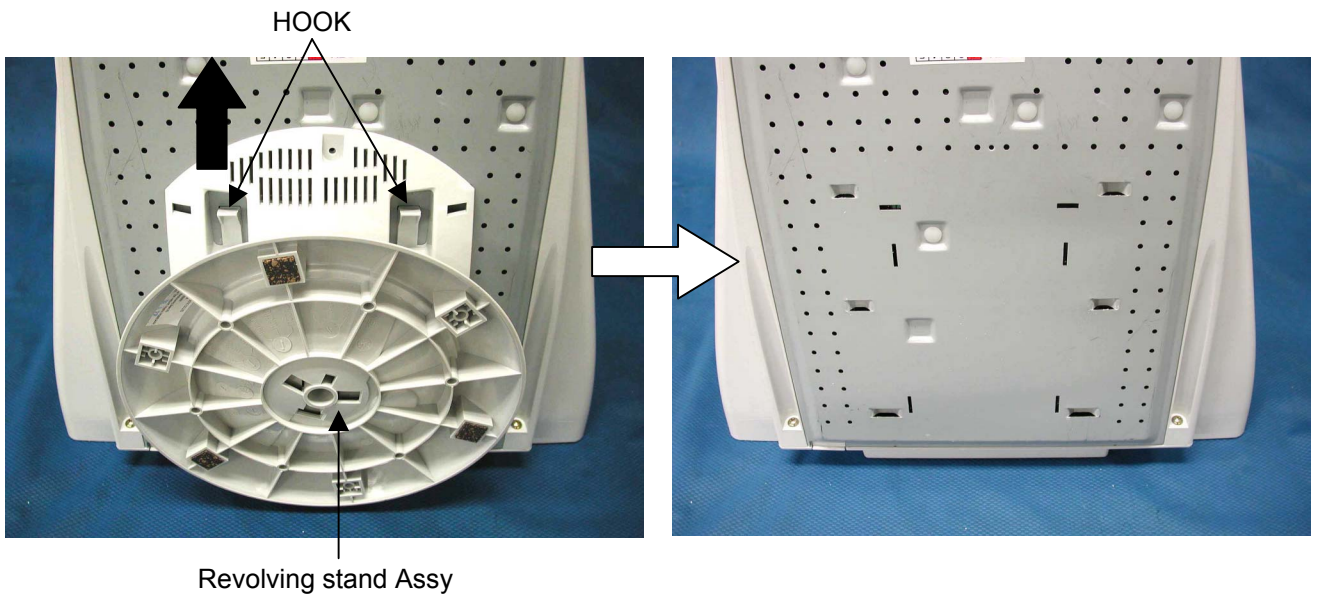
Cabinet Back

1. Remove the two screws (#2CBRITS*4*12*15BF).

screws (#2CBRITS*4*12*15BF)
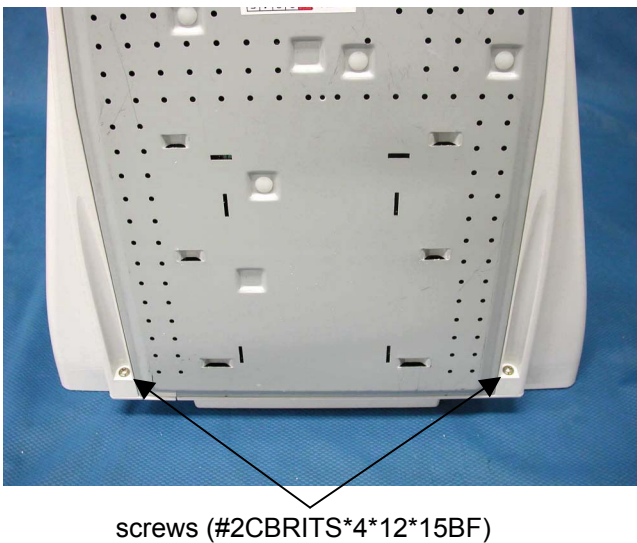
CRT BOARD

1. Five terminals are removed, and six solder is removed.

terminals   ◯ solder
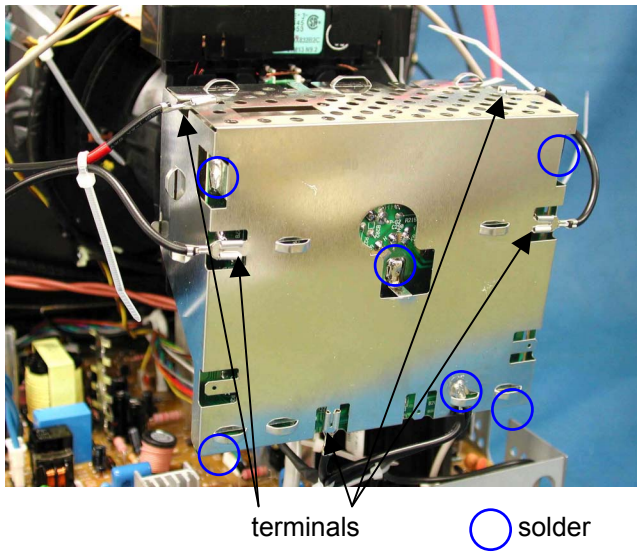
2. Disconnect the connectors "S201", "S202", "S203" and "GND".

3. Unsolder the wires "White wire", "Red wire" and "Gray wire".

GND   S202   S201   S203

Gray wire   White wire   Red wire
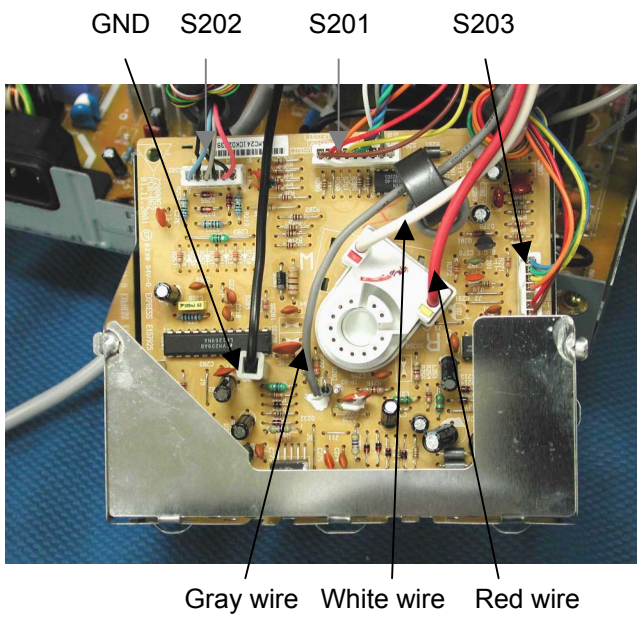
MAIN BOARD

1. Disconnect the connectors "S102", "S701" and "CRT PWB (GND)".

2. Remove the screw (PL-CPTS*3*8*15BF).
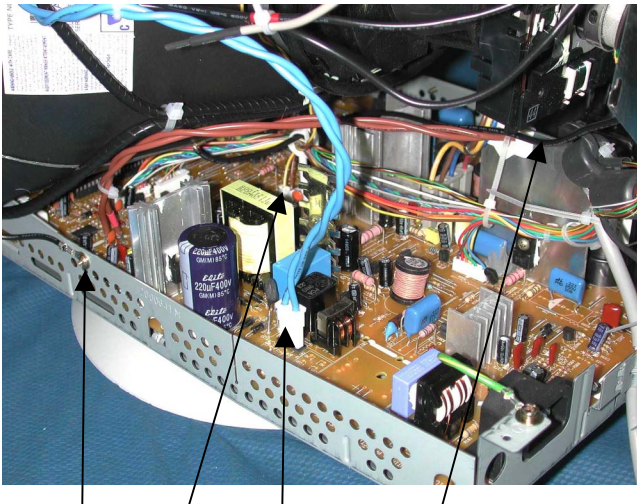
Screw   S701   S102   CRT PWB (GND)

3. Remove the two screws (PL-CPTS*3*8*15BF) and screw (PL-CPIMS*4*10*15BF).
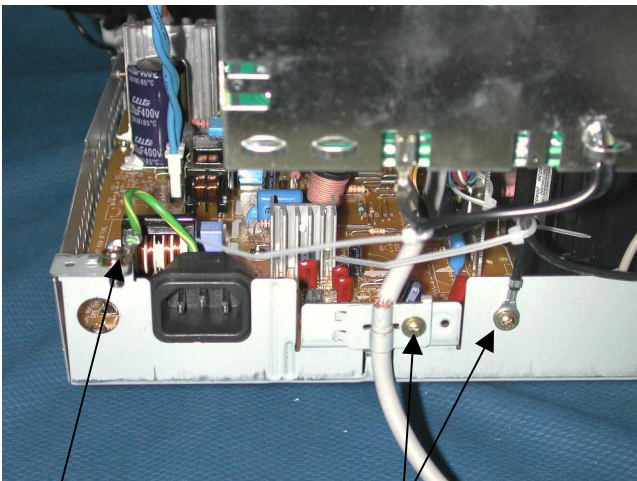
Screw
(PL-CPIMS*4*10*15BF)

Screw
(PL-CPTS*3*8*15BF)

4. Cut the three Ties and disconnect the connectors "TPC" and "S301".

5. Remove the screw (PL-CPTS*3*8*15BF).

6. Remove the Anode cap from CRT.

   NOTE: Carefully discharge the CRT anode by shorting it to ground before removing anode cap.
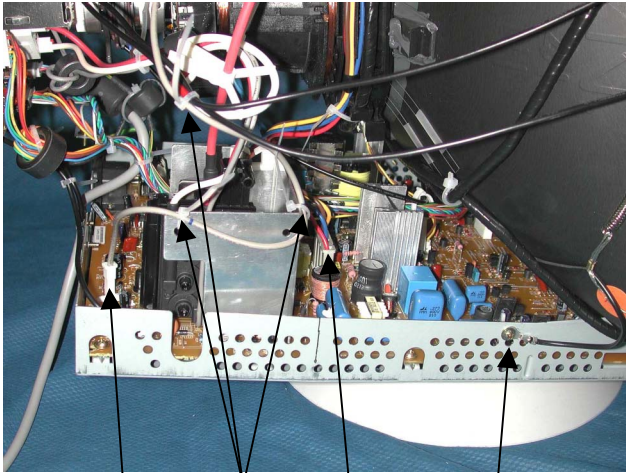
TPC   Ties   S301   Screw

7. Remove the two screws (#2CBRITS*4*12*15BF) and remove the Chassis Base from Cabinet Front ASSY.
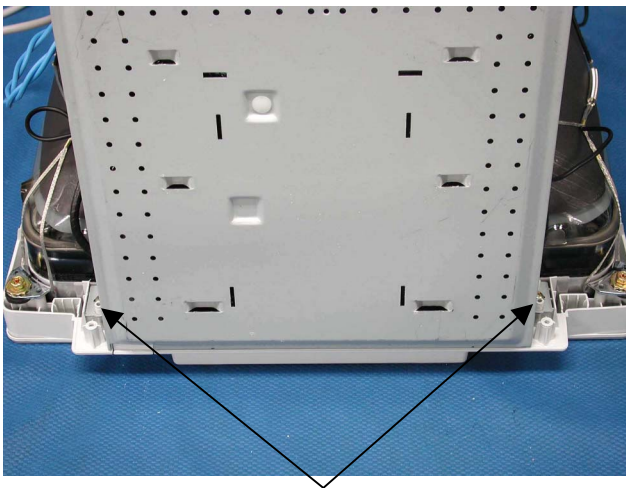
screw (#2CBRITS*4*12*15BF)

8. Remove the eight screws (PL-CPTS*3*8*15BF) and remove the Main Board from Chassis Base.
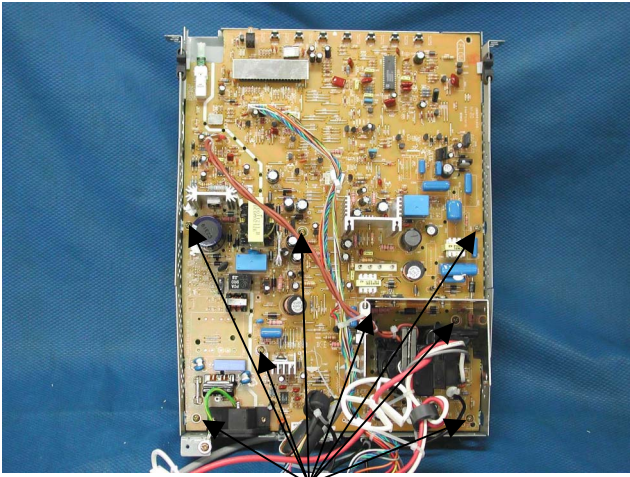
screw (PL-CPTS*3*8*15BF)

ADJUSTMENT PROCEDURES

TABLE OF CONTENTS

1. Adjustment & Inspection Tools

(A) Color Analyzer   (B) Signal Generator CHROMA 2135 or compatible

(C) Multi Meter   (D) Hi-Voltage Probe

(E) Convergence Meter   (F) Degaussing Probe

(G) Power Meter   (H) Automatic Alignment system

2. Timing Table (Factory Mode –20 Modes)

MODE	RESOLUTION	H-SYNC EREQ.	V-SYNC FREQ	H . POLARITY	V . POLARITY
1	VGA350	31.5KHz	70Hz	+	-
2	VGA400	31.5KHz	70Hz	-	+
3	VGA480	31.5KHz	60Hz	-	-
4	MACII35K	35.0KHz	66Hz	-	-
5	800*600(56)	35.2KHz	56Hz	+	+
6	8514A	35.5KHz	87Hz	+	+
7	640*480(75)	37.5KHz	75Hz	-	-
8	EVGA400	37.8KHz	84Hz	-	+
9	800*600(60)	37.8KHz	60Hz	+	+
10	640*480	43.3KHz	85Hz	-	-
11	800*600(75)	46.8KHz	75Hz	+	+
12	1024*768(60)	48.3KHz	60Hz	-	-
13	MACII 49K	49.7KHz	74Hz	-	-
14	800*600(85)	53.6KHz	85Hz	+	+
15	1024*768(70)	56.4KHz	70Hz	-	-
16	1024*768(75)	60.0KHz	75Hz	+	+
17	640*480(120)	63.7KHz	120Hz	-	-
18	1280*1024(60)	64.0KHz	60Hz	+	+
19	800*600(100)	64.0KHz	100Hz	+	+
20	1024*768(85)	68.6KHz	85Hz	+	+

3. Normal Condition Definition

(A) Input AC Voltage 110V/60Hz.

(B) Warm up time minimum 30 minutes.

(C) Full White Pattern.

(D) All VR's adjust to Center Position.

(F) Color temp 9300K

4. Hot Key Operation

(A) Factory Mode: power on + '+' key + '-' key.

   *To hide the Factory menu temporary in Factory mode:

     Push "RESET" key once while Menu is displayed, then Menu disappears.

     Push "RESET" key once more, then Menu reappears.

(B) Auto Alignment Mode: power on + '-' key.

(C) Diagnosis Mode : no sync power on + 'Reset' key.

(D) Factory Menu

TAB 1) BRIGHTNESS / CONTRAST
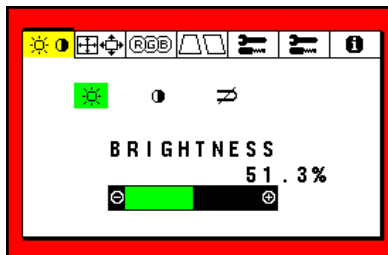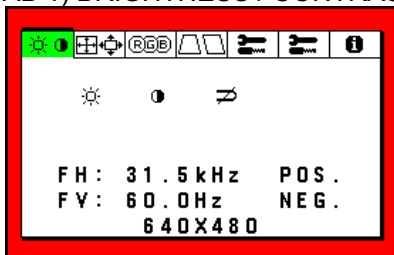
☼ : Brightness
◗ : Contrast

TAB 2) POSITION / SIZE
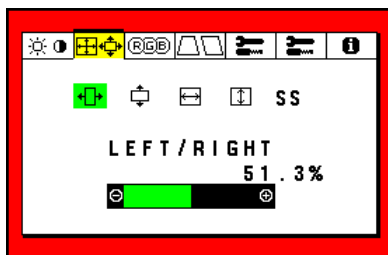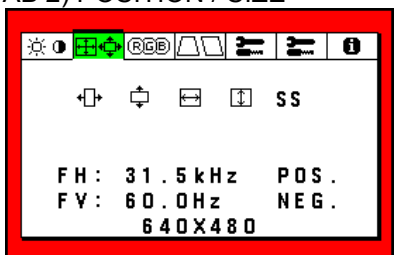
◄⎐► : Left / Right (H.Position)
⎐ : Down / Up (V.Position)
⬌ : Narrow / Wide (H.Size)
⬍ : Short / Tall (V.Size)
S S : Sub Size (Sub H. size)

TAB 3) COLOR ADJUST
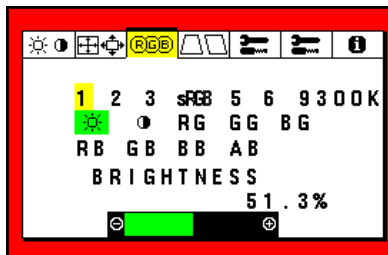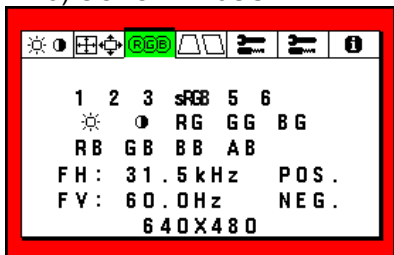
1: 9300K
2: 8200K
3: 7500K
sRGB: sRGB
5: 5000K
6: N/A

☼ : Brightness
◗ : Contrast
R G : Red Gain
G G : Green Gain
B G : Blue Gain
R B : Red Bias
G B : Green Bias
B B : Blue Bias
A B : ABL Adjust

TAB 4) DISTORTION
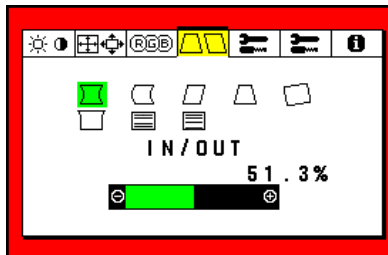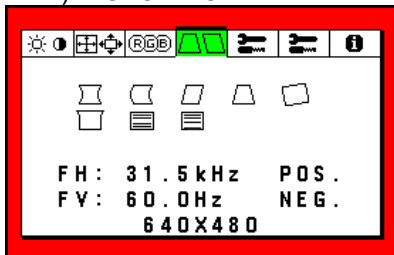
⊐⊏ : In / Out (Side Pincushion)
⊏ : Left / Right (Pin Balance)
⊐ : Tilt (Parallelogram)
⊿ : Align (Trapezoid)
◯ : Rotate
⊔ : Top / Bottom Corner
☰ : Vertical Linearity
☰ : Vertical Linearity Balance

TAB 5) TOOLS 1
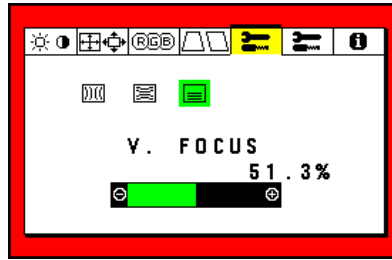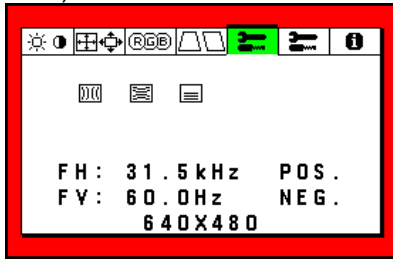
⊟: Vertical Focus

TAB 7) INFORMATION
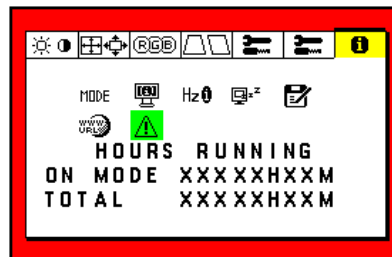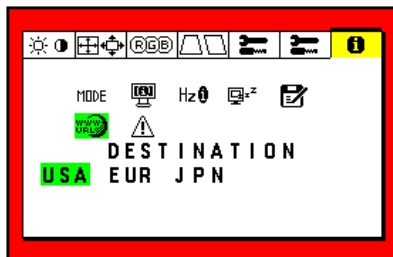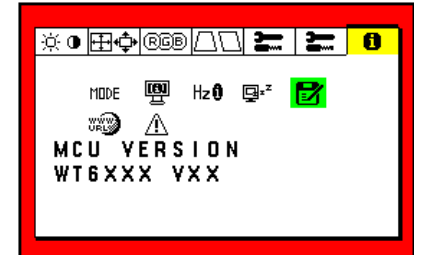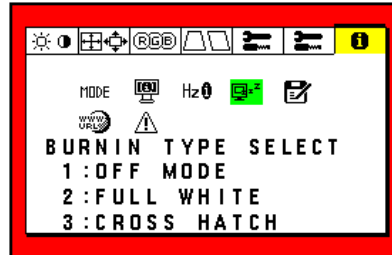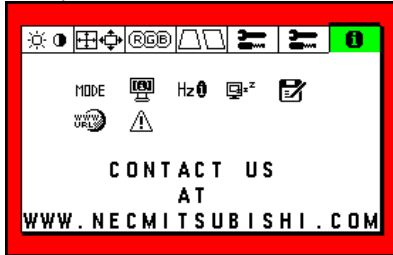
🖳ˣᶻ: Burnin Type Select
🗒: MCU Version
URL: Destination
⚠: Hours Running

5. B+ Check

(A) Mode: No.12.

(B) Pattern: Full White. (Brightness set to cut off)

(C) Check other power sources are: 82V ±2V, 13.6V ±0.3V, 6.2V ±0.3V, 49V ±1.5V, -11.5V ±0.5V.

6. X-RAY Test

(A) Mode: No.12

(B) Pattern: Normal Crosshatch (Brightness just cut off)

(C) Test

Apply a resistor(39K, 1/4W, 1%) between TP3 and TP4 then power on, Monitor should be active in X-Ray protector.

7. H. V. B+ Confirmation

(A) Mode: No.12

(B) Pattern: Full Black(Brightness just cut off)

(C) Check that the high voltage is 25.5kV ±0.7kV.

8. H-Raster Center Adjustment

(A) Mode: No.18

(B) Pattern: Crosshatch Reverse

(C) Adjust the Brightness Control so that the background is visible.

(D) Change SW301 position to center background raster.

9. Preset Picture Size and position Adjustment

(A) Factory mode setting

(B) Signal: All signals   Pattern: Cross hatch

     * Perform the preset picture size and position adjustment for above all signals.

(C) Select the "⟷" icon, then set to 70%.

(D) Select the '⊹▱' , "⇕" , "**S S**" , "⬚" " icon in OSM TAB 2.

(E) Adjust the picture size and position as listed below by "−" and "+" SW.

Picture size

    H: 315 ±2mm

    V: 236 ±2mm

Picture position

    H: $|(X_{TOP}-X_{BOTTOM})| \leq 3mm$

    V: $|X_{LEFT}-X_{RIGHT})| \leq 3mm$
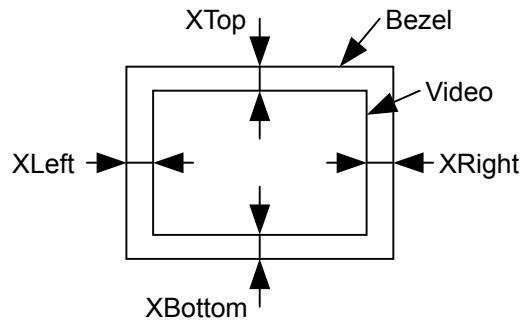
10. White Balance adjustment

(A) Setting

    Enter Factory Mode,

    Mode: No.20, Pattern: Full White.

    Warm up 60 min.

    Make External Degauss.

(B) Cut Off Adjustment

    1. Select the color Mode 9300K.

    2. Cut Off Adjustment : Video Signal Off(0.Vp-p),Bright Control set to Max.

    3. R.Bias, G.Bias and B.Bias set to 34.9%.

    4. Adjust the VR307, at the Brightness 3.4~5.1 cd/m^2 , setting.

    5. 9300K (Select color Mode 9300)
      Adjust R.Bias, B.Bias to make x=283, y=297, with readjusting G2 to keep the brightness between 3.4~5.1cd/m^2 .

(C) "9300K, 8200K, 7500K, 5000K MODE" White Balance Adjustment

    1. 9300K (Select color Mode 9300K)

      1) 50*50mm Green block Pattern, Brightness Control set to Max., Contrast Control set to Max, Adjust G.Gain control to Y=154cd/m^2 .

      2) Video signal off (0.Vp-p), Brightness control set to 0.2cd/m^2 .

3) Adjust R.Gain control and B.Gain control to x=283, y=297 (Pattern: Full White).

2. 8200K (Select color Mode 8200K)

1) 50*50mm Green block Pattern, Brightness Control set to Max., Contrast Control set to Max, Adjust G.Gain control to Y=154cd/m^2 .

2) Video signal off 0.Vp-p), Brightness control set to 0.2cd/m^2.

3) Adjust R.Gain control and B.Gain control to x=290, y=313 (Pattern: Full White).

3. 7500K (Select color Mode 7500K)

1) 50*50mm Green block Pattern, Brightness Control set to Max., Contrast Control set to Max, Adjust G.Gain control to Y=154cd/m^2 .

2) Video signal off (0.Vp-p), Brightness control set to 0.2cd/m^2.

3) Adjust R.Gain control and B.Gain control to x=300, y=315 (Pattern: Full White).

4. 5000K (Select color Mode 5000K)

1) 50*50mm Green block Pattern, Brightness Control set to Max., Contrast Control set to Max, Adjust G.Gain control to Y=154cd/m^2 .

2) Video signal off (0 Vp-p), Brightness control set to 0.2cd/m^2.

3) Adjust R.Gain control and B.Gain control to x=345, y=359 (Pattern: Full White).

5. ABL Adjustment and Brightness Preset

1) Color set to 9300K. Pattern is Full White.

2) Brightness, contrast control to max., Adjust "AB" to Y=103cd/ m^2.

3) Brightness preset: set to 1. 2) position –40 steps.

(D) "sRGB MODE" White Balance Adjustment (Select color Mode sRGB)

1) Contrast set to Max., Adjust Brightness to Max.

2) Change Pattern to 50*50mm Green block, Adjust G.Gain control to Y=154cd/m^2.

3) Video Signal off (0.Vp-p), Adjust Brightness to 0.1 cd/m^2.

4) Change Pattern to 50 *50 mm White block, Adjust R.Gain and B.Gain to control to x=313, y=329.

5) Adjust contrast control to Y=96 cd/m^2.

Note: Do not readjust the Contrast control at sRGB mode after W/B adjustment finish.

(E) "SB MODE" White Balance Adjustment (Select the color Mode SB MODE)

   1) Select the color mode "SB Mode".

   2) Video signal off (0Vp-p), Adjust brightness to 0.1 cd/m^2, contrast to Max.

   3) Change pattern to 50*50 green block, Adjust G.Gain control to Y=223 cd/m^2.

   4) Change pattern to 50*50 white block, Adjust R.Gain and B.Gain to x=283, y=297.

   5) Change pattern to Full white, Brightness to Max.

     Adjust "AB" of SB Mode to Y=103 cd/m^2.

   6) Brightness preset : Video Signal off (0Vp-p), Adjust Brightness to 0.1cd/m^2.

11. Focus Adjustment

(A) Mode: No.16 (VESA 1024*768(75))

(B) Pattern: Green Crosshatch, Brightness just cut off, Contrast maximum.

(C) Adjust F1 VR of FBT (lower side VR) for the vertical line to become fine line.

(D) Adjust F2 VR of FBT (higher side VR) for the horizontal line to become fine line.

(E) Receive Focus adjustment pattern.

(F) Adjust F1 VR if vertical black line is not fall out.

(G) Adjust F2 VR if horizontal black line is not fall out.

(H) Use the video card "Trio64+", and receive Microsoft Excel "Work sheet" (1024*768(85)).

Make sure that there is no double line for horizontal at the center.

*Note:　Focus adjustment must be finished at F1 VR.

● Black dot is fall out

The shape of black dot (1 dot) fall out.

The shape of black dot (2dots) fall out .

FOCUS ADJUSTMENT PATTERN

F1 VR
F2 VR
G2 VR

Focus VR
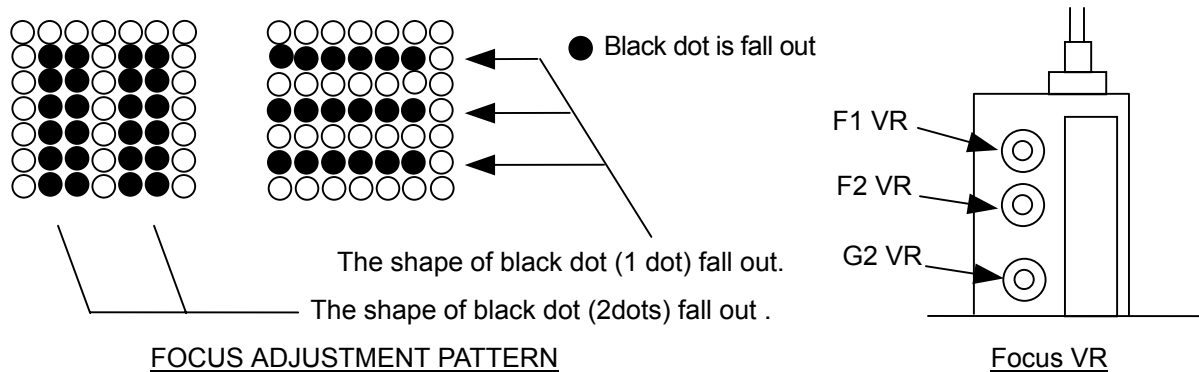
12. Purity Adjustment

(1)　Receive signal 14 (Cross hatch pattern).

(2)　The CRT face should be facing east and degauss the entire unit by external degaussing coil.

(3)　Make sure the single color purity.

   If not, readjust CPC magnet and touch up using correction magnets.

13. Convergence Adjustment

CH : Convergence error of horizontal direction

CV : Convergence error of vertical direction
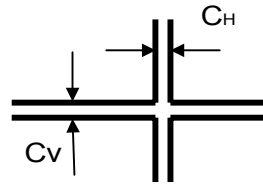
(1) Receive signal 14 (Cross hatch pattern).

(2) Measure convergence error. If it is out of spec, adjust convergence by 4-pole magnets and 6-pole magnets.
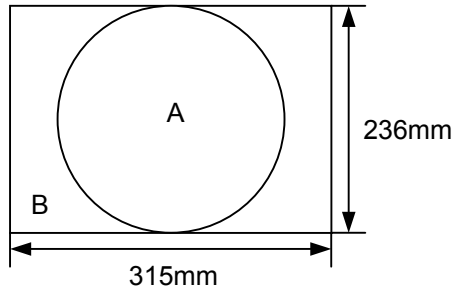
A Zone (A circle 236mm in the center of the CRT face center)

    CH, CV : Within 0.25mm

B Zone (Areas outside of zone A within the rectangle of 315mmx236mm)

    CH, CV : Within 0.35mm

14. Power Saving Function Inspection

(A) Mode: No.20

(B) Pattern: Full white

(C) Input voltage: AC240V/50Hz

(D) Inspection

1. It should be into power off Mode when the both horizontal sync and vertical sync are disable after 8 seconds. Check the LED color "Orange" and the power consumption must be less than 5W.

2. It should be recovered the normal Mode when the both horizontal sync and vertical sync are enable. Check the picture is normal and LED color "Green".

15. Distortion Adjustment

Factory mode setting

* After completion of adjustment exit the factory mode and data will be saved.

Signal: All signals   Cross hatch

Perform the adjust for signal No.14 in step 1 ~ 3.

Perform the adjust for above all signal in step 4 ~ 5.

1. Rotation Adjustment

   (1) Receive signal 14 (Cross hatch)

   (2) Select the " [ ] " icon in OSM TAB 4.

   (3) Make sure that the picture tilt meets the following standards.

$X \leq 1.0mm$

+ X

- X
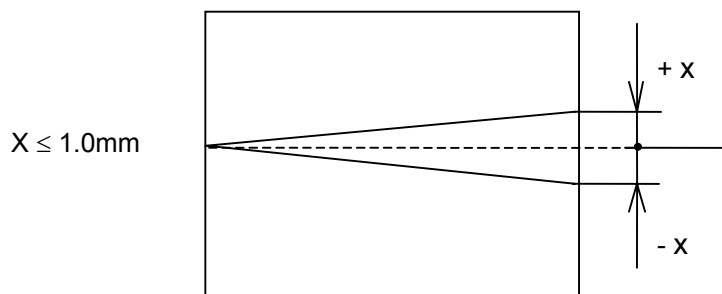
2. Pincushion Balance Adjustment

   (1) Select the " [ ] " icon in OSM TAB 4.

   (2) Make sure that the Pincushion Balance meets the following standards.

$A - B \leq 0.5mm$

A   B
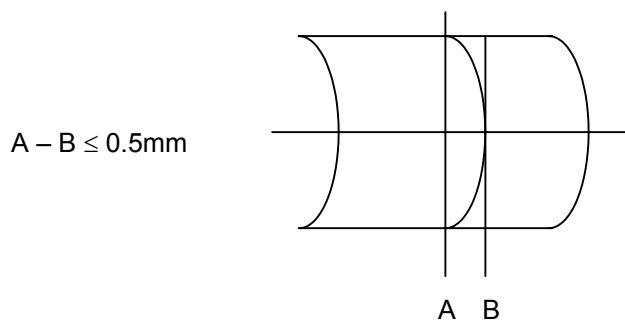
3. Parallelogram distortion Adjustment

    (1) Select the " ▱ " icon in OSM TAB 4.

    (2) Adjust "+", "-" SW so that the vertical line and horizontal line at the screen's center fall at right angles.
       (less than 90 ±0.5 degree)
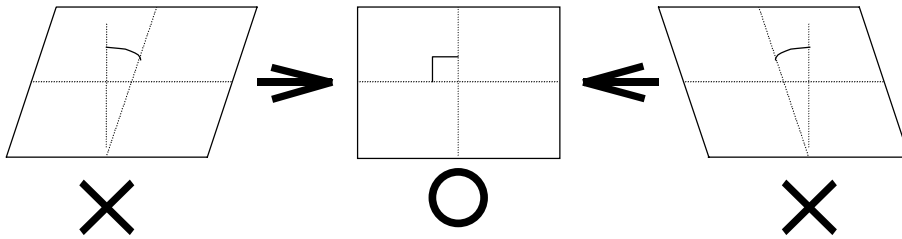
4. Side Pincushion Adjustment

    (1) Select the " ⊐⊏ " icon in OSM TAB 4.

    (2) Make sure that the side pincushion distortion meets the following standards.

              0.5mm   0.5mm

   0.5mm   0.5mm
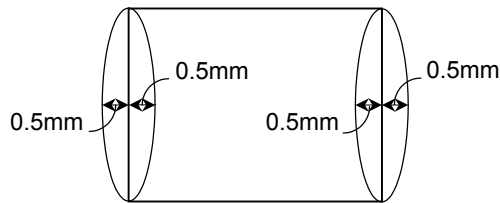
5. Trapezoid Distortion Adjustment

    (1) Select the " ⊿ " icon in OSM TAB 4.

    (2) Make sure that the trapezoid distortion meets the following standards.

$|(AB - CD)| \leq 1.0mm$

$|(AC - BD)| \leq 1.0mm$

16. Setting Before Shipment

  (A) Do Factory Preset in OSM TAB 6.

  (B) Set to following.

    TAB: Language … English

           OSM Lock … OFF

           IPM OFF MODE … Enable

17. Adjustment Magnetic Field

Vertical: +40uT, Horizontal: ±0uT(Neutral)

* Notes About Degaussing Method

Follow the degaussing procedure as below. (For prevent intertwinement of aperture grille.)

1) Use stick type degaussing probe at demagnetizing CRT.
   Do not use ring type degaussing probe.

2) In order to remove a magnetization from front, top, bottom and side of CRT, and bottom chassis.
   Do not switch off the degaussing probe abruptly. Move the degaussing probe slowly when degaussing.

   Note: If switch off the degaussing probe near the set, the set will be magnetized.

3) Degaussing method

When switch on the degaussing probe, keep distance between panel surface and degaussing probe more than 50cm. Move the degaussing probe vertically facing to the panel surface.

Keep distance of panel surface and degaussing probe to more than 15mm.

Starting from edge of CRT, move the degaussing probe toward CRT center in circular motion, spending 6 to 7 seconds. (Rounding about 4 or 5 times.)

Vertical   Horizontal
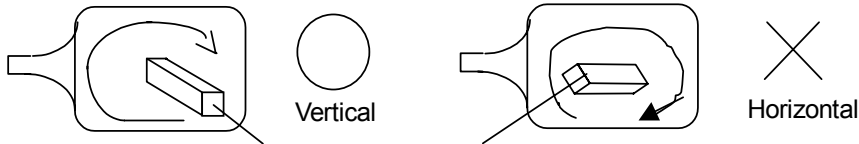
4) After sufficiently degaussing the CRT, move the degaussing probe slowly away from the panel surface while rotating from corner to center, taking more than 3 seconds. Turn off SW more than 1m away from the CRT. Degauss again if the unit is magnetized.

Over 1m

SW OFF

Magnetized Pattern Example
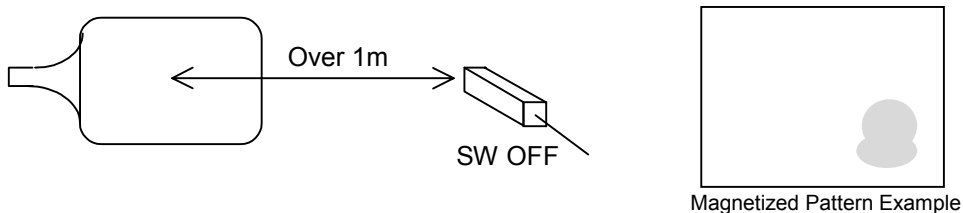
18. TIMING SHEET

Preset Mode No.		1	2	3	4	5	6
Signal Name		VGA350	VGA400	VGA480	MACII (35k)	800*600 (56)	8514/A XGA
Resolution		640*350	640*400	640*480	640*480	800*600	1024*768
Dot Clock	(MHz)	25.175	25.175	25.175	30.240	36.000	44.900
fh	(kHz)	31.47	31.47	31.47	35.00	35.16	35.52
fv	(Hz)	70.09	70.09	59.94	66.67	56.25	86.96
Total	(dot)	800	800	800	864	1024	1264
	(uS)	31.78	31.78	31.78	28.57	28.44	28.15
Disp	(dot)	640	640	640	640	800	1024
	(uS)	25.42	25.42	25.42	21.16	22.22	22.81
Front	(dot)	16	16	16	64	24	8
	(uS)	0.64	0.64	0.64	2.12	0.67	0.18
Sync Pulse	(dot)	96	96	96	64	72	176
	(uS)	3.18	3.81	3.81	2.12	2.00	3.92
Back	(dot)	48	48	48	96	128	56
	(uS)	1.91	1.91	1.91	3.17	3.56	1.25
Total	(H)	449	449	525	525	625	408.5
	(mS)	14.268	14.268	16.683	15.000	17.778	11.500
Disp	(H)	350	400	480	480	600	384
	(mS)	11.122	12.711	15.253	13.714	17.067	10.810
Front	(H)	37	12	10	3	1	0
	(mS)	1.176	0.381	0.318	0.086	0.028	0.000
Sync Pulse	(H)	2	2	2	3	2	4
	(mS)	0.064	0.064	0.064	0.086	0.057	0.113
Back	(H)	60	35	33	39	22	20
	(mS)	1.907	1.112	1.049	1.114	0.626	0.563
Interlace		NON	NON	NON	NON	NON	YES
Polarity	(H/V)	POS/NEG	NEG/POS	NEG/NEG	NEG/NEG	POS/POS	POS/POS
Composite Sync					NEG		
Composite Video							
Character Font		7*9	7*9	7*9	7*9	7*9	7*9
Serration		OFF	OFF	OFF	ON	OFF	OFF
EQP		OFF	OFF	OFF	OFF	OFF	OFF

Preset Mode No.		7	8	9	10	11	12
Signal Name		640*480 (75)	EVGA400 (VESA)	800*600 (60)	640*480 (85)	800*600 (75)	10*7(60) (VESA)
Resolution		640*480	640*400	800*600	640*480	800*600	1024*768
Dot Clock	(MHz)	31.500	31.5000	40.000	36.000	49.500	65.000
fh	(kHz)	37.50	37.86	37.88	43.27	46.88	48.36
fv	(Hz)	75.00	84.13	60.32	85.01	75.00	60.00
Total	(dot)	840	832	1056	832	1056	1344
	(uS)	26.67	26.41	26.40	23.11	21.33	20.68
Disp	(dot)	640	640	800	640	800	1024
	(uS)	20.32	20.32	20.00	17.78	16.16	15.75
Front	(dot)	16	24	40	56	16	24
	(uS)	0.51	0.76	1.00	1.56	0.32	0.37
Sync Pulse	(dot)	64	40	128	56	80	136
	(uS)	2.03	1.27	3.20	1.56	1.62	2.09
Back	(dot)	120	128	88	80	160	160
	(uS)	3.81	4.06	2.20	2.22	3.23	2.46
Total	(H)	500	450	628	509	625	806
	(mS)	13.333	11.886	16.579	11.76	13.333	16.666
Disp	(H)	480	400	600	480	600	768
	(mS)	12.800	10.565	15.840	11.093	12.800	15.880
Front	(H)	1	9	1	1	1	3
	(mS)	0.027	0.238	0.026	0.023	0.021	0.062
Sync Pulse	(H)	3	3	4	3	3	6
	(mS)	0.080	0.079	0.106	0.069	0.064	0.124
Back	(H)	16	38	23	25	21	29
	(mS)	0.427	1.004	0.607	0.578	0.448	0.600
Interlace		NON	NON	NON	NON	NON	NON
Polarity	(H/V)	NEG/NEG	NEG/POS	POS/POS	NEG/NEG	POS/POS	NEG/NEG
Composite Sync							
Composite Video							
Character Font		7*9	7*9	7*9	7*9	7*9	7*9
Serration		OFF	OFF	OFF	OFF	OFF	OFF
EQP		OFF	OFF	OFF	OFF	OFF	OFF

Preset Mode No.		13	14	15	16	17	18
Signal Name		MACII	800*600	10*7(70)	10*7(75)	640*480	12*10(60)
		(49.7k)	(85)	(VESA)	(VESA)	(120)	(VESA)
Resolution		832*624	800*600	1024*768	1024*768	640*480	1280*1024
Dot Clock	(MHz)	57.286	56.250	75.000	78.750	55.00	108.000
fh	(kHz)	49.73	53.67	56.48	60.02	63.66	63.98
fv	(Hz)	74.55	85.06	70.07	75.03	120.11	60.02
Total	(dot)	1152	1048	1328	1312	864	1688
	(uS)	20.11	18.63	17.71	16.66	15.71	15.63
Disp	(dot)	832	800	1024	1024	640	1280
	(uS)	14.52	14.22	13.65	13.00	11.645	11.85
Front	(dot)	32	32	24	16	32	48
	(uS)	0.56	0.57	0.32	0.20	0.582	0.44
Sync Pulse	(dot)	64	64	136	96	96	112
	(uS)	1.12	1.14	1.81	1.22	1.745	1.04
Back	(dot)	224	152	144	176	96	248
	(uS)	3.91	2.70	1.92	2.23	1.745	2.30
Total	(H)	667	631	806	800	530	1066
	(mS)	13.413	11.756	14.272	13.328	8.325	16.661
Disp	(H)	624	600	768	768	480	1024
	(mS)	12.548	11.179	13.599	12.795	7.540	16.005
Front	(H)	1	1	3	1	8	1
	(mS)	0.020	0.019	0.053	0.017	0.126	0.016
Sync Pulse	(H)	3	3	6	3	6	3
	(mS)	0.060	0.056	0.106	0.050	0.094	0.047
Back	(H)	39	27	29	28	36	38
	(mS)	0.784	0.503	0.513	0.466	0.566	0.594
Interlace		NON	NON	NON	NON	NON	NON
Polarity	(H/V)	NEG/NEG	POS/POS	NEG/NEG	POS/POS	NEG/NEG	POS/POS
Composite Sync		NEG					
Composite Video							
Character Font		7*9	7*9	7*9	7*9	7*9	7*9
Serration		ON	OFF	OFF	OFF	OFF	OFF
EQP		OFF	OFF	OFF	OFF	OFF	OFF

Preset Mode No.		19	20				
Signal Name		800*600 (100)	1024*768 (85)				
Resolution		800*600	1024*768				
Dot Clock	(MHz)	67.50	94.5				
fh	(kHz)	63.92	68.677				
fv	(Hz)	100.03	85				
Total	(dot)	1056	1376				
	(uS)	15.64	14.561				
Disp	(dot)	800	1024				
	(uS)	11.852	10.836				
Front	(dot)	40	48				
	(uS)	0.593	0.508				
Sync Pulse	(dot)	80	96				
	(uS)	1.185	1.016				
Back	(dot)	136	208				
	(uS)	2.015	2.201				
Total	(H)	639	808				
	(mS)	9.997	11.765				
Disp	(H)	600	768				
	(mS)	9.386	11.183				
Front	(H)	3	1				
	(mS)	0.047	0.015				
Sync Pulse	(H)	4	3				
	(mS)	0.063	0.044				
Back	(H)	32	36				
	(mS)	0.501	0.524				
Interlace		NON	NON				
Polarity	(H/V)	POS/POS	POS/POS				
Composite Sync							
Composite Video							
Character Font		7*9	7*9				
Serration		OFF	OFF				
EQP		OFF	OFF				

INSPECTION

TABLE OF CONTENTS

1.Scope

1.1 Introduction

This document defines the design and performance requirements for a 17 inch (16 inch Viewable), color display monitor. This monitor shall use a 17 inch Flat Aperture Grille type CRT. This monitor is capable of maximum resolution of 1280 x 1024 pixels at 66 Hz non-interlaced mode, and is capable of horizontal frequencies between 30kHz and 70kHz.

The following list shows the model name, Cabinet color, Audio function, and market.

CODE NAME	MODEL NAME	Cabinet color	Audio Base	MARKET	Ver.
Dplus74SB-BK(A)	Diamond Plus 74SB-BK	Black	No	USA/Canada	A ver.
Dplus74SB(B)	Diamond Plus 74SB	White	No	Europe	B ver.

1.2 General Description

1.2.1 Display Part

MODEL:1702

NO	Item			Spec.	REMARKS
1	CRT	Vendor / Model No.		Mitsubishi / M41LRY61X22	
		Type		Diamondtron M2 (Aperture Grille)	
		Size		43cm / 406mm Diagnonal Viewable Image (17" / 16" Diagonal Viewable Image)	
		Grille pitch(Phosphor pitch)		Approx.0.25mm (Approx.0.26mm)	Aperture Grille
		Phosphor Type		P22	
		Face-plate		AR-film(Anti-reflection and Anti-static)	
		Electron Gun Type		PX-DBF	
		Face-plate Transmission		approx.38%	
2	SCANNING	Horizontal Freq		30.0 - 70.0 kHz	
		Vertical Freq.		50 - 120 Hz	
3	SIGNAL INPUT	Video		Analog	0.7Vp-p
		Sync		Composite Sync	TTL Pos / Neg
				Separate Sync	TTL Pos / Neg
		Termination (Impedance)	Video	75 ohm to GND	
			Sync.	2.2K ohm to GND or more	
4	VIDEO	Clock frequency		120MHz	
5	SCREEN CHARACTERISTICS	Display Resolution(Maximum)		1280×1024 (66Hz) (Maximum) 1024x768 (85Hz) (recommend)	
		Display Size	Preset	315mm (H) * 236mm (V)	
			FullScan	325mm (H) * 244mm (V)	
		Misconvergence		Center: 0.25mm, Corner : 0.35mm	
		Brightness (Full White)		90cd/m^2(typ.) at 9300K	
6	CONTROL (User Controls)	Front		Power SW Exit, Left, Right, "-", "+", Select, Reset	7 control buttons
				Note: User can change Super Bright Mode by pressing a Select key.	
			OSM	Brightness, Contrast, Degauss H.Size, H.Position, V.Size, V.Position, Color Control (9300K, 8200K, 7500K, sRGB 5000K) ColorTemperature Control, RGB Gain Control(USER) SidePin In/Out, Side Pin Left/Right, Parallelogram, Trapezoid, Rotation, Moire Cancel(Horizontal) Language, OSM Position, OSM Turn off, OSM Lock, IPM OFF mode, Factory Preset URL indication, Display Mode, Monitor info, Refresh Notifier Diagnosis Indication	Micro-processor control.
7	CONNECTOR	Power Input		Power Cord (Length:1.8m, Color: Haze gray)	
		Signal Input		Mini 15pin D-sub (Length:1.8m, Color:Haze gray)	
8	POWER SUPPLY	Operating Range		AC100-240V, 50-60Hz	
		Power Consumption (Max.)		70W 1.5A@100-240VAC Power save ≤ 5W	
9	ENVIRONMENTAL CONDITION	Operating Temperature		5 - 35 °C	
		Operating Humidity		10 - 90 % (without condensation)	
10	WEIGHT			Net : 16.8kg / 37.0lbs, Gross : 19.8kg / 43.7lbs	
11	DIMENSIONS	Cabinet with Tilt / Swivel stand Carton		Net : W 397.0mm(15.6"), H 392.0mm(15.4"), D 415.5mm(16.4") Gross(Aver): W 530mm(20.9"), H 520mm(20.5"), D 565mm(22.2") Gross(B/Jver): W 510mm(20.1"), H 513mm(20.2"), D 565mm(22.2")	
12	REGULATION	Safety		UL1950(UL), CSA C22.2 No.950(C-UL), EN60950(TUV-GS), PCBC, GOST, PSB	
		EMC		FCC-B, DOC-B, EN55022-B, EN61000-3-2,-3-3, EN55024(IEC61000-4-2,-4-3,-4-4,-4-5,-4-6,-4-8,-4-11), C-tick	
		X-Ray		DHHS, Red Act, PTB	
		VLF / ELF		pr EN50279(MPR-III), TCO'99(Except Aver Black), TCO'95(For Aver Black)	
		Power Management		Energy Star, TCO99 (Except Aver Black),TCO'95 (For Aver Black)	
		Ergonomics		(ISO9241-3, ISO9241-7, ISO9241-8), TCO'99 (Except Aver Black), TCO'95 (For Aver Black)	
		Miscellaneous		TCO'99 (Except Aver Black), TCO'95 (For Aver Black), CE marking	
		Others		WHQL (Win ME, Win 2000, Win XP) DDC/CI	
13	OTHERS	Plug & Play		DDC2B,DDC/CI (Support 9pin-5V)	
14	FEATURE			Self Diagnosis Super Bright Mode	

1.3 Regulations

GEOGRAPHICAL REGION	REGULATIONS						
	SAFETY	EMC	X-RAY	ELF/VLF	Power Management	Ergonomics	Miscellaneous And others
Dplus74SB-BK(A)	UL C-UL TUV/GS	FCC-B DOC-B	DHHS Red Act	MPR-III TCO'99 (White) TCO'95 (Black)	Energy Star TCO'99 (White) TCO'95 (Black)	TUV-GS (IS9241-3 IS9241-7 IS9241-8) TCO'99 (White) TCO'95 (Black)	CE Marking WHQL (Win ME, Win 2000, Win XP)
Dplus74SB(B)	UL C-UL TUV-GS PCBC Gost PSB	C-tick EN55022-B EN55024 EN61000-3-2 EN61000-3-3	PTB	MPR-III TCO'99	Energy Star TCO'99	TUV-GS (IS9241-3 IS9241-7 IS9241-8) TCO'99	CE Marking WHQL (Win ME, Win 2000, Win XP)

* : This model is applied these regulations in case of including the audio base.

1.4 Regulation Information & Marking Location

Marking Location	Regulation	Information
(1)	UL	UL1950 3rd Edition (or UL60950 3rd edition)
(1)	C-UL	CAN/CSA-C22.2 NO.950:1995 (or CAN/CSA-C22.2 No.60950:2000)
(1), (2)	TUV-GS	EN60950 : 1992 & AD1/AD2/AD3/AD4/AD11, (or EN60950:2000) EK1-ITB 2000,ISO9241-3: 1992, ISO9241-7: 1998, ISO9241-8: 1997
(1)	PSB	Singapore Safety
(1)	CCIB	Chinese Safety & EMI
(1), (2)	FCC	47 CFR Chapter I Subpart B, Class B
-	DOC	Interference-Causing Equipment Standard ICES-003 Issue 3,Class B
-	DHHS	21CFR Chapter I Subchapter J
-	Red Act	Radiation Emitting Devices Act
-	PTB	German X-ray
-	MPR-II	MPR1990:10, MPR1990:8
-	MPR-III	prEN50297
(1), (2), (3)	TCO'95	Requirements for environmental labeling of personal computers
(1), (2), (3)	TCO'99	Requirements and test methods for environmental labeling of display (CRT) and Ecology
(1), (2), (3)	CE-Marking	EN60950: 1992 & AD1/AD2/AD3/AD4/AD11 EN55022: 1998 Class B, EN55024: 1998(IEC61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11) EN61000-3-2 : 1995 & AD1/AD2, EN61000-3-3 : 1995
(2)	Energy Star	International Energy Star office Equipment Program
(1), (2), (3)	PCBC	Poland Safety
(1), (2), (3)	Gost	Russian Safety
(1), (2)	C-tick	AS/NZS3548:1995+A1/A2:1997
(2), (3)	WHQL	Microsoft Windows® Hardware Quality Labs

Note:

(1) The mark is printed on the " Rating Label ".

(2) The mark is printed on the " Carton Box ".

(3) The mark is printed on the " User's Manual ".

2. CRT Specifications

Vendor	Mitsubishi
CRT Model No.	M41LRY61X22
Type	Diamondtron M2 (Aperture Grille)
Size	448.8 mm (17" diagonal surface) 406.4 mm (16" diagonal viewable image)
Grille pitch (Phosphor pitch)	Approx.0.25mm (Approx. 0.26mm)
Deflection Angle	90 degree
Phosphor Type	P22
Electron Gun Type	PX-DBF type
Light Transmission at Center (Approx.)	Approx. 38% (Include Face-plate coating)
Face-plate	AR-film (Anti-reflection and Anti-static)
Useful Screen dimensions	325.1 mm x 243.8 mm
Face-plate Curvature	H: R=50000 mm , V: R=80000 mm
Phosphor Color Coordinate	R: x=0.626 $\pm$ 0.020, y=0.338 $\pm$ 0.020 G: x=0.278 $\pm$ 0.020, y=0.601 $\pm$ 0.020 B: x=0.150 $\pm$ 0.020, y=0.068 $\pm$ 0.020

3. Electric Specifications

3.1 Deflections

Horizontal	Scanning Frequency	30.0 – 70.0 kHz
	Back Porch	≥ 0.2 μsec
	Blanking	≥ 3.6 μsec
	H-sync Width	≥ 0.8 μsec
Vertical	Scanning frequency	50 – 120 Hz
	V-sync + V-back Porch	≥ 500 μsec
	V-sync Width	2H ≤ Vs ≤ 8H
	V-Total Line	≥ 256H+ V-sync Width

3.2 Signal Input

Video Input Signal	R.G.B analog
Sync. Input Signal	External composite sync :TTL (N or P) External HD/VD separate sync :TTL (N or P)
Video Input Impedance	75 ohm to ground
Sync. Input Impedance	2.2k ohm to grand or more.
Signal Level	Video signal : 0.70V p-p ±5% Composite sync :TTL level Separate H/V-sync :TTL level

3.3 Video Performance

Video Clock Frequency	120MHz (Input signal)
Pulse Rise and Fall time	9.0nsec (typ.) 10 to 90% at 40Vp-p

The rise and fall time of the input video signal is 2.0nsec or less.

The pulse rise or fall time is determined using the formula :

$$Ta = \sqrt{Tm^2 - (Ts^2 + Tp^2 + Tsc^2)}$$

Where : Ta = Amplifier rise / fall time

Tm = Measured rise / fall time

Ts = Input signal rise / fall time

Tp = Probe effect on rise / fall time = 2.2 x Rl x Cp

Rl = Amplifier output resistance (ohm)

Cp = Total probe capacitance (F)

Tsc= Scope rise / fall time = 0.35 / Scope bandwidth (MHz)

3.4 Power Supply

Input Voltage	100 – 240 VAC ± 10%
Frequency	50 - 60Hz ± 3Hz

Power Consumption (Max.)	70W 100 – 240VAC, 1.5A
	Condition:
	Input voltage:100 - 240VAC
	  Signal: No.13 (1024x768(85Hz), (All white))
	  Contrast: Max, Brightness: Max,
	  H/V size: full scan
	  Others: default position

(Typical)	65W @ 120VAC /60Hz
	64W @ 230VAC /50Hz
	Condition:
	  Signal: No.13 (1024x768(85Hz), (All white))
	  Contrast: Max, Brightness: Cutoff,
	  H/V size: preset
	  Others: default position

AC leakage current	Except Japan ≤ 3.5mA (254V), Japan ≤ 0.2mA (100V)
Inrush current	≤ 42A 0-peak at 240VAC on cold starting (or ≤ 30Arms(half cycle) at 240VAC on cold starting) ≤ 100A 0-peak at 240VAC on hot starting (or ≤ 70Arms(half cycle) at 240VAC on hot starting)

3.5 Power Saving

	H-sync	V-sync	Video	Power Consumption	Recovery Time	LED Indicator
ON Mode	On	On	Active	70W (Max.)	-	Green
Off Mode	Off	On	Blank	≤ 5W	3 - 5 sec	Orange
	On	Off	Blank			
	Off	Off	Blank			

3.6 Degaussing

Auto Degaussing	The monitor has an automatic degaussing function which activates when the unit is turned on.
Manual Degaussing	This activates degaussing at the user's discretion after the unit is operating

The Monitor requires minimum 15 minutes after last degauss operation for full degauss capability.

4. Functions

4.1 Display Part

4.1.1 Front Controls
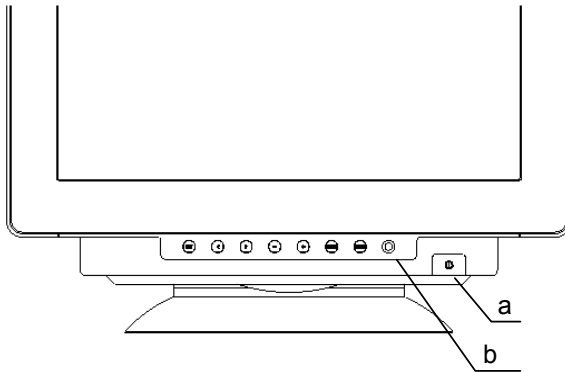
a : POWER SWITCH

b : POWER INDICATOR

c : EXIT BUTTON

d : ITEM SELECT BUTTONS

e : FUNCTION ADJUST BUTTONS

f : SELECT & SB Mode BUTTON

g : RESET BUTTON
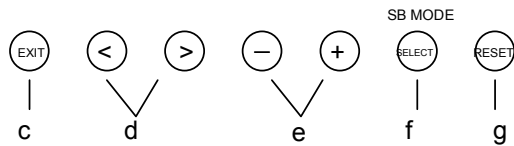
(While OSM is closed, User can change "Super Bright Mode" by pressing "SELECT" key.)

"Super Bright Mode" is enable to display brighter picture than "Normal Mode" by increasing video gain.)

4.1.2 OSM (On Screen Manager) Function

4.1.2.1 OSM Menu

Tab 1
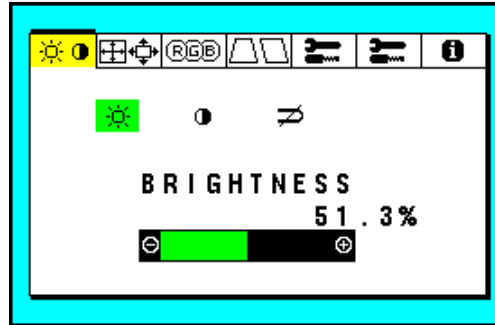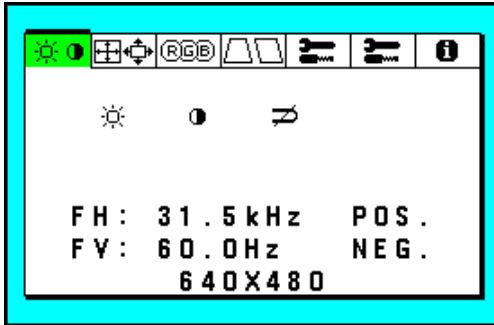
Tab 2
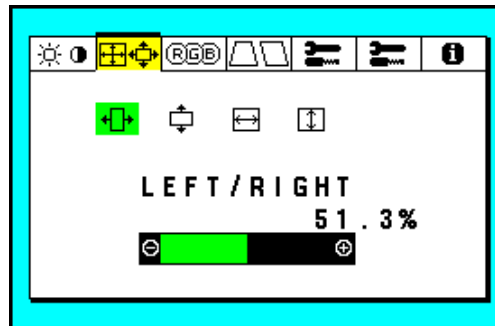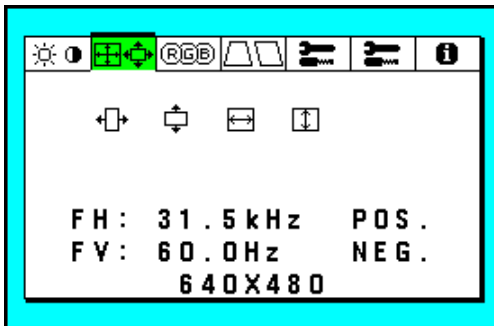
Tab 3
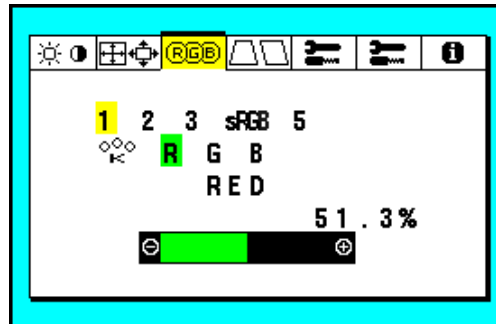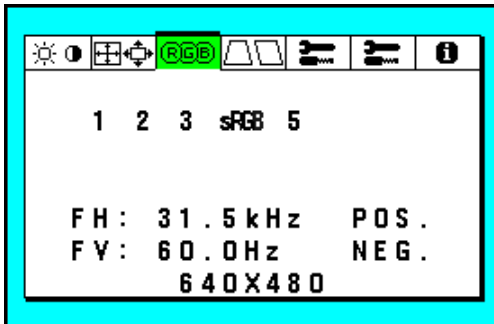
Tab 4
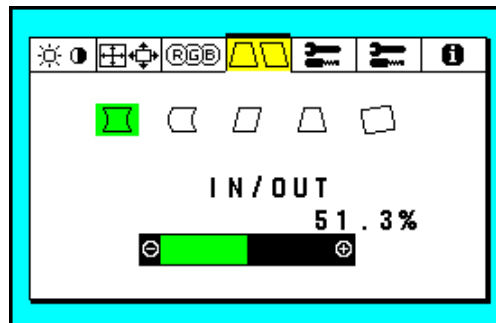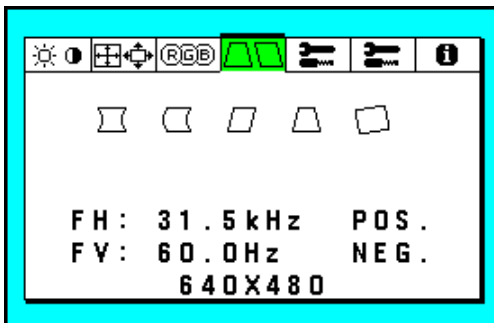
Tab 5
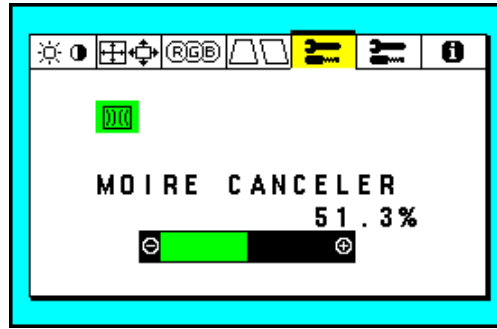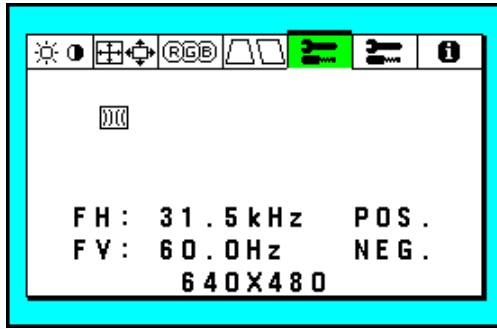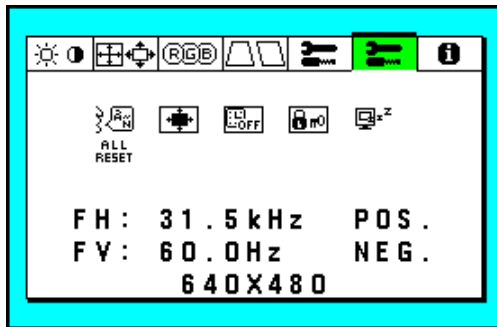
Tab 6   Tab 6 (Language)
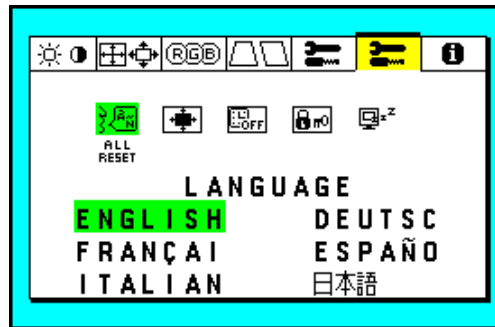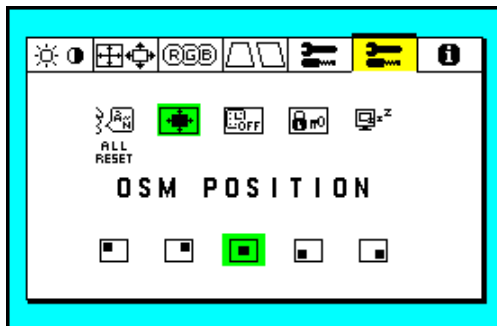
Tab 6 (OSM Position)   Tab 6 (OSM Turn off)
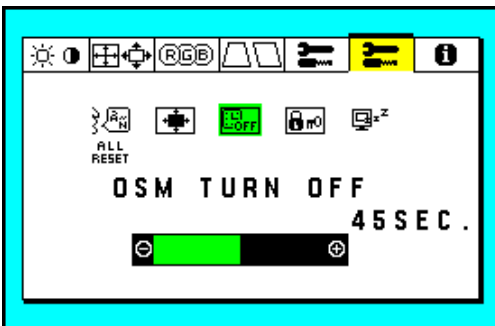
Tab 6 (OSM Lock)   Tab 6 (IPM OFF Mode)
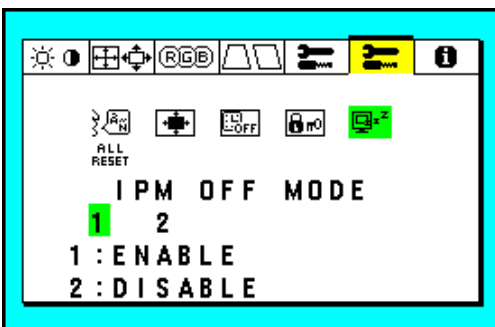
Tab 6 Factory Preset

FACTORY PRESET

PRESS ⊕

Tab 7 (URL indication)

MODE   Hz

CONTACT US
AT
WWW.NECMITSUBISHI.COM

Tab 7 (Display Mode)

MODE   Hz

DISPLAY MODE
FH: 31.5kHz   NEG.
FV: 60.0Hz   NEG.
MODE   PRESET- 3

Tab 7 (Monitor info.)

MODE   Hz

MONITOR INFO.
MODEL:DPLUS74SB
SERIAL NUMBER:
XXXXXXXXX

Tab 7 (Refresh Notifier)

MODE   Hz
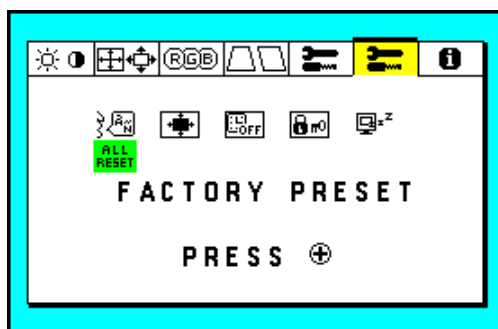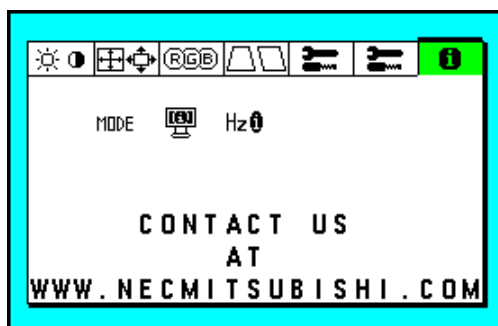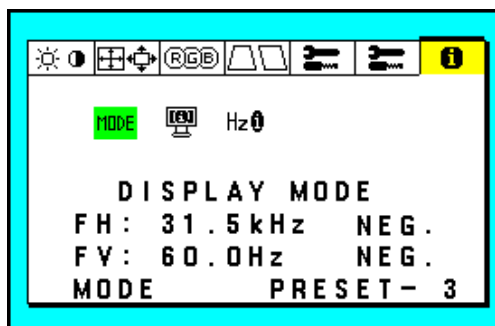
REFRESH NOTIFIER
1   2
1:ON
2:OFF
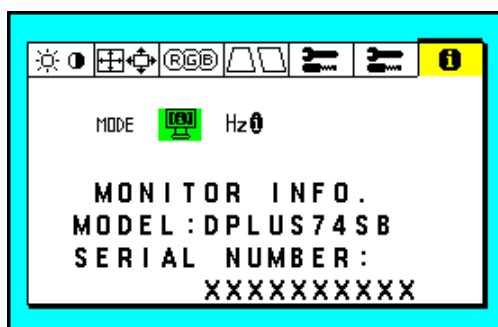
Refresh Notifier

REFRESH RATE LOWER
THAN RECOMMENDED

REFER TO
USER'S MANUAL FOR
MORE INFORMATION.

PRESS EXIT TO CLEAR

Item Reset


```
BRIGHTNESS
RESET WARNING
PRESS ⊕ TO RESET
      ⊖ TO CANCEL
```

Tab Reset


```
ENTIRE SUBMENU
RESET WARNING
PRESS ⊕ TO RESET
      ⊖ TO CANCEL
```

Factory Preset


```
ALL SETTING
RESET WARNING
PRESS ⊕ TO RESET
      ⊖ TO CANCEL
```

Others


```
DIAGNOSIS
INPUT CHECK
H:OFF  V:ON



COLOR CHECK
R  G  B
ZOOM▶
```



```
POWER SAVE
```



```
SUPER BRIGHT MODE ON


SUPER BRIGHT MODE OFF
```



```
ATTENTION
SIGNAL FREQENCY IS
OUT OF RANGE
    FH▶XXX.XkHz
    FV▶XXX.XHz

    PLEASE CHANGE
    SIGNAL TIMING
```

4.1.2.2 OSM Item Variability & Default Position.

Tab	Item		Default	Item Reset	Push"+"	Push"-"
1	Brightness	0-100%	Adjusted	Yes	Up	Down
	Contrast	0-100%	100%	Yes	Up	Down
	Degauss	-	-	-	Operate	-
2	Left/Right (H. Posi)	0-100%	Adjusted	Yes	Right	Left
	Down/Up (V. Posi)	0-100%	Adjusted	Yes	Up	Down
	Narrow/Wide (H. Size)	0-100%	Adjusted	Yes	Large	Small
	Short/Tall (V. Size)	0-100%	Adjusted	Yes	Large	Small
3	Color Number	1 (9300K)	1 (9300K)	Yes	-	-
		2 (8200K)		Yes	-	-
		3 (7500K)		Yes	-	-
		sRGB		Yes	-	-
		5 (5000K)		Yes	-	-
	Color Temperature	5000K-9300K	9300K	Yes	High	Low
	R/G/B gain control	0-100%	Adjusted	Yes	Up	Down
4	In/Out (Side_Pin)	0-100%	Adjusted	Yes		
	Left/Right(Side Pin Balance)	0-100%	Adjusted	Yes		
	Tilt (Parallelogram)	0-100%	Adjusted	Yes		
	Align (Trapezoidal)	0-100%	Adjusted	Yes		
	Rotate	0-100%	Adjusted	Yes		
5	Moire Canceler (Hor)	0-100%	0%	Yes	Increase	Decrease
6	Language	English / German / French / Spanish / Italian / Japanese	English	No	-	-
	OSM Position	5 position	Center	Yes	Cursor move to Left/Right	
	OSM Turn off	5-120 sec	45sec	Yes	Turn off Time shorter	Turn off Time longer
	OSM Lock	OFF/ON	OFF	No	Lock on: "Select" + "+"key	
	IPM OFF Mode	Enable/ Disable	1 (Enable)	No	Cursor move to Left/Right	
	Factory Preset	-	-	-	All Reset	No operate
7	URL indication	WWW.NECMITSUBISHI.COM				
	Display Mode	FH : Horizontal Frequency & Polarity FV : Vertical Frequency & Polarity				
	Monitor Info.	Mitsubishi Brand:"DPLUS74SB" & Serial Number				
	Refresh Notifier	OFF/ON	OFF	Yes	Cursor move to Left/Right	
others	Super Bright Mode	OFF/ON	OFF	No	Can switch "OFF/ON" by "SERECT" key	

* Default show factory shipping condition.

*The detail function of OSM is written at "2002 model OSM specification".

4.1.3 Back Panel

   a: AC POWER CONNECTOR (3P IEC Plug)

   b: SIGNAL INPUT CONNECTOR pig-tail type (D-SUB 15P)

        Signal Cable: Length:1800 ±50mm, Color: Hazegray (NEC#8508)
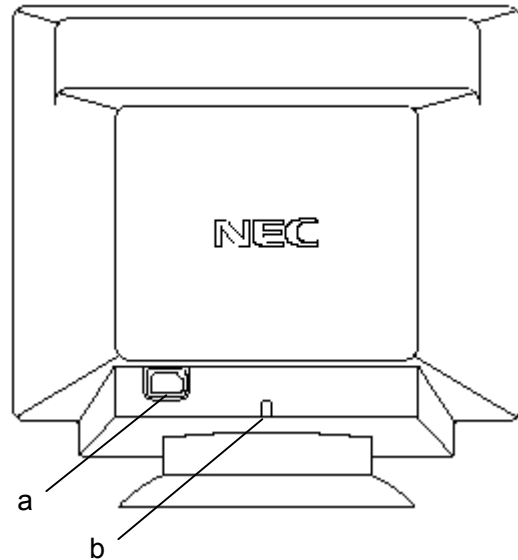
4.1.4 Connector Pin Assignment

   1) Signal Input Connector (mini D-sub 15P pig-tail cable)

Pin	Signal
1	Red-video
2	Green-video
3	Blue-video
4	Gnd
5	DDC Gnd
6	Red Gnd
7	Green Gnd
8	Blue Gnd
9	DDC +5V
10	Sync Gnd
11	Gnd
12	Serial data
13	H-sync or Composite sync
14	V-sync
15	Serial clock
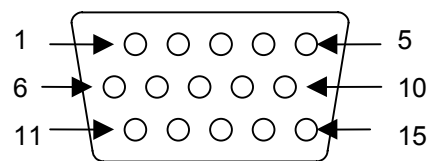
Signal Cable Connector

4.1.5 DDC (Display Data Channel) Functions

VESA DDC 2B (EDID data only), (Support 9 pin – 5V)

VESA DDC/CI (The details is written at "DDC/CI Command & VCP for NPG design model")

4.1.6 Preset Timing

Factory-presets: 13 (See Appendix 1 for detail timing parameters.)

(Signal Nos.3,7,10,13 are adjustment Signals and Signal Nos.2, 4, 5, 6, 8, 9, 11, 12 are rough adjustment Signals.)

User-presets : 7

Preset Timing Discrimination

Horizontal Frequency	≥ 1kHz
Vertical Frequency	≥ 1Hz
Sync Signal Polarity	H or V-sync signal polarity is different

* The monitor is able to discriminate input signals by at least one of above parameters.

4.1.7 Self Diagnosis Function

Monitor show the abnormal condition by Blinking LED.

Contents of Information	LED Blink
X-ray protector operate	◯○ ⬭○
Beam protector circuit operate	◯○ ⬭○
High voltage circuit no operate	◯○ ◯○ ◯○ ◯○ ⬭○
High voltage value is abnormal	◯○ ◯○ ◯○ ◯○ ⬭○
Oscillation circuit no operate	◯○ ◯○ ◯○ ◯○ ⬭○
Internal I2C bus line is abnormal	◯○ ◯○ ◯○ ◯○ ◯○ ◯○ ⬭○
No H/V sync	Turn on orange LED continually

Notes: ◯ LED off (0.5sec)

◉ LED orange on (0.5sec)   ⬭ LED orange on (2sec)

"Blinking LED" is repeated until the monitor is turned off.

5. Display Quality

5.1 Basic Test Conditions

AC Voltage	120VAC 60Hz or 220VAC 50Hz
Video Signal	No.13, 1024 x 768 (85Hz) (fH=68.7kHz fV=85Hz) Video signal 0.70 ±0.01Vp-p
Picture	Reverse cross hatch pattern
Warm Up	More than 30 min. with full white picture
Temperature	20 – 25 degree C
Relative Humidity	40 - 80 %
Magnetic Field	BH=0.000mT, BV=0.040mT (Northern Hemisphere) BH=0.000mT, BV=-0.040mT (Southern Hemisphere)
Contrast & Brightness	Contrast maximum and Brightness default position
Display Size	315 x 236 mm for 4:3 aspect ratio
Ambient light	200 ± 50 lx
Luminance Meter	Minolta CA100 or Equivalent

   If no description, the test below are applied under the Basic Test Condition.
   Unless specified, the monitor is set at the factory default setting.

5.2 Picture Size and Position
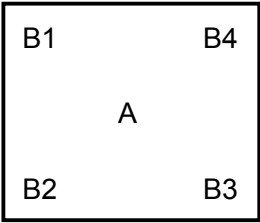
Adjustment Signal: Signal No.3, 7, 10, 13	Size	Horizontal : 315mm ± 3.0 mm Vertical : 236mm ± 3.0 mm
	Position	Horizontal : | XLef t – Xright | ≤ 3.0mm Vertical : | XTop - XBottom | ≤ 3.0mm The picture should adjust underscan.
Rough Adjustment Signal: Signal No.2, 4, 5, 6, 8, 9, 11, 12	Size	Horizontal : 315 mm ± 6.0 mm Vertical : 236 mm ± 6.0 mm
	Position	Horizontal : | XLef t - XRight | ≤ 6.0mm Vertical : | XTop - XBottom | ≤ 6.0mm The picture should adjust underscan.
Signal No.1 (VGA350)	Adjust the vertical size to maximum.	
Figure		

5.2.1 Size and Position Control Ranges

Signal No.2 to 13 Size Control Ranges	The horizontal and vertical size control should be controllable to "FullScan" at the maximum position. * Except MAC Signal (Signal No. 4, 9)
Signal No.1 to 13 Position Control Ranges	Image position can be controlled to the center position of the bezel opening.

5.3 Luminance (Brightness)

Signal No.13 (1024*768@85Hz)
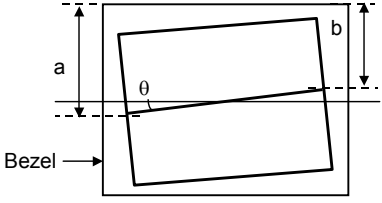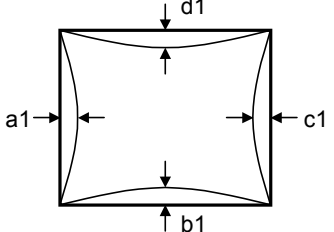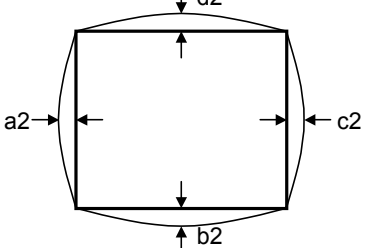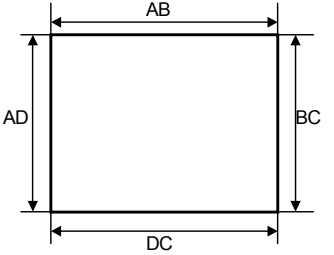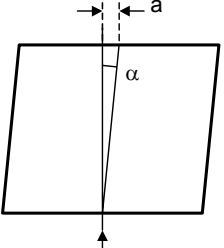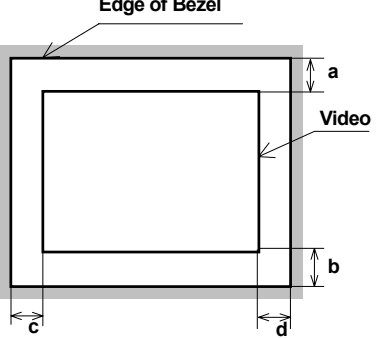
5.3.1 Luminance at CRT center (Full white pattern)	Contrast : Max.
	Brightness : Set to cut off
	  $76 cd/m^2 \leq$ Full White ≤ 110 cd/m^2
	  (at 9300K + 8 M.P.C.D.)
	* When Brightness control to MAX, the luminance should be over 90cd/m^2

5.3.2 Luminance at CRT center (Window pattern) (H:33%,V:33%)	Contrast : Max.
	Brightness : Set to cut off
	  120 cd/m^2 $\leq$ Window pattern $\leq$ 160 cd/m^2
	  (at 9300K + 8 M.P.C.D.)
	
	SB Mode :ON
	Contrast: :Max.
	Brightness :Set to cut off
	  Window pattern = 300cd/m^2 +30/-0
	(at 9300K +8 M.P.C.D.)

5.3.3 Luminance Variation (Full white pattern) Contrast : MAX Brightness : Adjust to 90cd/m^2	$$125\% \geq \frac{Bi}{A} \times 100 \geq 75\%$$ B1 B4 A B2 B3

5.3.4 Back Raster Luminance (Full black pattern)	Brightness : default position
	  Raster ≤ 0.20 cd/m^2
	  Raster must not visible at minimum Brightness control.
	Brightness : MAX position
	  2.0 cd/m^2 $\leq$ Raster $\leq$ 8.0 cd/m^2

5.4 Color

Signal No.13 (1024*768@85Hz)

5.4.1 Color Temperature (Window pattern) (H:33%,V:33%) Contrast : Max. Brightness : Cut off	Color-1: 9300K + 8 M.P.C.D. $\qquad$ Xref=0.283 $\pm$ 0.015 $\qquad$ Yref=0.297 $\pm$ 0.015
	Color-2: 8200K $\qquad$ X=0.290 $\pm$ 0.015 $\qquad$ Y=0.313 $\pm$ 0.015
	Color-3: 7500K $\qquad$ X=0.300 $\pm$ 0.015 $\qquad$ Y=0.315 $\pm$ 0.015
	Color-4: sRGB (Luminance: 80 +20/-10 cd/m^2) $\qquad$ X=0.313 $\pm$ 0.015 $\qquad$ Y=0.329 $\pm$ 0.015
	Color-5: 5000K $\qquad$ X=0.345 $\pm$ 0.015 $\qquad$ Y=0.359 $\pm$ 0.015
5.4.2 Color Tracking of Contrast control (Window pattern) (H:33%,V:33%)	$\qquad$ X = Xref $\pm$ 0.020 $\qquad$ Y = Yref $\pm$ 0.020 Color setting : 9300K Contrast Control: <u>from 20cd/m^2 to MAX.</u> Brightness : Cut off
5.4.3 Color Tracking of brightness control (Window pattern) (H:33%,V:33%)	$\qquad$ X = Xref $\pm$ 0.020 $\qquad$ Y = Yref $\pm$ 0.020 Color setting : 9300K Contrast Control: 50 cd/m^2(at Brightness cut off) Brightness : <u>from Max. to Min.</u>
5.4.4 sRGB color quality (Full white pattern)	RED : $\quad$ x=0.640 +0.020/-0.035 $\qquad\qquad$ Y=0.330 +0.030/-0.020 Green: $\quad$ x=0.300 +0.020/-0.035 $\qquad\qquad$ Y=0.600 +0.020/-0.020 Blue: $\quad$ x=0.150 +0.015/-0.015 $\qquad\qquad$ Y=0.060 +0.030/-0.015 White: $\quad$ x(sRGB)=0.3127 $\pm$ 0.020 $\qquad\qquad$ y(sRGB)=0.3290 $\pm$ 0.020 $\qquad\qquad$ |x(sRGB)-y(sRGB)|< 0.020 Brightness:Y=80 +20/-10 cd/m^2 Gamma: S-g=2.2 $\pm$ 0.2
5.4.2 White Uniformity (Full white pattern) Contrast : MAX Brightness : Adjust to 90cd/m^2	White color temperature(x,y) at B1,B2,B3,B4 is as follows. A(x ref, y ref) x $\leq$ x ref $\pm$ 0.015 y $\leq$ y ref $\pm$ 0.015 B1 $\qquad$ B4 $\qquad$ A B2 $\qquad$ B3

5.5 Geometric Distortion

5.5.1 Raster Rotation/Tilt Signal No. 3, 7, 10, 13 $\|a - b\| \leq 1.8$ mm or -0.5 degree $\leq \theta \leq \pm 0.5$ degree	
5.5.2 Pincushion Signal No. 3, 7, 10, 13 Top : d1 $\leq$ 1.5 mm Bottom : b1 $\leq$ 1.5 mm Left side : a1 $\leq$ 1.5 mm Right side : c1 $\leq$ 1.5 mm	
5.5.3 Barrel Signal No. 3, 7, 10, 13 Top : d2 $\leq$ 1.1mm Bottom : b2 $\leq$ 1.1 mm Left side : a2 $\leq$ 1.5 mm Right side : c2 $\leq$ 1.5 mm	
5.5.4 Trapezoid Signal No. 3, 7, 10, 13 (a) Horizontal $\dfrac{\|AD-BC\|}{AD+BC}\times100\leq0.8\%$ or $\|AD\text{-}BC\| \leq 3.7$mm (b) Vertical $\dfrac{\|AB-DC\|}{AB+DC}\times100\leq0.5\%$ or $\|AB\text{-}DC\| \leq 3.1$mm	
5.5.5 . Parallelogram Signal No. 3, 7, 10, 13 -1.6mm $\leq a \leq +1.6$mm or -0.5 degree $\leq \alpha \leq +0.5$ degree	
5.5.6 Overall Distortion Signal No. 3, 7, 10, 13 Top : $\|a_{max} - a_{min}\| \leq 2.0$mm Bottom : $\|b_{max} - b_{min}\| \leq 2.0$mm Left side : $\|c_{max} - c_{min}\| \leq 2.0$mm Right side : $\|d_{max} - d_{min}\| \leq 2.0$mm Signal No.2,4,5,6,8,9,11,12 Top : $\|a_{max} - a_{min}\| \leq 3.0$mm Bottom : $\|b_{max} - b_{min}\| \leq 3.0$mm Left side : $\|c_{max} - c_{min}\| \leq 3.0$mm Right side : $\|d_{max} - d_{min}\| \leq 3.0$mm	

5.6 Linearity

Linearity	H: ≤ 20%(30-43k) , ≤ 12%(43-55k) , ≤ 10%(55-70k) , adjacent: ≤ 7%
	V: ≤ 10% , adjacent: ≤ 7%

* at preset timings

* With Green-Crosshatch (17 lines horizontally by 13 lines vertically) applied.

* The formula used to calculate linearity is:

$$\frac{Xmax - Xmin}{(Xmax + Xmin)/2} \times 100\% \qquad \frac{Ymax - Ymin}{(Ymax + Ymin)/2} \times 100\%$$

X1=X2=X3=…=X16

Y1=Y2=Y2=…=Y12

5.7 Misconvergence

Misconvergence	Zone A: X, Y ≤ 0.25 mm within the 236 mm diameter circle
	Zone B: X, Y ≤ 0.35 mm within 315 mm x 236 mm

* With White Crosshatch (17 lines horizontally by 13 lines vertically) applied.
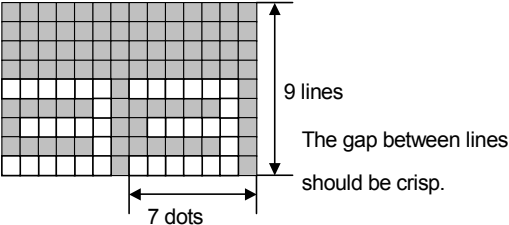
* Zone A is a circular area with 236mm diameter at the center.

* Zone B is a rectangular area (315mm x 236mm) outside of the Zone A.
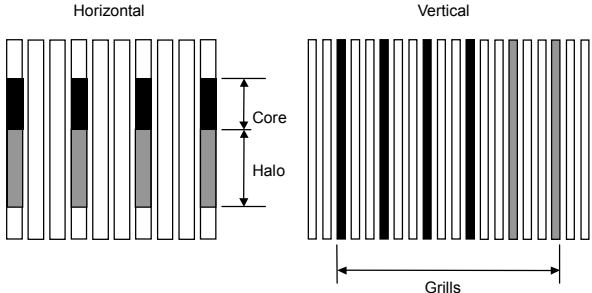
* Use worst case horizontal/vertical misconvergence between any two primary colors.

5-21
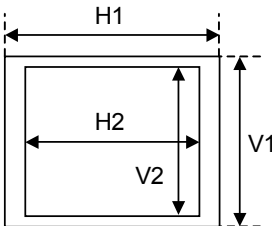
5.8 Focus

Focus Signal No.13 Contrast : Max. Brightness: Cut off	Resolution: 1024 x 768 (85Hz) Character: 7 x 9 pixel "∃" Color : White Judgment: "∃" character are readable with clearly at the whole screen.

5.9 Halo

Halo Signal No.13 Contrast : Max. Brightness: Preset	Judgment: Each color (Red, Blue) line do not form halos. Vertical lines : halos + core are less than 6 grills(R,B) Horizontal lines : core : halos = less than 1.5

5.10 Raster Regulation

Raster Size Regulation (Full White pattern)	Judgment: 1.The picture size should not vary more than following spec. by luminance change from 100cd/m^2 to 30cd/m^2. 2.The picture size should not vary more than following spec. by input voltage change in 90-132VAC and 198-264VAC. Size Change Spec. Signal No.13 $$\frac{|H1-H2|}{H2} \leq 0.5\%$$ $$\frac{|V1-V2|}{V2} \leq 0.5\%$$ All preset signals except No.13 $$\frac{|H1-H2|}{H2} \leq 0.7\%$$ $$\frac{|V1-V2|}{V2} \leq 0.7\%$$

6. CRT Screen and Faceplate Blemish Limits

6.1 CRT Face Plate Defect

6.1.1 Inspection Condition

(1) In the operating condition, observe the defect on the screen under following condition.

9,300K (x=0.283, y=0.297) white raster or the element monochrome raster which its brightness is 34cd/m^2 (10ft·L) on the screen center surrounding light is about 10 Lux.

(2) In the non-operating condition, observe the defect of the screen under light of about 200 Lux, measured at the faceplate.

(3) Inspection shall be made more than 45 cm away from the screen.

(4) Observe the screen on white raster and each monochrome color of red, green and blue.

6.1.2 Division of Zone

A screen is divided into following 2 zones.

zone A :   Area inside the rectangle that its size measures the followings in the center of screen.

H : 300 mm, V : 225 mm

zone B :   Area outside the above rectangle

6.1.3 Limits

(1) CRT face defect

(a) Distance (minimum distance)

(b) Average diameter
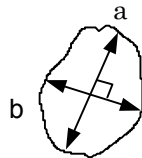
Turn of $\dfrac{a+b}{2}$ (a: length, b: width)

(c) Limit

* Dark spot, Blocked aperture

Average diameter (mm)	A	B	A + B	minimum distance
0.51 ~	0	0	0	-
0.31 ~ 0.50	0	0	0	-
0.15 ~ 0.30	6 (note 1)	6 (note 1)	10 (note 1)	10 mm

* Discoloration, stain, Missing phosphor, etc.

Average diameter (mm)	A	B	A + B	minimum distance
0.51 ~ 0.75	0	1	-	20 mm
0.15 ~ 0.50	2	3	-	20 mm

Note 1 : No missing spot larger than specified are allowed in Zone A.

Note 2 : The spec applies to each color.

5-23

(2) Face plate defect

(a) Blisters, opaque spots and elongated closed blisters

Average diameter (mm) #1	Allowable number (pcs)			Minimum Separation (mm)
	Zone A	Zone B	Total	
0.76 ~	0	0	0	30
0.51 ~ 0.75	0	1	1	
0.26 ~ 0.50	2	3	5	
0.11 ~ 0.25	-	-	-	#2

#1: Mean diameter shall be either one of the following values, which is smaller.

(a+b)/2 or a/20+2b   (a: length , b: width)

#2:Maximum 5 pcs. In area of φ10mm.

(b) Scratch

Width (mm)	Allowable Length (mm)
0.16 ~	rejected
0.11 ~ 0.15	3
0.06 ~ 0.10	26
~ 0.05	unlimited

(c) Other glass defects

Flaw, crack and lack cannot be distinguish easily by naked eye.

Iron rust conforms to limited sample.

6.2 AR-film's Surface Defect

6.2.1 Inspection Condition

(1) Put a valve on an inspective stand and Illuminate it from the top with white fluorescent light.

(2) Valve surface Illuminance is more than 1000Lux and less than 1000Lux.

(3) Observe from distance of 40cm from surface, disregard flaws which can not be distinguished from this distance.

6.2.2 Division of Zone

A screen is divided into following 3 zones.

zone A : Area inside the rectangle that its size measures the followings in the center of screen.

H : 300 mm, V : 225 mm

zone B : Area outside zone A and inside the fluorescent surface edge.

zone C : Area outside the fluorescent surface edge.
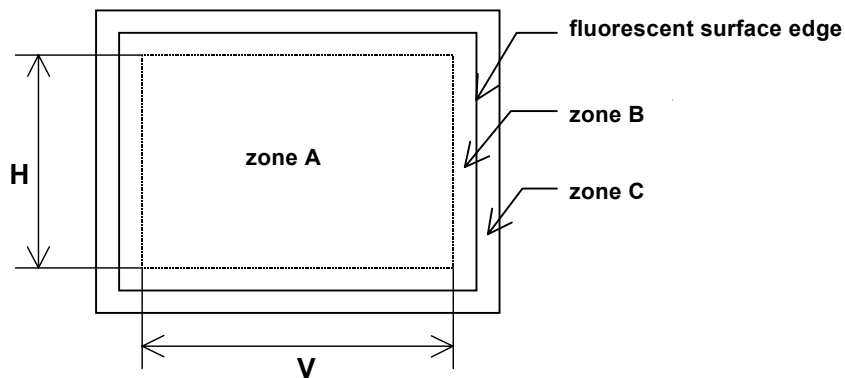
6.2.3 Limits

(1) Scratch

Width (mm)	Allowable Length (mm)(Zone A + Zone B)
0.16 ~	reject
0.11 ~ 0.15	13
0.06 ~ 0.10	26
~ 0.05	unlimited

NOTE 1 : Even though width of scratch is more than 0.16mm, regard scratch whose contrast is weak extremely as stain and apply standard of 6.2.3(2).

NOTE 2 : Do not recognize flaws which injures goods prices though it is not especially stipulated as for zone C.

(2) Opaque flaws (ex. Stain) and coating peeling

Do not apply the following standard to zone C.

Classify flaws by contrast and judge it by size every the contrast.

Definition of a contrast

High contrast :   The foreign substance which shuts off light from fluorescence surface.

Middle contrast : A semitransparent foreign substance and stain.
(ex. coating material which has been changed)

Low contrast :   stain and dust which do not reflect light from fluorescence surface and can be distinguished by its appearance.

Note : Ignore the light spot with no interference color.

(However, Non of them with its size in excess of 3.75 mm is acceptable, that damages the product quality.)

Standard

Average diameter classified by a contrast (Note 1) (mm)			Allowable number		Allowable Length (mm)
High contrast	Middle contrast	Low contrast	zone A	zone B	
~ 0.10	~ 0.20	~ 0.50	Ignore	Ignore	-
0.11 ~ 0.25	0.21 ~ 0.50	0.51 ~ 1.25	2 〔4〕	4 〔5〕	20
0.26 ~ 0.50	0.51 ~ 1.00	1.26 ~ 2.50	1 〔4〕	2 〔4〕	40
0.51 ~ 0.75	1.01 ~ 1.50	2.51 ~ 3.75	0 〔4〕	1 〔4〕	80

Values inside [ ] represent acceptable number in low contrast.

See the table in the next page for total defect number, which is acceptable in low contrast.

NOTE 1 : Convert (a+b)/2 or a/20 + 2b small value into average diameter.

　　　　(a: length, b: width)

total number of a low contrast flaws	zone A	zone B
Standard classified by zones	6	8
Total (zone A + zone B)	10	

NOTE 1 : Acceptable interval shall be larger one in the case that defects have different interval.

NOTE 2 : There is no standard regarding zone C. Therefore, no defect is accepted that may deteriorate the value of products. Defect level by consultation. Discuss is necessary.

NOTE 3 Tolerance of defect size is approx. 10%.

7. Inspection of PLUG & PLAY Communication and OSM "MONITOR INFORMATION" for Model Name/ Serial Number

7.1 A System Construction

This system should be connected as shown below.
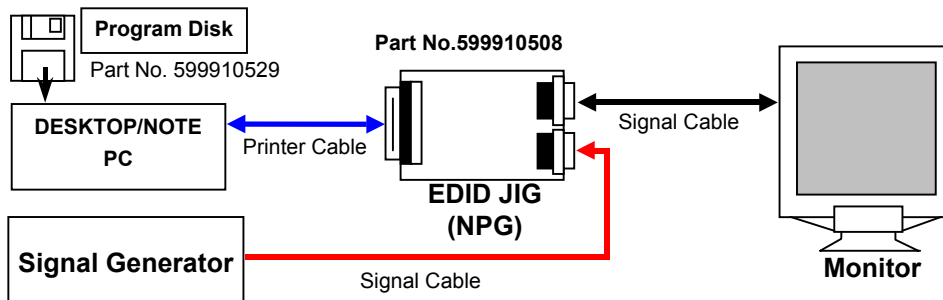
7.2 Input Signal

Horizontal sync frequency: Not specified.

Vertical sync frequency: Not specified.

7.3 Programs Required

CN8701.EXE
DP74SB.BAT
DP74SB.TXT

7.4 Inspection Procedures

a. Power on pressing "-" button.

b. Copy the above-mentioned programs in an adequate directory.

c. Set up the MO-DOS mode. (DOS Prompt of Windows95/98 is also acceptable.)

d. Execute the DP74SB.BAT from the command line.

e. "MONITOR INFO." of the OSM is indicated, and a model name and a serial number are confirmed.
When the model name and the serial number are not written in or it differs, h or later is performed.

f. Press the F1 key to start the inspection of DDC1.
As a result of inspection, when EDID data is not written in or it differs, h or later is performed.

g. Press the F2 key to start the inspection of DDC2B.
As a result of inspection, when EDID data is not written in or it differs, h or later is performed..

h. Check the serial number of the set and enter an input of the following code from the keyboard.

08109691   Serial Number (*+Model Code + 3 Spaces + Serial No. +*)

Example: *08109693…2150001YB*

i. Press the Enter key. Then, the EDID data, OSM model name, and the serial number begin to be written in.
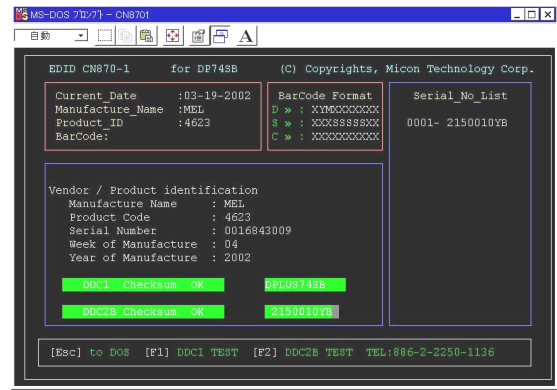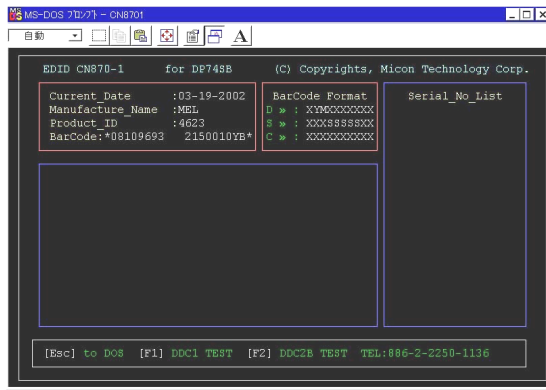
j. Display "MONITOR INFO." of the OSM, and confirm that the model name and serial number have been correctly written.
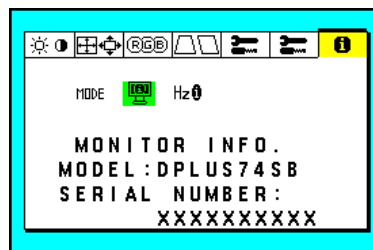
k. Press the F1 key to start the inspection of DDC1.

After the completion of inspection, the contents of EDID are displayed. If an error should occur, the related error message will be displayed in the bottom area of the screen. Refer to Paragraph 7.5 in regard to the meaning of this error message.

l. Press the F2 key to start the inspection of DDC2B.

After the completion of inspection, the contents of EDID are displayed. If an error should occur, the related error message will be displayed in the bottom area of the screen. Refer to Paragraph 7.5 in regard to the meaning of this error message.
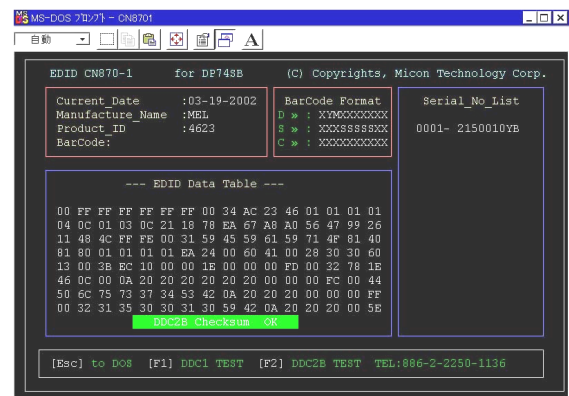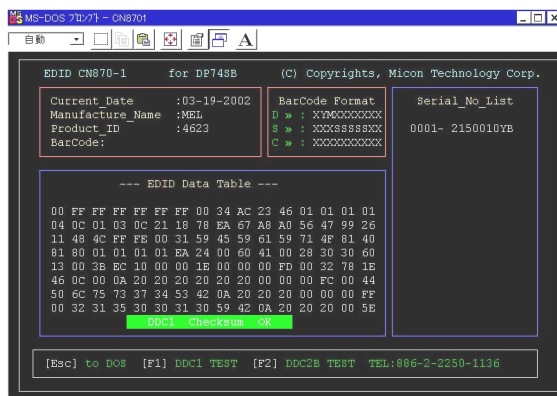
7.5 Error Messages

- IIC Communication Error

  Communication disabled

- EDID Check Sum Error

  Entry of false EDID

- DDC1 Does Not Find Head Data

  DDC1 Communication disabled

- DDC2 Does Not Find Head Data

  DDC2 Communication disabled

7.6 EDID Data File

The EDID data file text is shown below. When you write or inspect EDID for this monitor, the following table can be used.

File name : DP74SB.TXT

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	00	FF	FF	FF	FF	FF	FF	00	34	AC	23	46	01	01	01	01
10	30 *1	0B *2	01	03	0C	21	18	78	EA	67	A8	A0	56	47	99	26
20	11	48	4C	FF	FE	00	31	59	45	59	61	59	71	4F	81	40
30	81	80	01	01	01	01	EA	24	00	60	41	00	28	30	30	60
40	13	00	3B	EC	10	00	00	1E	00	00	00	FD	00	32	78	1E
50	46	0C	00	0A	20	20	20	20	20	20	00	00	00	FC	00	44
60	50	6C	75	73	37	34	53	42	0A	20	20	20	00	00	00	FF
70	00	31 *3	5A *3	30 *3	30 *3	30 *3	30 *3	31 *3	59 *3	41 *3	0A *3	20 *3	20 *3	20 *3	00	11 *4

Table 7.6 Data list

*1 : address 10h   Manufactured month x 4
*2 : address 11h   Manufactured year - 1990
*3 : address 71h ~ 7Dh   Input serial number (ASCII code)
                                      Add 0Ah after serial number.
                                      Add 20th remaining address.
*4 : address 7Fh   Checksum. The sum of entire 128byte shall be equal to 00h.

Appendix 1 Preset Timing Chart
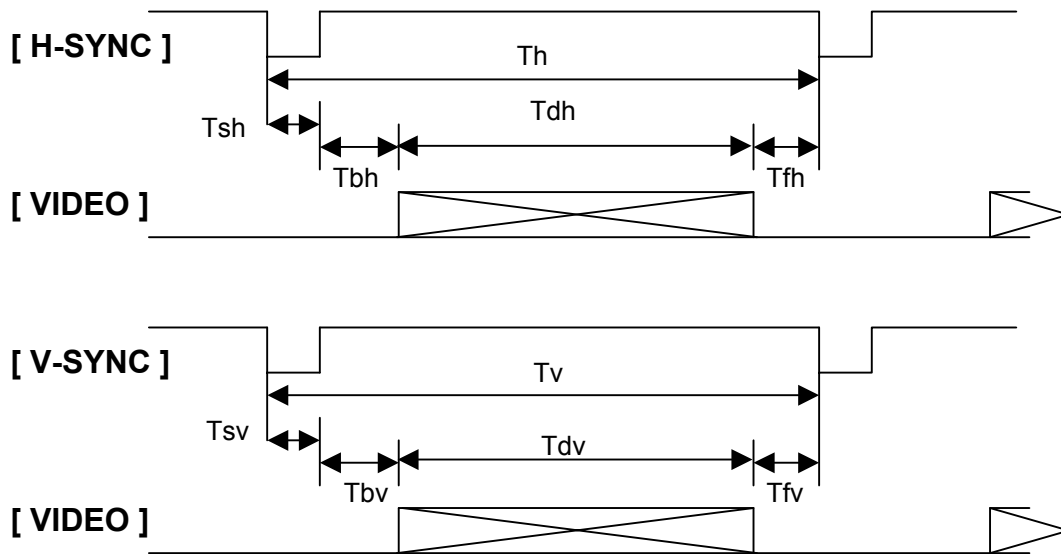
Preset Signal

No	Signal Name	Clock (MHz)	Fh (kHz)	Fv (Hz)	Th (uSec) (dot)	Tsh (uSec) (dot)	Tfh (uSec) (dot)	Tbh (uSec) (dot)	Tdh (uSec) (dot)	Tv (mSec) (line)	Tsv (mSec) (line)	Tfv (mSec) (line)	Tbv (mSec) (line)	Tdv (mSec) (line)	Hs	Vs
1	VGA 720*350(70)	28.322	31.469	70.087	31.777 (900)	3.813 (108)	0.636 (18)	1.907 (54)	25.422 (720)	14.268 (449)	0.064 (2)	1.176 (37)	1.907 (60)	11.122 (350)	+	-
2	VGA 720*400(70)	28.322	31.469	70.087	31.777 (900)	3.813 (108)	0.636 (18)	1.907 (54)	25.422 (720)	14.268 (449)	0.064 (2)	0.381 (12)	1.112 (35)	12.711 (400)	-	+
3	VGA 640*480(60)	25.175	31.469	59.940	31.778 (800)	3.813 (96)	0.636 (16)	1.907 (48)	25.422 (640)	16.683 (525)	0.064 (2)	0.318 (10)	1.049 (33)	15.253 (480)	-	-
4	Mac640*480	30.240	35.000	66.667	28.571 (864)	2.116 (64)	2.116 (64)	3.175 (96)	21.164 (640)	15.000 (525)	0.086 (3)	0.086 (3)	1.114 (39)	13.714 (480)	-	-
5	VESA 640*480(75)	31.500	37.500	75.000	26.667 (840)	2.032 (64)	0.508 (16)	3.810 (120)	20.317 (640)	13.333 (500)	0.080 (3)	0.027 (1)	0.427 (16)	12.800 (480)	-	-
6	VESA 800*600(75)	49.500	46.875	75.000	21.333 (1056)	1.616 (80)	0.323 (16)	3.232 (160)	16.162 (800)	13.333 (625)	0.064 (3)	0.021 (1)	0.448 (21)	12.800 (600)	+	+
7	VESA 640*480(85)	36.000	43.269	85.008	23.111 (832)	1.556 (56)	1.556 (56)	2.222 (80)	17.778 (640)	11.764 (509)	0.069 (3)	0.023 (1)	0.578 (25)	11.093 (480)	-	-
8	VESA 1024*768(60)	65.000	48.363	60.004	20.677 (1344)	2.092 (136)	0.369 (24)	2.462 (160)	15.754 (1024)	16.666 (806)	0.124 (6)	0.062 (3)	0.600 (29)	15.880 (768)	-	-
9	MAC832*624	57.283	49.725	74.550	20.111 (1152)	1.117 (64)	0.559 (32)	3.910 (224)	14.524 (832)	13.414 (667)	0.060 (3)	0.020 (1)	0.784 (39)	12.549 (624)	-	-
10	VESA 800*600(85)	56.250	53.674	85.061	18.631 (1048)	1.138 (64)	0.569 (32)	2.702 (152)	14.222 (800)	11.756 (631)	0.056 (3)	0.019 (1)	0.503 (27)	11.179 (600)	+	+
11	VESA 1024*768(75)	78.750	60.023	75.029	16.660 (1312)	1.219 (96)	0.203 (16)	2.235 (176)	13.003 (1024)	13.328 (800)	0.050 (3)	0.017 (1)	0.466 (28)	12.795 (768)	+	+
12	VESA 1280*1024(60)	108.00	63.981	60.020	15.630 (1688)	1.037 (112)	0.444 (48)	2.296 (248)	11.852 (1280)	16.661 (1066)	0.047 (3)	0.016 (1)	0.594 (38)	16.005 (1024)	+	+
13	VESA 1024*768(85)	94.500	68.677	84.997	14.561 (1376)	1.016 (96)	0.508 (48)	2.201 (208)	10.836 (1024)	11.765 (808)	0.044 (3)	0.015 (1)	0.524 (36)	11.183 (768)	+	+

TROUBLE SHOOTING

TABLE OF CONTENTS

Refer to User's Manual trouble shooting section before using this chart.

1. NO OPERATION, POWER LED FLASH

```
        ┌─────────────────────┐
        │  POWER LED FLASH    │
        └─────────────────────┘
                  │
                  ▼
            ╱─────────╲
           ╱  POWER SW ╲
           ╲  TURN OFF ╱
            ╲─────────╱
                  │
                  ▼
        ╱───────────────────╲
       ╱  MULTIMETER TEST    ╲
       ╲  Q307, U302         ╱
        ╲ D110, D111, D112, D113 ╱
         ╲───────────────────╱
                  │
                  ▼
            ╱─────────╲            ┌──────────────────────────────────────┐
           ╱  CHECK    ╲           │ 1. DC P/S O/P VOLTAGE SET AT 12V,CURRENT │
           ╲  U302     ╱───────────│    SET AT 600MA. POSITIVE CONNECT TO    │
            ╲─────────╱            │    C330"+". NEGATIVE CONNECT TO U302-pin 7. │
                  │                │                                        │
                  │                │ 2. SCOPE SET AT 10V/DIV, 10US/DIV, PROBE │
                  │                │    CONNECT TO Q319-GATE AND U302pin 6.  │
                  │                └──────────────────────────────────────┘
                  ▼
            ╱─────────╲                    ┌─────────────────────┐
           ╱ U302 PIN6 ╲       NO          │      CHECK          │
           ╲ PULSE O/P ╱───────────────────▶│  U302 PIN 10 VCC   │
            ╲─────────╱                    │   PIN 4 SAWTOOTH    │
                  │                        │     PIN 8, 5V       │
                  │                        └─────────────────────┘
                  ▼                                  │
        ┌─────────────────┐                          ▼
        │   POWER SW      │                ┌─────────────────────┐
        │   TURN OFF      │                │      FAILURE        │
        └─────────────────┘                │    U302, Q106       │
                                           └─────────────────────┘
```

2. NO OPERATION, POWER LED OFF

```
┌─────────────────┐
│   POWER SW      │
│   TURN OFF      │
└─────────────────┘
         │
         ▼
      ╱────────╲
     ╱  CHECK    ╲
    ╱   F101      ╲
     ╲           ╱
      ╲────────╱
         │
         ▼
      ╱────────╲
     ╱  CHECK    ╲
    ╱   Q101      ╲
     ╲           ╱
      ╲────────╱
         │
         ▼
      ╱────────╲
     ╱  CHECK    ╲───────  ┌──────────────────────────────────────────┐
    ╱   U101      ╲        │ 1.  DC P/S O/P VOLTAGE SET AT 17V,CURRENT SET │
     ╲           ╱         │     AT 200MA. POSITIVE CONNECT TO C109"+". │
      ╲────────╱           │     NEGATIVE CONNECT TO C105"-".          │
         │                 │                                          │
         │                 │ 2.  SCOPE SET AT 10V/DIV, 10US/DIV, PROBE  │
         │                 │     CONNECT TO Q101-GATE AND C105"-".      │
         ▼                 └──────────────────────────────────────────┘
      ╱────────╲                        ┌──────────────────┐
     ╱ U101 PIN6 ╲      NO              │     CHECK        │
    ╱  PULSE O/P  ╲─────────────────────▶│ U101 PIN 7 VCC   │
     ╲           ╱                       │ PIN 4 SAWTOOTH   │
      ╲────────╱                         │   PIN 8, 5V      │
         │                               └──────────────────┘
         │                                        │
         ▼                                        ▼
┌─────────────────┐                    ┌──────────────────┐
│   POWER SW      │                    │    FAILURE       │
│   TURN ON       │                    │ R114, R120, ZD106│
└─────────────────┘                    └──────────────────┘
```

3. VIDEO NOISE, UNSYNCHRONOUS

```
                    ┌─────────────────────┐
                    │       CHECK         │
                    │ Q101 G-S FREQUENCY  │
                    └─────────────────────┘
                               │ YES
                               ▼
┌──────────────────┐      ◇◇◇◇◇◇◇◇◇◇◇      ┌──────────────────────┐
│ CHECK D124, R116 │◄─NO─ SYNCRONIZE ─NO─►│  CHECK HORIZONTAL    │
│ D109, R115, R117 │      WITH H-SYNC     │ FREQUENCY D124 TO GND│
└──────────────────┘      ◇◇◇◇◇◇◇◇◇◇◇      └──────────────────────┘
                               │ YES
                               ▼
                          ◇◇◇◇◇◇◇◇◇◇◇◇
                             CHECK
                         Q319 G-S FREQUENCY
                          ◇◇◇◇◇◇◇◇◇◇◇◇
                               │
                               ▼
┌──────────────────┐      ◇◇◇◇◇◇◇◇◇◇◇      ┌──────────────────────┐
│  CHECK R30X, FBT │◄─NO─ SYNCRONIZE ─NO─►│  CHECK HORIZONTAL    │
│      PIN6        │      WITH H-SYNC     │ FREQUENCY C359 TO GND│
└──────────────────┘      ◇◇◇◇◇◇◇◇◇◇◇      └──────────────────────┘
                               │
                               ▼
                    ┌─────────────────────┐
                    │  NORMAL OPERATION   │
                    └─────────────────────┘
```

4. NO VIDEO

```
        ┌─────────────────┐
        │    NO VIDEO     │
        └─────────────────┘
                 │ YES
                 ▼
          ╱─────────────╲
         ╱    CHECK       ╲        NO      ┌─────────────────┐
        ╱  SCREEN CONTROL  ╲──────────────▶│   REFER TO      │
        ╲   CLOCKWISE      ╱               │  "NO RASTER"    │
         ╲               ╱                 │   ON PAGE       │
          ╲─────────────╱                  └─────────────────┘
                 │ YES
                 ▼
          ╱─────────────╲
         ╱    CHECK       ╲        NO      ┌─────────────────┐
        ╱  U201 PIN 5, 6, 7 ╲────────────▶│   TROUBLE IN    │
        ╲   SIGNAL LEVEL   ╱               │  R/G/B SIGNAL,  │
         ╲               ╱                 │  SIGNAL CABLE   │
          ╲─────────────╱                  └─────────────────┘
                 │ YES
                 ▼
          ╱─────────────╲
         ╱    CHECK       ╲        NO      ┌─────────────────┐
        ╱ U201 PIN 18,19,20 ╲───────────▶│ PROBLEM IN U201 │
        ╲   SIGNAL LEVEL   ╱               │ CLAMP (PIN 23)  │
         ╲               ╱                 │ U201 12V VOLTAGE│
          ╲─────────────╱                  └─────────────────┘
                 │ YES
                 ▼
          ╱─────────────╲
         ╱    CHECK       ╲        NO      ┌─────────────────┐
        ╱ U204 PIN 6, 7, 9 ╲────────────▶│ PROBLEM IN U204 │
        ╲   SIGNAL LEVEL   ╱               │ 12V, 80V VOLTAGE│
         ╲               ╱                 └─────────────────┘
          ╲─────────────╱
                 │ YES
                 ▼
          ╱─────────────╲
         ╱    CHECK       ╲        NO      ┌─────────────────┐
        ╱  CATHODE VIDEO   ╲────────────▶│  PROBLEM IN     │
        ╲    LEVEL         ╱               │ R255, R235, R215│
         ╲               ╱                 └─────────────────┘
          ╲─────────────╱
                 │ YES
                 ▼
        ┌─────────────────┐
        │ PROBLEM IN CRT  │
        └─────────────────┘
```

5. NO RASTER

```
┌─────────────────┐
│   NO RASTER     │
└─────────────────┘
         │ YES
         ▼
      CHECK                    NO      ┌─────────────────┐
      B+        ──────────────────────▶│  POWER SUPPLY   │
                                       │     CHECK       │
         │ YES                         └─────────────────┘
         ▼
      CHECK
   U302 PIN 14, 15               NO     ┌─────────────────┐
     H/V SYNC    ───────────────────────▶│   PROBLEM IN    │
                                        │    MCU U701     │
         │ YES                          └─────────────────┘
         ▼
      CHECK
  U302 PIN 18, 19, 8             NO     ┌─────────────────┐
       SYNC      ───────────────────────▶│   PROBLEM IN    │
                                        │   U701, U302    │
         │ YES                          └─────────────────┘
         ▼
      CHECK
  T301 PIN 3 VOLTAGE            NO      ┌──────────────────────┐
  56V, 68V(AT H-FREQ. ──────────────────▶│    PROBLEM IN        │
     31.5KHz)                           │ U302, Q319, D335, L304│
                                        │ OR DEFLECTION YOKE   │
         │ YES                          └──────────────────────┘
         ▼
    CHECK Q307
 COLLECTOR ABOUT              NO        ┌─────────────────┐
    1050Vp-p     ──────────────────────▶│   PROBLEM IN    │
                                        │ Q307, Q308, T302,│
         │ YES                          │   D307, D308    │
         ▼                              └─────────────────┘
     CHECK G1
  VOLTAGE ABOUT              NO         ┌─────────────────┐
    -45~65V      ──────────────────────▶│   PROBLEM IN    │
                                        │ Q305, Q306, D318 │
         │ YES                          │   T301, C344    │
         ▼                              └─────────────────┘
┌─────────────────┐
│   PROBLEM IN    │
│   G2 VOLTAGE    │
└─────────────────┘
```

6. TROUBLE IN H. V SYNC

```
┌─────────────────────┐
│ PROBLEM IN          │
│ HOR. OR VER. SYNC   │
└─────────────────────┘
         │ YES
         ▼
      CHECK
   CONNECTOR S702        NO        ┌─────────────────┐
   (PIN4, 5), SIGNAL  ─────────▶   │ PROBLEM IN      │
                                   │ SIGNAL CABLE    │
         │ YES                     └─────────────────┘
         ▼
      CHECK
   U701 (PIN 40,39)       NO       ┌─────────────────────┐
   H/V SYNC.          ─────────▶   │ PROBLEM IN          │
   SIGNAL                          │ H/V SYNC LINE &     │
                                   │ Q301, Q401          │
         │ YES                     └─────────────────────┘
         ▼
      CHECK                     CHECK
   U701 (PIN 32,33)   NO     U701 (PIN 5)      NO     ┌─────────────┐
   H/V SYNC.       ─────▶    VOLTAGE        ─────▶    │ PROBLEM IN  │
   SIGNAL                    5V?                      │ 5V LINE     │
                                                      └─────────────┘
         │ YES                     │ YES
         ▼                         ▼
      CHECK                     CHECK
   U302 PIN 14, 15    NO     U701 (PIN 8)      NO     ┌──────────────────┐
                   ─────▶    FREQ.12MHz     ─────▶    │ PROBLEM IN U203  │
                                                      │ 12V, 80V VOLTAGE │
         │ YES                     │ YES              └──────────────────┘
         ▼                         ▼
┌─────────────┐           ┌─────────────┐
│ PROBLEM IN  │           │ PROBLEM IN  │
│ U302        │           │ U701        │
└─────────────┘           └─────────────┘
```

7. POOR PINCUSHION

```
┌─────────────────┐
│     POOR        │
│   PINCUSHION    │
└─────────────────┘
         │
         ▼
      ╱────────╲                              ┌─────────────────┐
     ╱ PARABOLA ╲────── YES ──────────────►   │  CHECK U301,    │
     ╲   WAVE   ╱                             │   Q316~Q318     │
      ╲────────╱                              └─────────────────┘
         │
         NO
         │
         ▼
      ╱────────╲                              ┌─────────────────┐
     ╱  CHECK   ╲                             │                 │
    ╱ U302 PIN 11╲───── YES ──────────────►   │ CHECK R390, U301│
     ╲ PARABOLA ╱                             │                 │
      ╲────────╱                              └─────────────────┘
         │
         NO
         │
         ▼
      ╱────────╲                              ┌─────────────────┐
     ╱  CHECK   ╲                             │                 │
    ╱ U302 PIN 14╲───── YES ──────────────►   │ CHECK 12V & U302│
     ╲SYNC INPUT ╱                            │                 │
      ╲────────╱                              └─────────────────┘
         │
         NO
         │
         ▼
┌─────────────────┐
│ CHECK U701 (PIN 32)│
│     OUTPUT      │
└─────────────────┘
```

CIRCUIT DESCRIPTION

TABLE OF CONTENTS

1. Power supply circuit

1.1 Outline

This power supply unit uses switching mode technology, and is an off-line mode type unit that provides several different DC outputs. The scanning frequency is available in different values ranging from 31 kHz to 69 kHz. Moreover, it is capable of operating at an AC input voltage of 100V ~ 240V and an AC frequency of 50-60 Hz ±3Hz.

The block diagram is the functional construction schematics, that shows the major functions of this power supply unit.

1.2 Harmonics (OPTION)

L107 is a harmonic choke circuit that reduces the harmonic peak currents, for the purpose of fulfilling the requirement items of IEC 1000-3-2.

1.3 EMI

The EMI circuit has a 2-stage construction, with the first stage consisting of the common mode choke unit and one X-capacitor, and the second stage consisting of the common mode choke unit and four Y-capacitors.

R101 is the X-capacitor bleed resistor. When the power supply switch is turned OFF, this resistor carries out the emergency charging of the capacitor C101.

The EMI is the circuit that prevents monitor switching noise from being generated, there by minimizing the negative influence on other electronic equipment.

1.4 AC rectifier and smoothing capacitor

The AC input is rectified by means of the full-bridge rectifier, that consists of the diodes D101 to D104. The AC voltage is converted into the DC voltage by passing through the next stage, that consists of the smoothing capacitor C105.

TH101 is a NTC thermistor for the power supply at the in-rush current limit.

1.5 Degaussing circuit

The degaussing circuit consists of the PTC thermistor TH102, the degaussing coil and relay RL101. The relay is controlled by means of the +12V control signal coming from the CPU.

1.6 Transformer and energy induction

1) When the PWM controls IC KA3842A chip, a driving pulse is generated at the gate of the transistor Q101, and Q101 turns ON. The current returns from the "plus" (+) side of the energy-supplying capacitor C105 to the "minus" (-) side of the same capacitor C105, passing through the transformer Q101 D-S. During the ON cycle, the energy is stored in the transformer T101. The transistor Q101 turns OFF when the driving pulse disappears from Q101. As a result, all voltages of the dot ends of the winding flow to the positive direction and reach the fly-back rectifier. At that point of time, the diodes of the rectifier of the secondary side turn ON, a temporary energy is induced at the secondary side, and the ON cycle of the driving pulse is repeated.

2) The power supply MOS FET Q101 carries out the ON/OFF operation of the control unit, by means of U101 KA3842A. KA3842A is a PWM (pulse width modulation) IC chip, with 16 V starting voltage and 10 V cut-off voltage.

The following list shows the pin layout of KA3842A pulse width modulation IC chip.

Pin 1:	Feedback	Pin 2:	Compensation
Pin 3:	Current sensor	Pin 4:	Oscillator
Pin 5:	Ground (GND)	Pin 6:	Pulse output
Pin 7:	VCC	Pin 8:	VREF (5.1 V)

3) Overcurrent protection

R111 is a sensor resistor, and it has the function of increasing the current of this loop when the output of the secondary side is either in the overloaded state or is insufficient.

Since the current passing through the R111 sensor resistor has a voltage dropping effect, the operation of the output pulse is stopped when a voltage lower than 1 Volt is detected at pin number 3 of KA3842A 3chip, and the switch of the power supply MOS FET is kept in the "break" state until the VCC voltage is charged up to 16 Volts, and the operation of U101 KA3842A resumes. When it is not clearly known whether there is voltage shortage or not, however, this circuit repeats the ON/OFF switching, and the power supply LED lights up.

4) Starting circuit

The resistors R122 and R123 and the transistor U103 and diode D131 and resistor R169 and zener diode ZD101 are for operation starting. When the circuit starts its operation, the power supply transformer T101 supplies the auxiliary 12 Volt power to the control IC chip U101 via pins 6 and 7 of the winding transformer T101.

5) Synchronization circuit

The synchronization signal is induced from the fly-back transformer (FBT), and carries out the synchronization with the power supply frequency. The frequency range is from 31 kHz to 70 kHz, and the component elements of the synchronization circuit are D124, R116, D109, R115 and R117.

6) Feedback circuit

The feedback circuit loop induces the 12 V voltage through the pin 6 and the pin 7 of the power supply transformer. This voltage is connected with the pin 3 of the IC chip U101 by passing through U103, R135, R136 and passing next through is a regular loop.

7) Snubber circuit

The snubber circuit has the function of clamping the ON/OFF spikes of the power supply MOS-FET, and its component elements D105, C106, R106 make up a snubber that turns OFF the power supply MOS-FET.

8) Secondary rectifier and smoothing rectifier

The secondary rectifier is a harmonic rectifier consisting of D111, C124 and R128, and it works as a snubber circuit as well. The capacitors C120 and C138 are smoothing rectifiers working on the 49 Volt DC output. There are also other DC outputs, such as 80 Volt (D110), 13.5 Volt (D112) and 6.3 Volt (D113).

1.7 Power saving

Suspend mode   : Every DC voltage operation of the CRT is turned OFF.
           The color of the power LED101 switches from green to orange.

OFF mode   : This is the mode in which the CPU control unit turns OFF the power supply, but
           the power turns ON when the user touches the keyboard.
           The power LED switches to dark orange color.

1) When the power switch is turned ON, and there is no sync pulses to the video cable, the video shifts from the free-run mode to the suspend mode. Transistor Q107 turns OFF and the operation returns to the OFF mode within a few seconds.

2) As for the sequence of steps that turn the operation to the OFF mode, if the keyboard is not touched for a given period of time that a preset in advance, the CPU outputs the LOW level signal to transistor Q107, then Q105 turns OFF, transistor Q108 and Q104 turn OFF. As a result the power is shut out at that state.

3) When the user touches the keyboard in the OFF mode, the operation resumes, the video signals V-SYNC and H-SYNC turn ON the CPU via resistors R129 and R173, then the transistors Q105 and Q107 turn ON, transistors Q104 and Q108 turn ON. As a result the operation returns to the ON state.

1.8 DC/DC

The DC/DC voltage is DC 49 volts, and since the set-up voltage is variable from 62 volts to 160 volts, it is variable depending on the horizontal sync. The frequency band is variable from 31 kHz to 69 kHz. The voltage is fed back from the fly-back transformer (FBT). The DC/DC output voltage is used as high-voltage input of FBT T301.

1) DC/DC is a step-up circuit, and consists mainly of the choke L304, the transistor Q319, the diode D335 and U302.

2) PWM controls U302 IC TDA4857, a driving pulse is generated at the gate of transistor Q319 turning it ON. During the ON cycle, the energy is stored in the choke L304.
Transistor Q319 turns OFF when the driving pulse disappears from the gate.
As a result, the voltage at the dot terminal of the winding flows in the positive direction and goes to the fly-back rectifier. The energy stored in the choke L304 enters the FBT, passing through choke L304, diode D335 and capacitor C373.

3) The feedback is detected by the FBT via diode D310, capacitor C326, resistor R349, variable resistor VR102 and fixed resistor R382, and is connected to U302 pin 5.
This is loop is the regular type one.

4) The frequency of the sync signal coming from video H-SYNC is variable from 31 kHz to 69 kHz. The circuit consists of the R30X.

5) The soft start circuit consists of resistor R30P, capacitor C309, diode D303 and Q326.

2. MCU

Monitor MCU Specification

Frequency Specification

H-freq.　: 29.5K – 70kHz

V-freq.　: 43 – 160Hz

Judge polarity only when horizontal frequency is 31.5 kHz and 37.8 kHz

Support composite sync detection

System Architecture

1. MCU – Weltrend WT6260, 60K bytes ROM size
2. EEPROM – 24C08 series, 8K bit, with ID code for identify initialization.
3. OSD – Myson MTV030N-46

Input

1. Sync input　　　– 2 pins for H-sync & V-sync frequency inverted input.
2. Key input　　　– 2 pins for A/D key input (SELECT. UP, DOWN and RECALL).
3. Burn-in ID input – 1 pins for Burn-in ID input.
4. Reset input　　　– low pulse for reset MCU
5. Crystal input – 2 pins using 8MHz crystal.

Output – MCU digital pin

1. Degauss – Active high pulse for 2.5 sec when in degauss. MCU will activate degauss while power on.
2. CS output – 3 pins (CS2, CS1, CS0) for CS control

H-sync	CS2	CS1	CS0
H-sync $<$ 33.25kHz	0	0	0
33.25kHz $<$ H-sync $<$ 36.50kHz	0	1	0
36.50kHz $<$ H-sync $<$ 40.50kHz	0	1	1
40.50kHz $<$ H-sync $<$ 45.10kHz	1	0	0
45.10kHz $<$ H-sync $<$ 51.60kHz	1	0	1
51.60kHz $<$ H-sync $<$ 55.10kHz	1	1	0
55.10kHz $<$ H-sync $<$ 62.15kHz	1	1	0
62.15kHz $<$ H-sync	1	1	1
Mode change	0	0	0

3. Power saving – 2 pins (PMUS, PMUO) for power saving control

　　　　　　– if Hf > 70kHz or Hf < 23kHz, enter power saving mode (suspend).

　　　　　　– enter power saving mode after 3 sec when condition is met.

　　　　　　– enter suspend mode first for 3 sec before enter off mode if off mode condition is met.

Mode	H-sync freq.	V-sync freq.	Burn-in ID	PMUS	PMUO
Normal	Yes	Yes	---	1	1
Stand By	No	Yes	---	0	1
Suspend	Yes	No	---	0	1
Off	No	No	Low	0	0
Burn-in	No	No	High	1	1

4. Mute – 2 pins for screen mute

　Mute1 – active low pulse for about 0.6 sec when mode change.

　Mute2 – active low pulse for about 1.0 sec when mode change, active with mute 1 simultaneously.

5. D/A – 14 pins (PWM output) are Brightness, Contrast, H-phase, H-size, V-center, V-size,
　　　　Pincushion, Trapezoid, Rotation, Parallel, Pin-balance, R-gain, G-gain and B-gain.

　　– DAC value 255 means the maximum output volts except Parallel PWM.

　　– All D/A except Rotation, Brightness, Contrast, R-gain G-gain B-gain are mode dependent
　　　functions.

　　– Parallel is voltage inverter function.

6. Sync output – 2 pins for H-sync and V-sync negative output, normal high.

7. DDC – 2 pins (DDC SDA/DDC SCL) for DDC1/DDC2B or auto alignment control.

　　　– In auto alignment mode, all keys and OSD are disabled.

8. SDA/SCL – 2 pins for EEPROM and OSD control.

9. WP – 1 pin, high for EEPROM write protect.

Control Panel Operation

KEY

| **KEY name** | **EXIT** | **<** | **>** | **+** | **-** | **SELECT** | **RESET** |
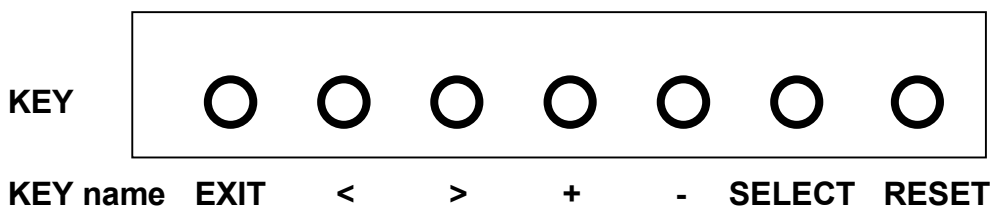
1. Key arrangement – 7 keys for OSD control.

2. Hot key operation

　Factory Mode: SELECT Key + UP (+) Key if pressed when the power SW on.

GENERAL DESCRIPTION

The WT62P2 is a microcontroller for digital controlled monitor with Universal Serial Bus (USB) interface. It contains an 8-bit CUP, 60K bytes Flash memory, 1024 bytes RAM, 256 bits bit-addressable RAM, 14 PWMs, parallel I/Os, SYNC signal processor, timer, DDC1/2B interface, master/slave IC interface, low speed USB device module, 6-bit A/D converter and watch-dog timer.

FEATURES

- 8-bit 6502 compatible CPU with 6MHz operating frequency
- 60K bytes flash memory, 1024 bytes SRAM, 256 bits bit-addressable SRAM
- 12MHz crystal oscillator
- 14 channels 8-bit PWM outputs
- Sync signal processor with H+V separation, H/V frequency counter, H/V polarity detection/control and clamp pulse output
- Six free-running sync signal outputs (Horizontal frequency up to 106kHz 85Hz@1600x1200)
- Self-test pattern
- DDC1/2B module for EDID1.3, EDID2.0 and Enhance EDID
- Fast mode master/slave I²C interface (up to 400kHz)
- Embedded USB function with endpoint 0 and endpoint 1
- Built-in 3.3V regulator for USB transceiver
- Watch-dog timer
- Maximum 28 programmable I/O pins
- One 8-bit programmable timer
- 6-bit A/D converter with 4 selectable inputs
- One external interrupt request input
- Low VDD reset

ORDERING INFORMATION

Package Type	Part Number
42-pin PDIP	WT62P2-N42
42-pin Shrink PDIP	WT62P2-K42
40-pin PDIP	WT62P2-N40
44-pin SOP	WT62P2-S44
44-pin PLCC	WT62P2-L44

42-pin PDIP
42-pin SPDIP

WT62P2-N42
WT62P2-K42

Pin	Signal		Pin	Signal
1	D+		42	D-
2	PWM2		41	VIN
3	PWM1		40	HIN
4	PWM0		39	PWM3
5	RESET/3V3		38	PD5/PWM4
6	VDD		37	PD4/PWM5
7	GND		36	PD3/PWM6
8	OSCO		35	PD2/PWM7
9	OSCI		34	PD1/HOUT
10	PB5/SDA2		33	PD0/VOUT
11	PB4/SCL2		32	PA7/PWM13/CLAMP
12	PB3/PAT		31	PA6/PWM12
13	PB2		30	PA5/PWM11
14	PB1/HFI		29	PA4/PWM10
15	PB0/HFO		28	PA3/PWM9
16	IRQ		27	PA2/PWM8
17	PC7/SOGIN		26	PA1/SCL1
18	PC6		25	PA0/SDA1
19	PC5		24	PC0/AD0
20	PC4		23	PC1/AD1
21	PC3/AD3		22	PC2/AD2

* 40-pin PDIP is used in this model.

40-pin PDIP

WT62P2-N40

Pin	Signal		Pin	Signal
1	PWM2		40	VIN
2	PWM1		39	HIN
3	PWM0		38	PWM3
4	RESET/3V3		37	PD5/PWM4
5	VDD		36	PD4/PWM5
6	GND		35	PD3/PWM6
7	OSCO		34	PD2/PWM7
8	OSCI		33	PD1/HOUT
9	PB5/SDA2		32	PD0/VOUT
10	PB4/SCL2		31	PA7/PWM13/CLAMP
11	PB3/PAT		30	PA6/PWM12
12	PB2		29	PA5/PWM11
13	PB1/HFI		28	PA4/PWM10
14	PB0/HFO		27	PA3/PWM9
15	IRQ		26	PA2/PWM8
16	PC7/SOGIN		25	PA1/SCL1
17	PC6		24	PA0/SDA1
18	PC5		23	PC0/AD0
19	PC4		22	PC1/AD1
20	PC3/AD3		21	PC2/AD2

44-pin SOP

WT62P2-S44

Pin	Signal		Pin	Signal
1	D+		44	D-
2	PWM2		43	VIN
3	PWM1		42	HIN
4	PWM0		41	PWM3
5	RESET/3V3		40	PD5/PWM4
6	VDD		39	PD4/PWM5
7			38	
8	GND		37	PD3/PWM6
9	OSCO		36	PD2/PWM7
10	OSCI		35	PD1/HOUT
11	PB5/SDA2		34	PD0/VOUT
12	PB4/SCL2		33	PA7/PWM13/CLAMP
13	PB3/PAT		32	PA6/PWM12
14	PB2		31	PA5/PWM11
15	PB1/HFI		30	PA4/PWM10
16	PB0/HFO		29	PA3/PWM9
17	IRQ		28	PA2/PWM8
18	PC7/SOGIN		27	PA1/SCL1
19	PC6		26	PA0/SDA1
20	PC5		25	PC0/AD0
21	PC4		24	PC1/AD1
22	PC3/AD3		23	PC2/AD2

44-pin PLCC

WT62P2-L44

Top pins (left to right): 6 RESET/3V3, 5 PWM0, 4 PWM1, 3 PWM2, 2 PWM2, 1 D+, 44 D-, 43 VIN, 42 HIN, 41 PWM3, 40 PWM3

Pin	Signal		Pin	Signal
7	VDD		39	PD5/PWM4
8	GND		38	PD4/PWM5
9	OSCO		37	PD3/PWM6
10	OSCI		36	PD2/PWM7
11	PB5/SDA2		35	PD1/HOUT
12	PB4/SCL2		34	PD0/VOUT
13	PB3/PAT		33	PA7/PWM13/CLAMP
14	PB2		32	PA6/PWM12
15	PB1/HFI		31	PA5/PWM11
16	PB0/HFO		30	PA4/PWM10
17	IRQ		29	PA3/PWM9

Bottom pins (left to right): 18 PC7/SOGIN, 19 PC6, 20 PC5, 21 PC4, 22 PC3/AD3, 23 PC2/AD2, 24 PC1/AD1, 25 PC0/AD0, 26 PA0/SDA1, 27 PA1/SCL1, 28 PA2/PWM8

PIN ASSIGNMENT AND PACKAGE TYPE

Pin No.				Pin Name	I/O	Descriptions
L40	S44	42	40			
1	1	1	-	D+	I/O	USB D+ signal.
2	2	2	1	PWM2	O	PWM2 output (10V open-drain).
3	3	3	2	PWM1	O	PWM1 output (5V open-drain).
4	4	4	3	PWM0	O	PWM0 output (5V open-drain).
5	5	5	4	/RESET/3V3	I	Reset input and +3.3V regulator output for USB tranceiver power supply.
6	-	-	-	NC		No Connection.
7	6	6	5	VDD		+5V power supply.
-	7	-	-	NC		No Connection.
8	8	7	6	GND		Ground.
9	9	8	7	OSCO	I/O	12MHz oscillator output.
10	10	9	8	OSCI	I	12MHz oscillator input.
11	11	10	9	PB5/SDA2	I/O	Port B5 or I^{2}C interface data line.
12	12	11	10	PB4/SCL2	I/O	Port B4 or I^{2}C interface clock line.
13	13	12	11	PB3/PAT	I/O	Port B3 or test pattern output.
14	14	13	12	PB2	I/O	Port B2.
15	15	14	13	PB1/HFI	I/O	Port B1 or half frequency divider input.
16	16	15	14	PB0/HFO	I/O	Port B0 or half frequency divider output.
17	17	16	15	/IRQ	I	Interrupt request input, A low level on this can generate interrupt.
18	18	17	16	PC7/SOGIN	I/O	Port C7 or Sync on Green input.
19	19	18	17	PC6	I/O	Port C6.
20	20	19	18	PC5	I/O	Port C5.
21	21	20	19	PC4	I/O	Port C4.
22	22	21	20	PC3/AD3	I/O	Port C3 or ADC input 3.
23	23	22	21	PC2/AD2	I/O	Port C2 or ADC input 2.
24	24	23	22	PC1/AD1	I/O	Port C1 or ADC input 1.
25	25	24	23	PC0/AD0	I/O	Port C0 or ADC input 0.
26	26	25	24	PA0/SDA1	I/O	Port A0 or DDC interface SDA pin.
27	27	26	25	PA1/SCL1	I/O	Port A1 or DDC interface SCL pin.
28	28	27	26	PA2/PWM8	I/O	Port A2 or PWM8 output.
29	29	28	27	PA3/PWM9	I/O	Port A3 or PWM9 output.
30	30	29	28	PA4/PWM10	I/O	Port A4 or PWM10 output.
31	31	30	29	PA5/PWM11	I/O	Port A5 or PWM11 output.
32	32	31	30	PA6/PWM12	I/O	Port A6 or PWM12 output.
33	33	32	31	PA7/PWM13/ CLAMP	I/O	Port A7 or PWM13 output or clamp pulse output.
34	34	33	32	PD0/VOUT	I/O	Port D0 or Vsync output.
35	35	34	33	PD1/HOUT	I/O	Port D1 or Hsync output.
36	36	35	34	PD2/PWM7	I/O	Port D2 or PWM7 output.
37	37	36	35	PD3/PWM6	I/O	Port D3 or PWM6 output.
-	38	-	-	NC		No Connection.
38	39	37	36	PD4/PWM5	I/O	Port D4 or PWM5 output.
39	40	38	37	PD5/PWM4	I/O	Port D5 or PWM4 output.

40	41	39	38	PWM3	I/O	PWM3 output (10V open-drain)
41	42	40	39	HIN	I	Hsync input.
42	43	41	40	VIN	I	Vsync input.
43	-	-	-	NC		No Connection.
44	44	42	-	D-	I/O	USB D-signal.

PIN DESCRIPTION

FUNCTIONAL DESCRIPTION

CPU

8-bit 6502 compatible CPU wiht 16-bit address bus and 8-bit data bus operates at 6MHz.The non-maskable interrupt (/NMI) of 6502 is modified to be maskable and is defined as INT0 with higher priority. The interrupt request (/IRQ) of 6502 is defined as INT1 with lower priority.

Please refer the 6502 reference menu for more detail.

RAM

The 1024 bytes SRAM include:
128 bytes SRAM are from $0080H to $00FFH
256 bytes SRAM are from $0100H to $01FFH
256 bytes SRAM are from $0200H to $02FFH
256 bytes SRAM are from $0300H to $03FFH
128 bytes SRAM are from $0400H to $047FH

The 256 bits bit-addressable SRAM are from $0500H to $05FFH

Flash Memory

60K bytes flash memory for program. Address is located from $1000 to $FFFFh.

The following addresses are reserved for special purpose:
$FFFAh (low byte) and $FFFBh (high byte): INT0 interrupt vector.
$FFFCh (low byte) and $FFFDh (high byte): program reset interrupt vector.

$FFFEh (low byte) and $FFFFh (high byte): INT1 interrupt vector.

Address	Content
$0000h : $003Fh	Registers
$0040h : $007Fh	Reserved
$0080h : $00FFh	128 bytes RAM
$0100h : $01FFh	256 bytes RAM
$0200h : $02FFh	256 bytes RAM
$0300h : $03FFh	256 bytes RAM
$0400h : $047Fh	128 bytes RAM
$0480h : $04FFh	Reserved
$0500h : $05FFh	Bit-addressable 256 bits RAM
$0600h : $0FFEh	Reserved
$0FFFh	Configuration Register
$1000h : : : $FFFFh	Flash ROM
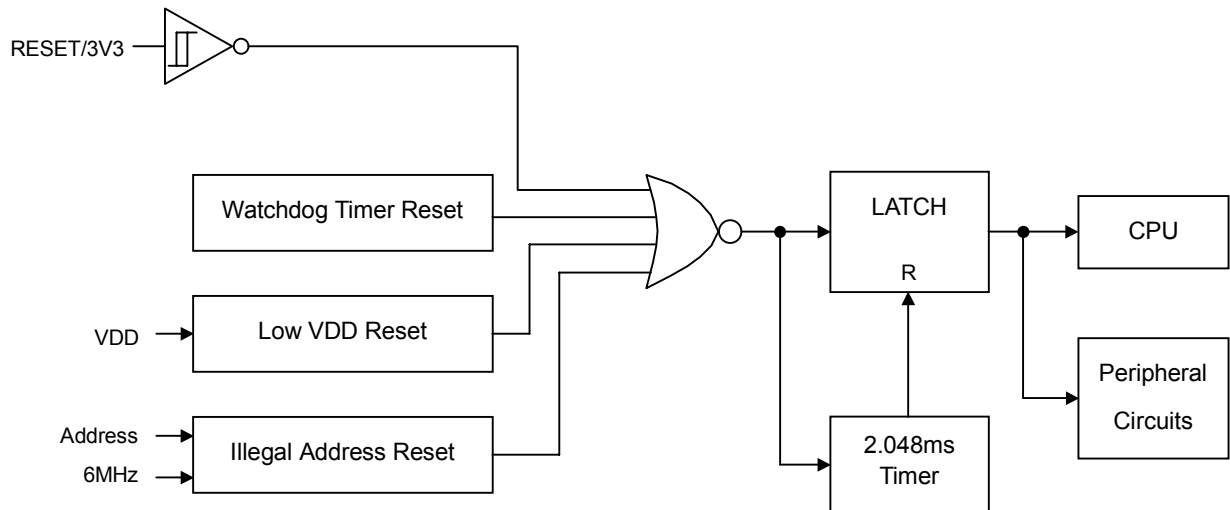
Fig. 1 Reset Signals

Memory Mapping
External Reset
A low level on the RESET/3.3V pin will generate reset.

Illegal address Reset
When the address bus of CPU goes to illegal address, a reset pulse will be generated.
The illegal address is defined as $0040h~$007Fh, $0300h~$0FFEh and $1000h~$7FFFh.

Low VDD Voltage Reset
When VDD is below 3.9V, an internal reset signal is generated. The reset signal will last 2.048 ms after the voltage is higher than 3.9V.

Watchdog Timer Reset
If a time-out happens when watchdog timer is enabled, a reset pulse is generated. Please refer watchdog timer section for more information.

I/O Port

I/O Port A

Pin PA0 and PA1 are shared with DDC interface SDA1 and SCL1 When ENDDC bit is "0", these two pins become an I/O port. If PA0OE bit is set, Pin PA0 is an **open-drain** output. If PA0OE is cleared, Pin PA0 is an input pin with no internal pull-up resistor. The operation of PA1 is same as PA0. Fig. 2 Shows the structure of PA0.
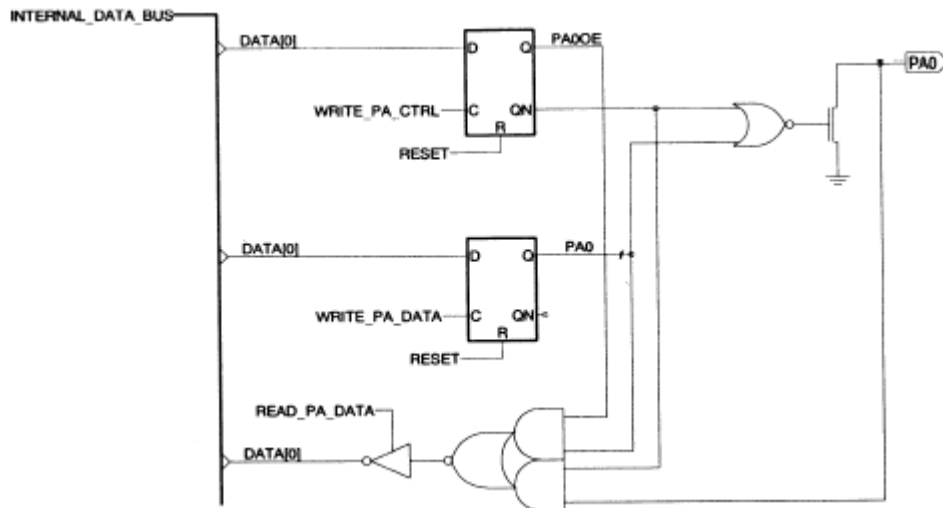
Fig.2 Structure of PA0 and PA1

Pins PA2 to PA6 are shared with PWM output. When corresponding EPWMx bit is "0", the pin is I/O port.
If PAxOE bit is set, it is a push-pull type output. If PAxOE bit is cleared, it is an input pin with internal pull-up resistor.
Pin PA7 is shared with PWM13 output and clamp pulse output. When both EPWM13 bit and ENCLP bit are "0", this pin becomes I/O port. If PA7OE bit is set, it is a push-pull type output. If PA7OE bit is cleared, it is an input pin with internal pull-up resistor.
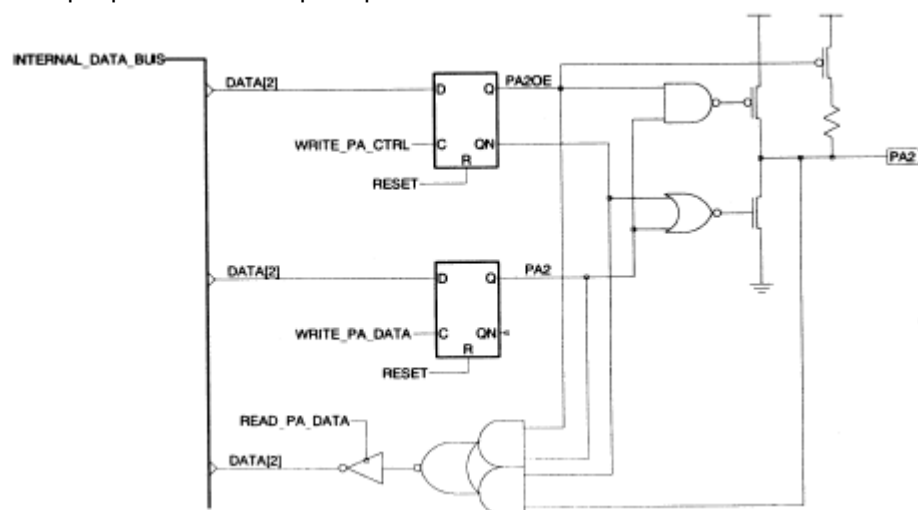
Fig.3 Structure of PA2

SYNC Processor

The functional block diagram of SYNC Processor is shown in Fig. 4. It contains H and V polarity detection circuit, H and V frequency counter, composite sync signal separation circuit, free-running H and V sync signal generator, vedio signal generation circuit for burn-in test and clamp pulse generator.
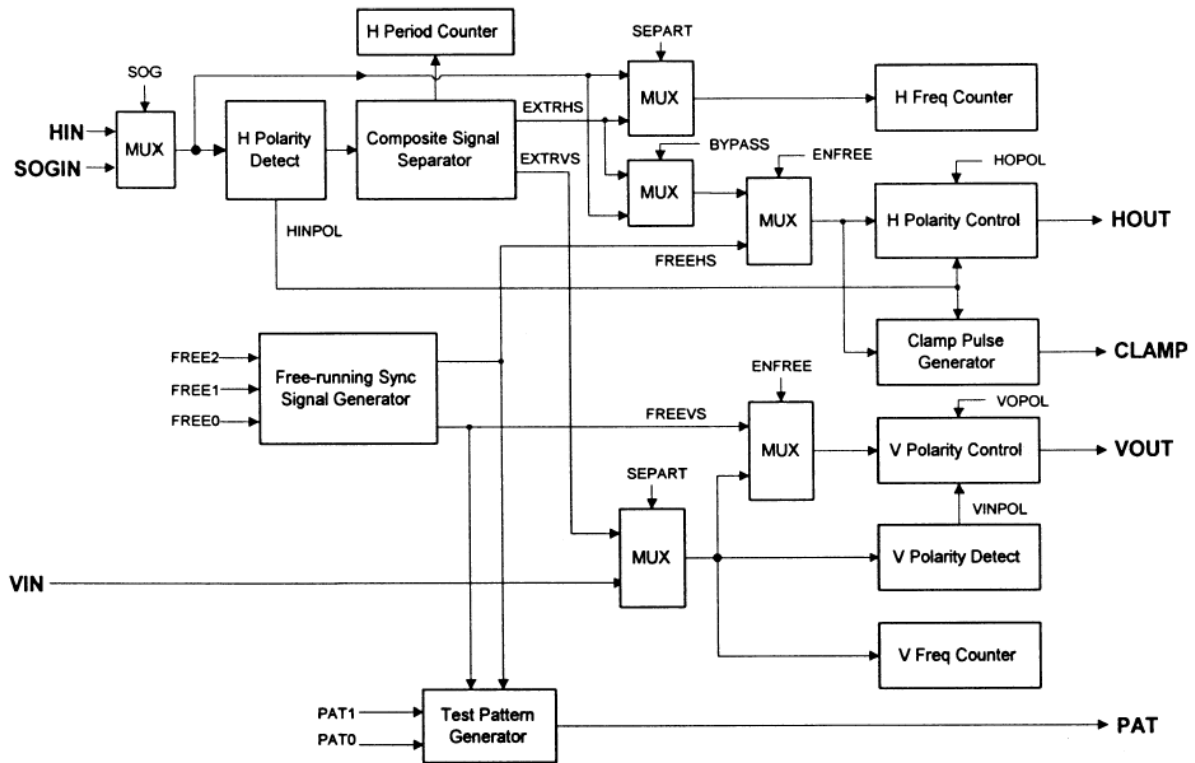
Fig.4 Block diagram of sync signal processor

Horizontal Polarity Detect

The horizontal polarity is detected by sampling HIN signal at 5.5~6.5us after rising and falling edge of HIN. If the result of sampling is low and lasts 192~256us with no change, the polarity is positive (HINPOL=1). If the result of sampling is high and lasts 192~256us with no change, the polarity is negative (HINPOL=0).

Vertical Polarity Detect

Vertical polarity is detected by sampling VIN level at 2.048ms after rising edge of VIN. If the level is low, the polarity is positive (VINPOL=1). If the level is high, the polarity is negative (VINPOL=0). But if SEPART bit is set, the VINPOL bit is "1" because the Vsync from composite signal separator is always positive polarity.

Output Polarity Control

The polarities of HOUT and VOUT are controlled by HOPOL and VOPOL bites. When the bit is set, the output polarity is positive. When the bit is cleared, the output polarity is negative.

Composite Sync Signal Separator

Composite sync signal separator extract Vsync signal from HIN or SOGIN input pin by filtering pulses which is less than 6us. The output Vsync signal will be widened about 5.5~6.5us. The output Hsync will be replaced by 2us pulse during Vsync pulse.

The composite sync signal separator can handle H+V and H exclusive OR V signals. Fig. 5 shows the timig relationship of the extracted H and V sync signals.

If Hsync output do not want to insert pseudo H pulses (EXTRHS signal) during Vsync pulse, set BY-PASS bit can let HOUT pin output waveform same as Hsync input (Note: polarity can be controlled by HOPOL bit).
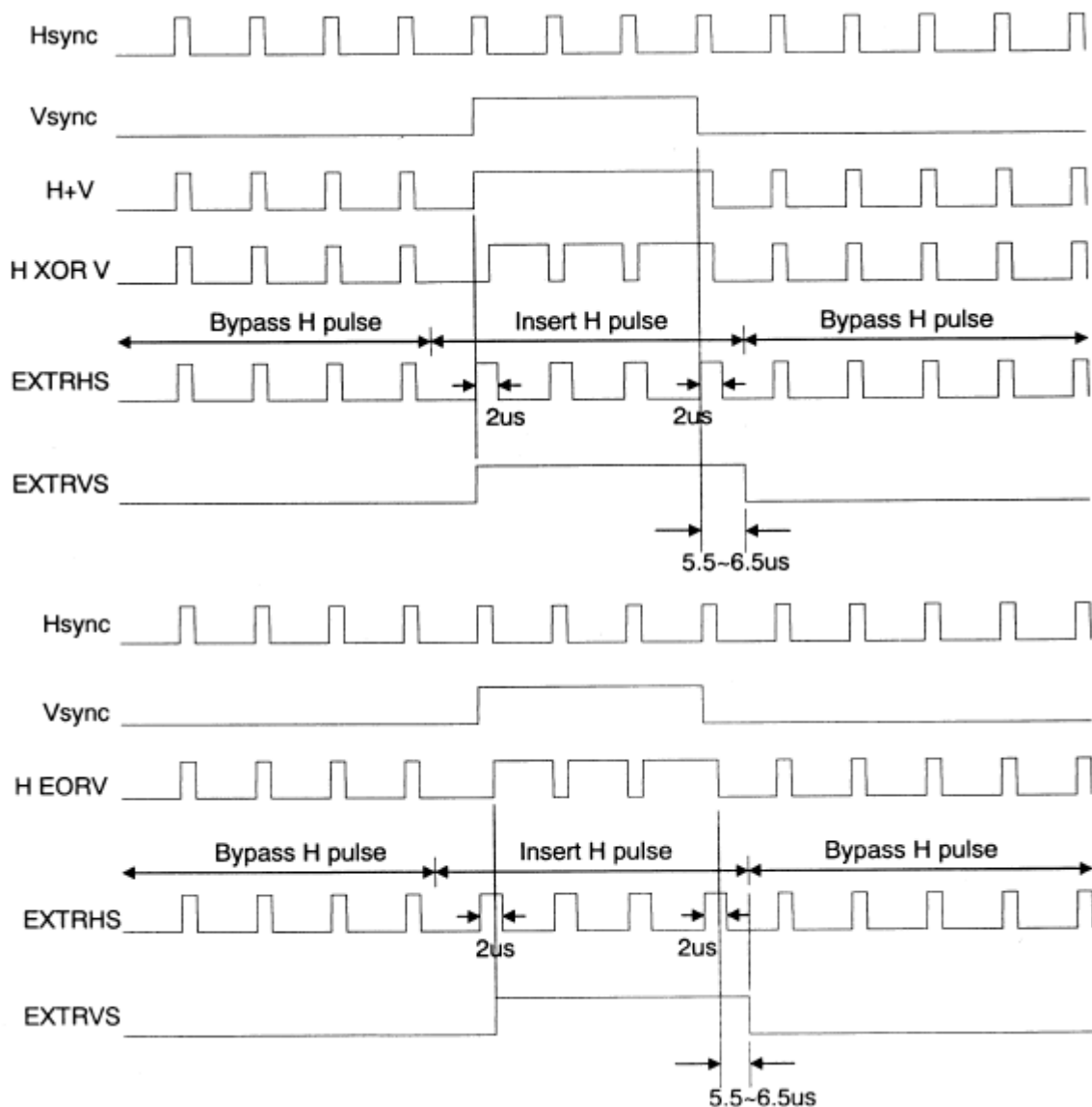
Fig.6 Timing relationship of composite sync signal separator

Free-running sync signal and self-test pattern

The self-generated free run sync signals are output from HOUT and VOUT pins when ENFREE bit is set.

Four kinds of standard VESA timings are selected by FREE1 and FREE0 bits.

Self-test pattern signal is output form PAT pin when ENPAT bit is set. PAT1 and PAT0 bits select different self-test pattern.

| PAT1 = 0, PAT0 = 0 | PAT1 = 0, PAT0 = 1 | PAT1 = 1, PAT0 = 0 | PAT1 = 1, PAT0 = 1 |
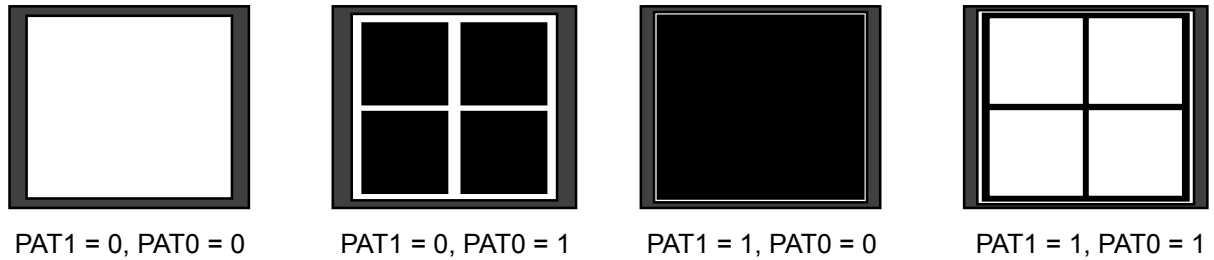
Fig. 7 Test Pattern

		X00	X01	010	011	110	111
F_H	Hot frequency	31.496kHz	48kHz	63.83kHz	81.25kHz	90.909kHz	106.195kHz
F_V	Ver frequency	59.993Hz	72.072Hz	59.878Hz	64.865Hz	84.8Hz	84.96Hz
T_{HT}	Hor total time	31.75us	20.833us	15.667us	12.333us	11us	9.417us
T_{VT}	Ver total time	16.669ms	13.875ms	16.7ms	15.417ms	11.792ms	11.771ms
T_{HS}	H sync time	3.833us	2.417us	1us	1.083us	1us	0.833us
T_{HB}	H Back porch + H Left border	2 us	1.417us	2.417us	1.833us	1.583us	1.417us
T_{HF}	H Front porch + H Right border	0.708us	1.125us	0.542us	0.375us	0.375us	0.292us
T_{VS}	V sync time	$2 \times T_{HT}$	$6 \times T_{HT}$	$3 \times T_{HT}$	$3 \times T_{HT}$	$3 \times T_{HT}$	$3 \times T_{HT}$
T_{VB}	V Back porch + V Top border	$33 \times T_{HT}$	$23 \times T_{HT}$	$38 \times T_{HT}$	$46 \times T_{HT}$	$44 \times T_{HT}$	$46 \times T_{HT}$
T_{VF}	V Front porch + V Bottom border	$11 \times T_{HT}$	$38 \times T_{HT}$	$3 \times T_{HT}$	$2 \times T_{HT}$	$2 \times T_{HT}$	$2 \times T_{HT}$
T_{VIDEO}	Video pulse width	41.67ns	41.67ns	41.67ns	41.67ns	41.67ns	41.67ns
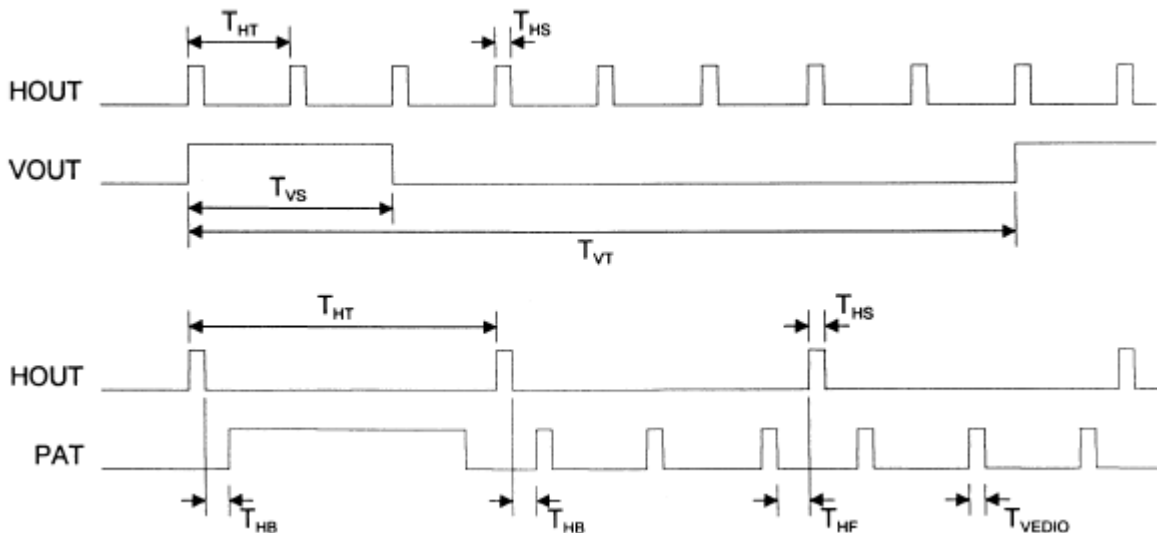
Fig.8 Free-running sync signal and test pattern timing

DDC Flow Chart

START

set ENDDC(W15.7)
slave I address =>DDC_AR0(W16)
slave II address =>DDC_AR1(W17)

DDCRDY(R15.7)=1? — No
Yes

DDC2(R15.5)=1? — No
Yes

DDC data => DDC_TX(W14)

SCLH2L(R15.6)=1? — No
Yes

SCLH2L(R15.6)=1? — No
Yes

DDC 1

set CLRH2L(W15.6) & DDC2(W15.5)
#11100000B => W15
clear CLRH2L(W15.6)
#10100000B => W15

DDC1 => DDC2

DDCRDY(R15.7)=1? — Yes
No

128 Vsync or 2 s ? — No
Yes

clear DDC2(W15.5)
#10000000B => W15

MATCH(R15.1)=0? — No
Yes

slave II address subprogram

DDC 2

FIRST(R15.4)=1? — No
Yes

read DDC_RX(R14)
slave I address=A0 or A2or A4 or A6

STOP(R15.3)=1? — No
Yes

DDC2RW(R15.2)=1? — No
Yes

read DDC_RX(R14)

DDC2RW(R15.2)=1? — No
Yes

slave I address=>DDC_AR0(W16)

slave I address=>DDC_AR0(W16)

set TX(W15.2)
DDC data => DDC_TX(W14)

RXNACK1(R15.0)=0? — No
Yes

DDC data => DDC_TX(W14)

slave I address=>DDC_AR0(W16)

slave I address=>DDC_AR0(W16)

Master I²C Flow Chart
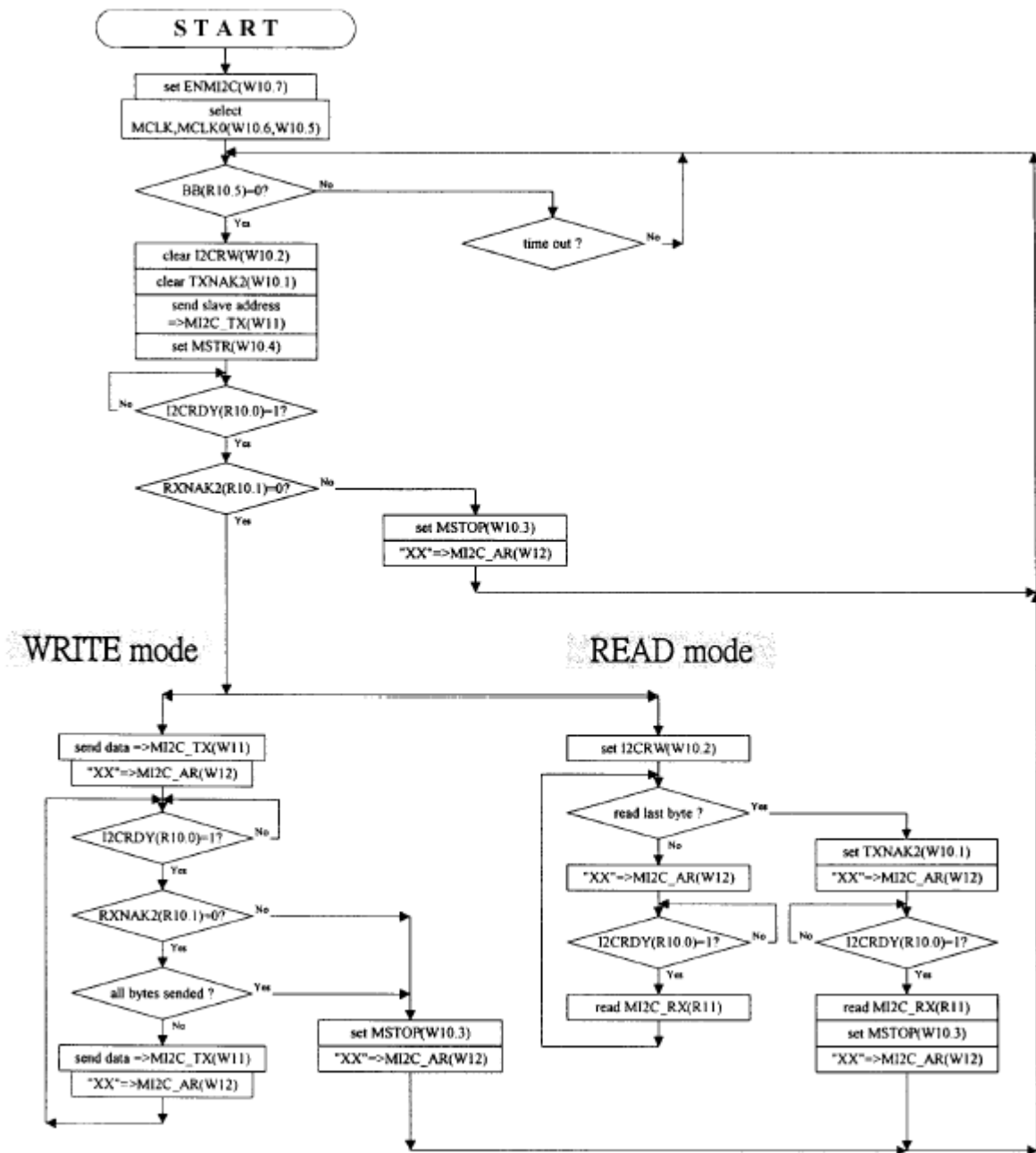
Master I²C (restart mode) Flow Chart

Slave I²C Flow Chart

START

set ENMI2C(W10.7)
slave address =>MI2C_AR(W12)
set SLAVE(W10.0)

MI2CRDY(R10.0)=1? — No
Yes

SFIRST(R10.4)=1? — No
Yes

SRW(R10.2)=1? — No
Yes
set I2CRW(W10.2)
send data => MI2C_TX(W11)
slave address=>MI2C_AR(W12)

SSTOP(R10.3)=1? — No
Yes
slave address=>MI2C_AR(W12)

SRW(R10.2)=1? — No
Yes
read MI2C_RX(R11)
slave address=>MI2C_AR(W12)

RXNAK2(R10.1)=0? — No
Yes
send data => MI2C_TX(W11)
slave address=>MI2C_AR(W12)
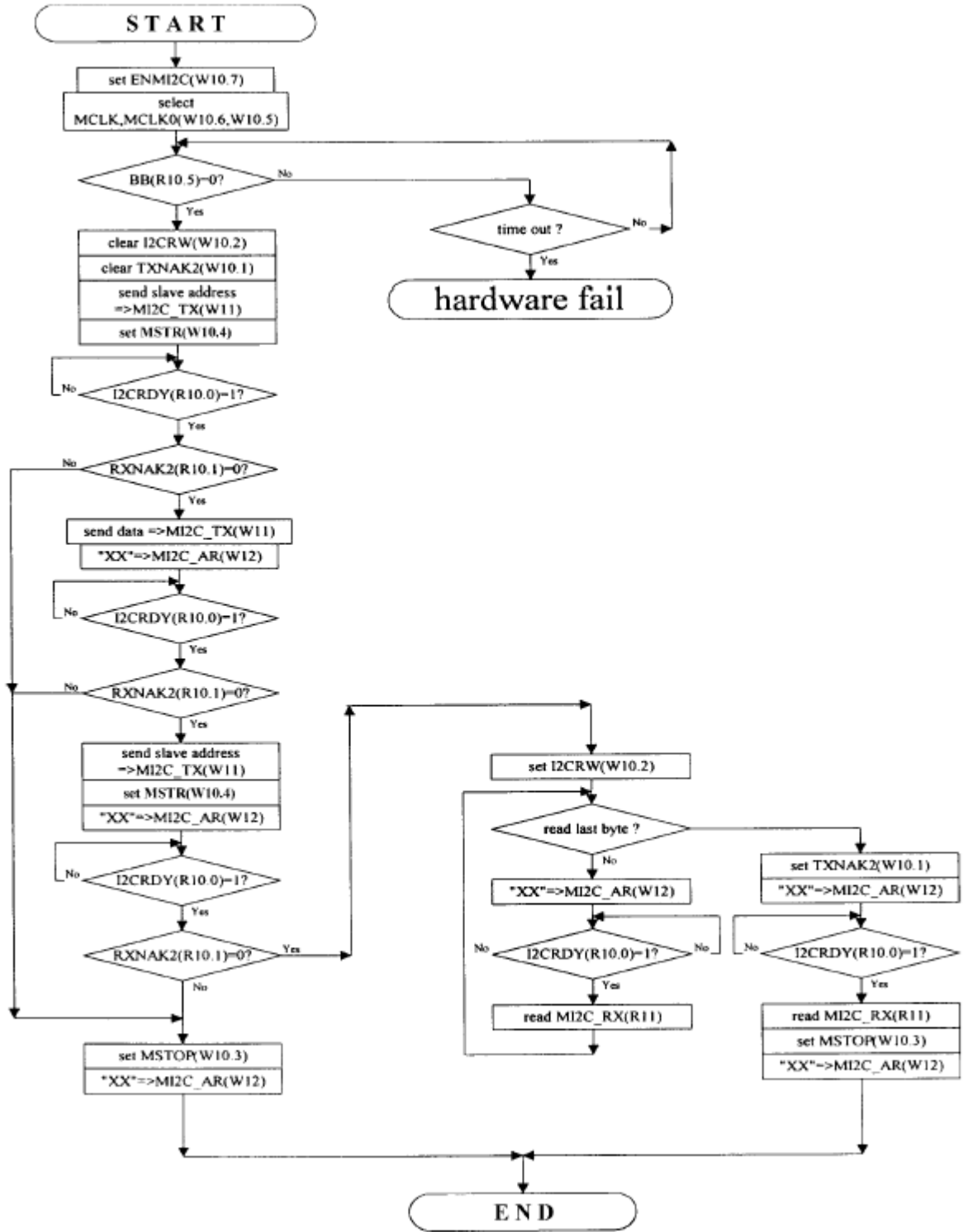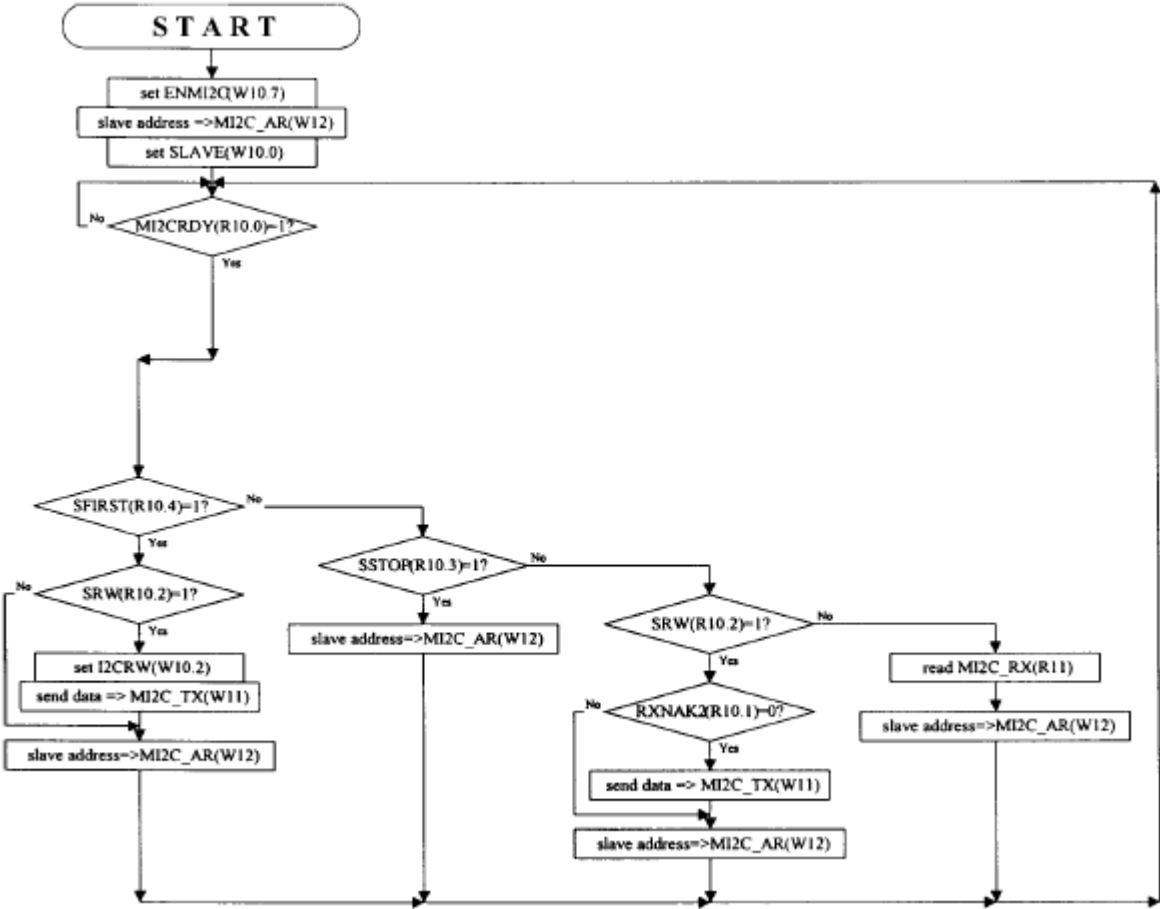
3. Horizontal deflection signal processing / Vertical and geometrical compensation of the raster

I²C-bus autosync deflection controller for PC monitors   **TDA4857**

FEATURES

Concept features

- Full horizotal plus vertical autosync capability
- Extended horizontal frequency range from 15 to 130kHz
- Comprehensive set of I²C-bus driven geometry adjustments and functions, including standby mode
- Very good vertical linearity
- Moire cancellation
- Start-up and switch-off sequence for safe operation of all power components
- X-ray protection
- Power dip recognition
- Flexible switched mode B+ supply function block for feedback and feed forward converter
- Internally stabilized voltage reference
- Drive signal for focus amplifiers with combined horizontal and vertical parabola waveforms
- DC controllable inputs for Extremely High Tension (EHT) Compensation
- SDIP32 Package

Synchronization

- Can handle all sync signals (horizontal, vertical, composite and sync-on-video)
- Output for video clamping (leading/trailing edge selectable by the I²C-bus), vertical blanking and protection blanking
- Output for fast unlock status of horizontal synchronization and blanking on grid 1 of picture tube.

Horizontal section

- I²C-bus controllable wide range linear picture position, pin unbalance and parallelogram correction via horizontal phase
- Frequency-locked loop for smooth catching of horizontal frequency
- Simple frequency preset of fmin and fmax by external resistors
- Low jitter
- Soft start for horizontal and B+ control drive signals.

Vertical section

- I²C-bus controllable vertical picture size, picture position, linearity (S-correction) and linearity balance
- Output for the I²C-bus controllable vertical sawtooth and parabola (for pin unbalance and parallelogram)
- Vertical picture size independent of frequency
- Differential current outputs for DC coupling to vertical booster
- 50 to 160 Hz vertical autosync range.

East-West (EW) section

- I²C-bus controllable output for horizontal pincushion, horizontal size, corner and trapezium correction
- Optional tracking of EW drive waveform with line frequency selectable by the I²C-bus.

Focus section

- I²C-bus controllable output for horizontal and vertical parabolas
- Vertical parabola is independent of frequency and tracks with vertical adjustments
- Horizontal parabola independent of frequency
- Adjustable pre-correction of delay in focus output stage.

BLOCK DIAGRAM

Fig.1 Block diagram and application circuit.
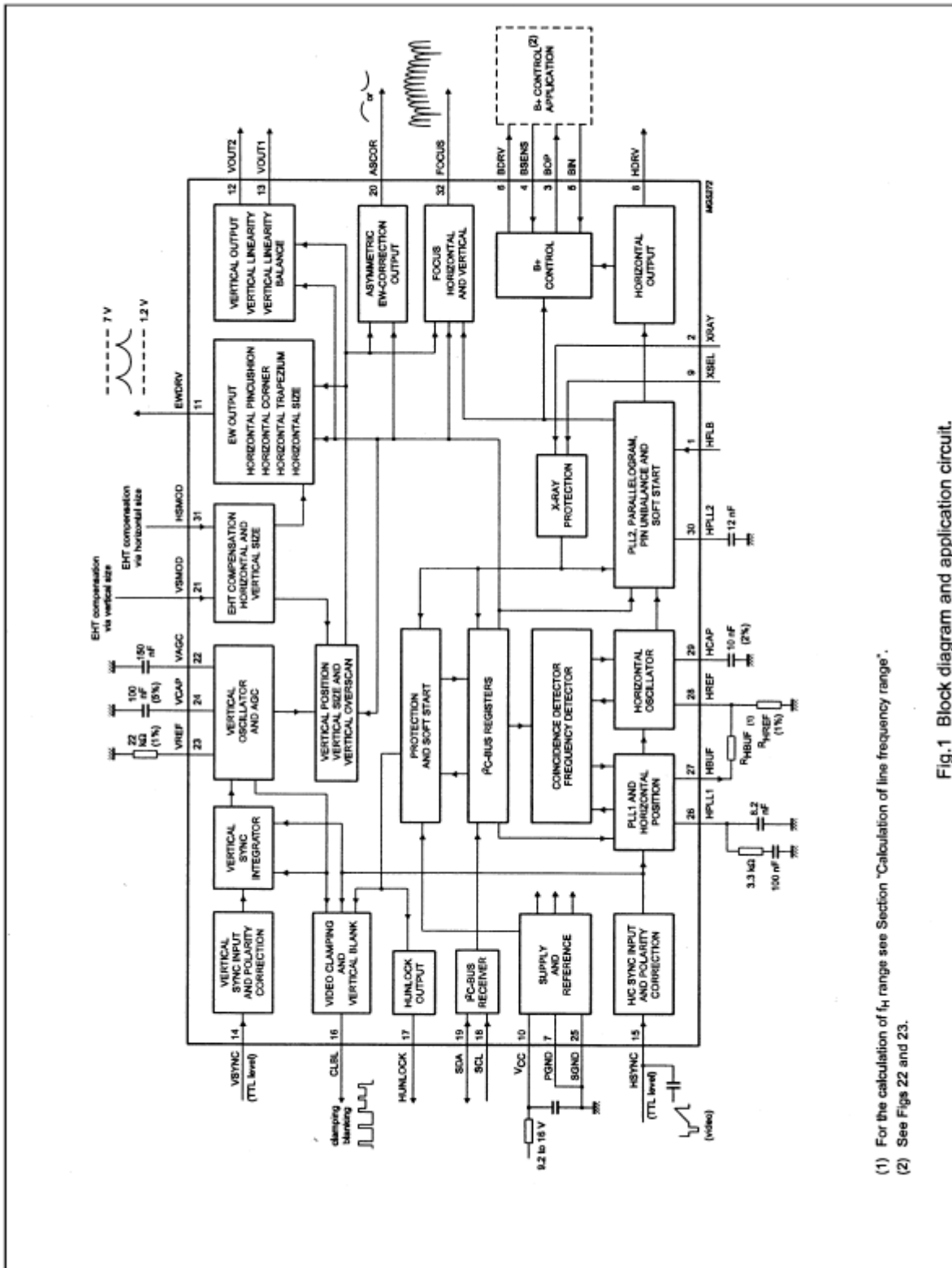
(1) For the calculation of f_H range see Section "Calculation of line frequency range".
(2) See Figs 22 and 23.

PINNING

SYMBOL	PIN	DESCRIPTION
HFLB	1	horizontal flyback input
XRAY	2	X-ray protection input
BOP	3	B+ control OTA output
BSENS	4	B+ control comparator input
BIN	5	B+ control OTA input
BDRV	6	B+ control driver output
PGND	7	power ground
HDRV	8	horizontal driver output
XSEL	9	select input for X-ray reset
Vcc	10	supply voltage
EWDRV	11	EW waveform output
VOUT2	12	vertical output 2 (ascending sawtooth)
VOUT1	13	vertical output 1 (descending sawtooth)
VSYNC	14	vertical synchronization input
HSYNC	15	horizontal/composite synchronization input
CLBL	16	video clamping pulse/vertical blanking output
HUNLOCK	17	horizontal synchronization unlock/protection/vertical blanking output
SCL	18	I²C-bus clock input
SDA	19	I²C-bus data input/output
ASCOR	20	output for asymmetric EW corrections
VSMOD	21	input for EHT compensation (via vertical size)
VAGC	22	external capacitor for vertical amplitude control
VREF	23	external resistor for vertical oscillator
VCAP	24	external capacitor for vertical oscillator
SGND	25	signal ground
HPLL1	26	external filter for PLL1
HBUF	27	buffered f/v voltage output
HREF	28	reference current for horizontal oscillator
HCAP	29	external capacitor for horizontal oscillator
HPLL2	30	external filter for PLL2/soft start
HSMOD	31	input for EHT compensation (via horizontal size)
FOCUS	32	output for horizontal and vertical focus

Fig.2 Pin configuration.
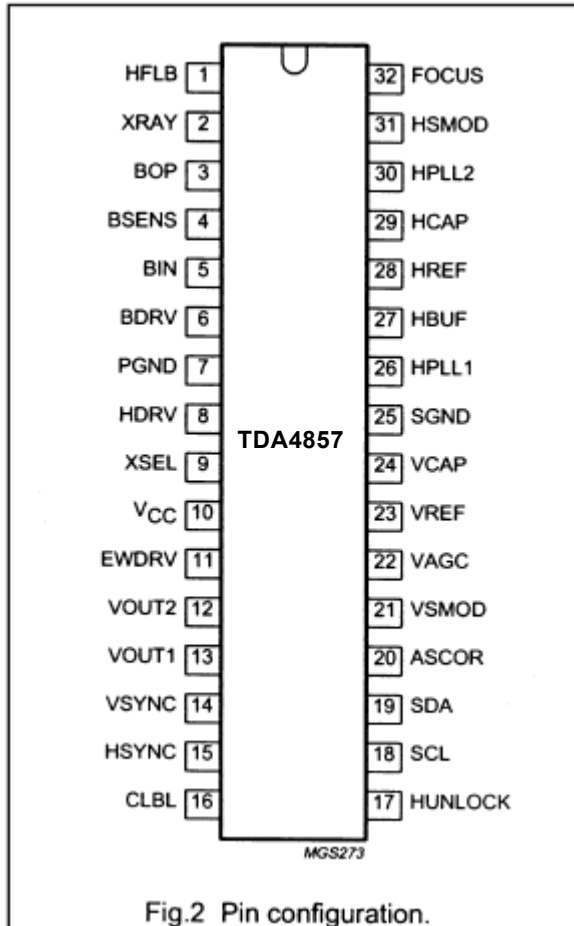
FUNCTIONAL DESCRIPTION

Horizontal sync separator and polarity correction

HSYNC (pin 15) is the input for horizontal synchronization signals, which can be DC-coupled TTL signals (horizontal or composite sync) and AC-coupled negative-going video sync signal. Video syncs are clamped to 1.28V and sliced at 1.4V. This results in a fixed absolute slicing level of 120 mV related to top sync.

For DC-coupled TTL signals the input clamping current is limited. The slicing level for TTL signals is 1.4 V.

The separated sync signal (either video or TTL) is integrated on an internal capacitor to detect and normalize the sync polarity.

Normalized horizontal sync pulses are used as input signals for the vertical sync integrator, the PLL1 phase detector and the frequency-locked loop.

Vertical sync integrator

Normalized composite sync signals from HSYNC are integrated on an internal capacitor in order to extract vertical sync pulses. The integration time is dependent on the horizontal oscillator reference current at HREF (pin 28). The integrator output directly triggers the vertical oscillator.

Vertical sync slicer and polarity correction

Vertical sync signals (TTL) applied to VSYNC (pin 14) are sliced at 1.4V. The output signal of the sync slicer is integrated on an internal capacitor to detect and normalize the sync polarity. The output signals of vertical sync integrator and sync normalizer are disjuncted before they are fed to the vertical oscillator.

Video clamping/vertical blanking generator

The video clamping/vertical blanking signal at CLBL (pin 16) is a two-level sandcastle pulse which is especially suitable for video ICs such as the TDA488x family, but also for direct applications in video output stages.

The upper level is the video clamping pulse, which is triggered by the horizontal sync pulse. Either the leading or trailing edge can be selected by setting control bit CLAMP via the I²C-bus. The width of the video clamping pulse is determined by an internal single-shot multivibrator.

The lower level of the sandcastle pulse is the vertical blanking pulse, which is derived directly from the internal oscillator waveform. It is started by the vertical sync and stopped with the start of the vertical scan. This results in optimum vertical blanking. Two different vertical blanking times are accessible, by control bit VBLK, via the I²C-bus.

Blanking will be activated continuously if one of the following conditions is true:

   Soft start of horizontal and B+ drive [voltage at HPLL2 (pin 30) pulled down externally or by the I²C-bus]
   PLL1 is unlocked while frequency-locked loop is in search mode
   No horizontal flyback pulses at HFLB (pin 1)
   X-ray protection is activated
   Supply voltage at Vcc (pin 10) is low

Horizontal unlock blanking can be switched off, by control bit BLKDIS, via the I²C-bus while vertical blanking is maintained.

Frequency-locked loop

The frequency-locked loop can lock the horizontal oscillator over a wide frequency range. This is achieved by a combined search and PLL operation. The frequency range is preset by two external resistors and the

recommended maximum ratio is $\dfrac{f_{max}}{f_{max}} = \dfrac{6.5}{1}$

This can, for instance, be a range from 15.625 to 90kHz with all tolerance included.

Without a horizontal sync signal the oscillator will be free-running at f_{min}. Any change of sync conditions is detected by the internal coincidence detector. A deviation of more than 4% between horizontal sync and oscillator frequency switches the horizontal section into search mode. This means that PLL1 control currents are switched off immediately. The internal frequency detector then starts tuning the oscillator. Very small DC currents at HPLL1 (pin 26) are used to perform this tuning with a well defined change rate. When coincidence between horizontal sync and oscillator frequency is detected, the search mode is first replaced by a soft-lock mode which lasts for the first part of the next vertical period.
The soft-lock mode is then replaced by a normal PLL operation. This operation ensures smooth tuning and avoids fast changes of horizontal frequency during catching.

In this concept it is not allowed to load HPLL1.
The frequency dependent voltage at this pin is fed internally to HBUF (pin 27) via a sample-and-hold and buffer stange. The sample-and-hold stage removes all disturbances caused by horizontal sync or composite vertical sync from the buffered voltage. An external resistor connected between pins HBUF and HREF defines the frequency range.

Out-of-lock indication (pin HUNLOCK)

Pin HUNLOCK is floating during search mode, or if a protection condition is true. All this can be detected by the microcontroller if a pull-up resistor is connected to its own supply voltage.

For an additional fast vertical blanking at grid 1 of the picture tube a 1 V signal referenced to ground is available at this output. The continuous protection blanking (see Section "Video clamping/vertical blanking generator") is also available at this pin. Horizontal unlock blanking can be switched off, by control bit BLKDIS via the I²C-bus while vertical blanking is maintained.

Horizontal oscillator

The horizontal oscillator is of the relaxation type and requires a capacitor of 10 nF at HCAP (pin 29).
For optimum jitter performance the value of 10 nF must not be changed.

The minimum oscillator frequency is determined by a resistor from HREF to ground. A resistor connected between pins HREF and HBUF defines the frequency range.

The reference current at pin HREF also defines the integration time constant of the vertical sync integration.

Calculation of line frequency range

The oscillator frequencies fmin and fmax must first be calculated. This is achieved by adding the spread of the relevant components to the highest and lowest sync frequencies $f_{sync(min)}$ and $f_{sync(max)}$. The oscillator is driven by the currents in R_{HREF} and R_{HBUF}.

The following example is a 31.45 to 90 kHz application:

Table 1 Calculation of total spread

spread of	for f_{max}	for f_{min}
IC	±3%	±5%
C_{HCAP}	±2%	±2%
R_{HREF}, R_{HBUF}	±2%	±2%
Total	±7%	±9%

Thus the typical frequency range of the oscillator in this example is:

$f_{max} = f_{sync(max)} \times 1.07 = 96.3$ kHz

$f_{min} = \dfrac{f_{sync(min)}}{1.09} = 28.4$ kHz

The resistors R_{HREF} and $R_{HBUF_{par}}$ can be calculated using the following formulae:

$$R_{HREF} = \frac{78 \times kHz \times k\Omega}{f_{min} + 0.0012 \times f_{min}^2 \,[kHz]} = 2.61\,\Omega$$

$$R_{HBUFpar} = \frac{78 \times kHz \times k\Omega}{f_{max} + 0.0012 \times f_{max}^2 \,[kHz]} = 726\,\Omega$$

The resistor $R_{HBUF_{par}}$ os calculated as the value to R_{HREF} and R_{HBUF} in parallel.

The formulae for R_{HBUF} also takes into account the voltage swing across this resistor:

$$R_{HBUF} = \frac{R_{HREF} \times R_{HBUFpar}}{R_{HREF} - R_{HBUFpar}} \times 0.8 = 805\,\Omega$$

PLL1 phase detector

The phase detector is a standard type using switched current sources, which are independent of horizontal frequency. It compares the middle of horizontal sync with a fixed point on the oscillator sawtooth voltage. The PLL1 loop filter is connected to HPLL1 (pin 26).

See also Section "Horizontal position adjustment and corrections".

Horizontal position adjustment and corrections

Alinear adjustment of the relative phase between the horizontal sync and the oscillator sawtooth (in PLL1 loop) is achieved via register HPOS. Once adjusted, the relative phase remains constant over the whole frequency range.

Correction of pin unbalance and parallelogram is achieved by modulating the phase between oscillator sawtooth and horizontal flyback (in loop PLL2) via registers HPARAL and HPINBAL. If those asymmetric EW corrections are performed in the deflection stage, both registers can be disconnected from the horizontal phase via control bit ACD. This does not change the output at pin ASCOR.

Horizontal moire cancellation

To achieve a cancellation of horizontal moire (also known as 'video moire'), the horizontal frequency is divided-by-two to achieve a modulation of the horizontal phase via PLL2. The amplitude is controlled by register HMOIRE. To avoid a visible structure on screen the polarity changes with half of the vertical frequency.
Control bit MOD disables the moire cancellation function.

PLL2 phase detector

The PLL2 phase detector is similar to the PLL1 detector and compares the line flyback pulse at HFLB (pin 1) with the oscillator sawtooth voltage. The control currents are independent of the horizontal frequency. The PLL2 detector thus compensates for the delay in the external horizontal deflection circuit by adjusting the phase of the HDRV (pin 8) output pulse.

An external modulation of the PLL2 phase is not allowed, because this would disturb the pre-correction of the horizontal focus parabola.

Soft start and standby

If HPLL2 is pulled to ground, either by an external DC current or by resetting register SOFTST, the horizontal output pulses and B+ control driver pulses will be inhibited. This means that HDRV (pin 8) and BDRV (pin 6) are floating in this state. In both cases PLL2 and the frequency-lock loop are disabled, and CLBL (pin 16) provides a continuous blanking signal and HUNLOCK (pin 17) is floating.

This option can be used for soft start, protection and power-down modes. When pin HPLL2 is released again, an automatic soft start sequence on the horizontal drive as well as on the B-drive output will be performed.

A soft start can only be performed if the supply voltage for the IC is a minimum of 8.6V.

The soft start timing is determined by the filter capacitor at HPLL2 (pin 30), which is charged with a constant current during soft start. In the beginning the horizontal driver stage generates very small output pulses. The width of these pulses increases with the voltage at HPLL2 until the final duty cycle is reached. The voltage at HPLL2 increases further and performs a soft start at BDRV (pin 6) as well. After BDRV has reached full duty cycle, the voltage at HPLL2 continues to rise until HPLL2 enters its normal operating range. The internal charge current is now disabled. Finally PLL2 and the frequency-locked loop are activated. If both functions reach normal operation, HUNLOCK (pin 17) switches from the floating status to normal vertical blanking, and continuous blanking at CLBL (pin 16) is removed.

Output stage for line drive pulses [HDRV (pin 8)]

An open-collector output stage allows direct drive of an inverting driver transistor because of a low saturation voltage of 0.3V at 20mA. To protect the line deflection transistor, the output stage is disabled (floating) for a low supply voltage at Vcc.

The duty cycle of line drive pulses is slightly dependent on the actual horizontal frequency. This ensures optimum drive conditions over the whole frequency range.

X-ray protection

The X-ray protection input XRAY (pin 2) provides a voltage detector with a precise threshold. If the input voltage at XRAY exceeds this threshold for a certain time, then control bit SOFTST is reset, which switches the IC into protection mode. In this mode several pins are forced into defined states:

HUNLOCK (pin 17) is floating
The capacitor connected to HPLL2 (pin 30) is discharged
Horizontal output stage (HDRV) is floating
B+ control driver stage (BDRV) is floating
CLBL provides a continuous blanking signal.

There are two different methods of restarting ways the IC:
1. XSEL (pin 9) is opeb-circuit or connected to ground. The control bit SOFTST must be set to logic 1 via the I²C-bus. Then the IC returns to normal operation via soft start.
2. XSEL (pin 9) is connected to Vcc via an external resistor. The supply voltage of the IC must be switched off for a certain period of time, before the IC can be restarted again using the standard power-on procedure.

Vertical oscillator and amplitude control

This stage is designed for fast stabilization of vertical size after changes in sync frequency conditions.
The free-running frequency $f_{fr(v)}$ is determined by the resistor R_{VREF} connected to pin 23 and the capacitor C_{VCAP} connected to pin 24. The value of R_{VREF} is not only optimized for noise and linearity performance in the whole vertical and EW section, but also influences several internal reference. Therefore the value of R_{VREF} must not be changed. Capacitor C_{VCAP} should be used to select the free-running frequency of the vertical oscillator in accordance with the following formula:

$$f_{fr(V)} = \frac{1}{10.8 \times R_{VREF} \times C_{VCAP}}$$

To achieve a stabilized amplitude the free-running frequency ffr(v), without adjustment, should be at least 10% lower than the minimum trigger frequency.
The contributions shown in Table 2 canbe assumed.

Table 2 Calculation of $f_{fr(V)}$ total spread

Contributing elements	
Minimum frequency offset between $f_{fr(v)}$ and lowest trigger frequency	10%
Spread of IC	±3%
Spread of R_{VREF}	±1%
Spread of C_{VCAP}	±5%
Total	19%

Result for 50 to 160Hz application:

$$f_{fr(V)} = \frac{50\,Hz}{1.19} = 42\,Hz$$

The AGC of the vertical oscillator can be disabled by setting control bit AGCDIS via the I²C-bus. Aprecise external current has to be injected into VCAP (pin 24) to obtain the correct vertical size. This special application mode can be used when the vertical sync pulses are serrated (shifted); this condition is found in some display modes, e.g. when using a 100Hz up converter for video signals.

Application hint: VAGC (pin 22) has a high input impedance during scan. Therefore, the pin must not be loaded externally otherwise non-linearities in the vertical output currents may occur due to the changing charge current during scan.

Adjustment of vertical size, VGA overscan and EHT compensation

There are four different ways to adjust the amplitude of the differential output currents at VOUT1 and VOUT2.
1. Register VGIN changes the vertical size without affecting any other output signal of the IC. This adjustment is meant for factory alignments.
2. Register VSIZE changes not only the vertical size, but also provides the correct tracking of all other related waveforms (see section"Tracking of vertical adjustments"). This register should be used for user adjustments.
3. For the VGA350 mode register VOVSCN can activate a +17% step in vertical size.
4. VSMOD (pin 21) can be used for a DC controlled EHT compensation of vertical size by correcting the differential output currents at VOUT1 and VOUT2. The EW waveforms, vertical focus, pin unbalance and parallelogram corrections are not affected by VSMOD.

Adjustment of vertical position, vertical linearity and vertical linearity balance

Register VOFFS provides a DC shift at the sawtooth outputs VOUT1 and VOUT2 (pin 13 and 12) without affecting any other output waveform. This adjustment is meant for factory alignments.

Register VPOS provides a DC shift at the sawtooth output VOUT1 and VOUT2 with correct tracking of all other related waveforms (see Section "Tracking of vertical adjustments"). This register should be used for user adjustments. Due to the tracking the whole picture moves vertically while maintaining the correct geometry.

Register VLIN is used to adjust the amount of the vertical S-correction in the output signal. This function can be switched off by control bit VSC.

Register VLINBAL is used to correct the unbalance of vertical S-correction in the output signal.

Tracking of vertical adjustments

The adjustments via registers VSIZE, VOVSCN and VPOS also affect the waveforms of horizontal pincushion, vertical linearity (S-correction), vertical linearity balance, focus parabola, pin unbalance and parallelogram correction. The result of this interaction is that no readjustment of these parameters is necessary after an user adjustment of vertical picture size and vertical picture position.

Adjustment of vertical moire cancellation

To achieve a cancellation of vertical moire (also known as 'scan moire') the vertical picture position can be modulated by half the vertical frequency. The amplitude of the modulation is controlled by register VMOIRE and can be switched off via control bit MOD.

Horizontal pincushion (including horizontal size, corner correction and trapezium correction)

EWDRV (pin 11) provides a complete EW drive waveform. The components horizontal pincushion, horizontal size, corner correction and trapezium correction are controlled by the registers HPIN, HSIZE, HCORT, HCORB and HTRAP.

The corner correction can be adjusted separately for the top (HCORT) and bottom (HCORB) part of the picture.

The pincushion (EW parabola) amplitude, corner and trapezium correction track with the vertical picture size (VSIZE) and also with the adjustment for vertical picture position (VPOS). The corner correction does not track with the horizontal pincushion (HPIN).

Further the horizontal pincushion amplitude, corner and trapezium correction track with the horizontal picture size, which is adjusted via register HSIZE and the analog modulation input HSMOD. If the DC component in the EWDRV output signal is increased via HSIZE or Ihsmod, the pincushion, corner and trapezium component of the EWDRV output will be reduced by a factor of

$$1 - \frac{V_{HSIZE} + V_{HEHT}\left(1 - \frac{H_{HSIZE}}{14.4V}\right)}{14.4V}$$

The value 14.4V is a virtual voltage for calculation only. The output pin can not reach this value, but the gain (and DC bias) of the external application should be such that the horizontal deflection is reduced to zero when EWDRV reaches 14.4V.

HSMOD (pin 31) can be used for a DC controlled EHT compensation by correcting horizontal size, horizontal pincushion, corner and trapezium. The control range at this pin tracks with the actual value of HSIZE. For an increasing DC component V_{HSIZE} in the EWDRV output signal, the DC component V_{HEHT} caused by I_{HSMOD} will be reduced by a

factor of $1 - \frac{V_{HSIZE}}{14.4V}$ as shown in the equation above.

The whole EWDRV voltage is calculated as follows:

$V_{EWDRV} = 1.2V + [V_{HSIZE} + V_{HEHT} \times f(HSIZE) + (V_{HPIN} + V_{HCOR} + V_{HTRAP}) \times g(HSIZE, HSMOD)]h(I_{HREF})$ where:

$$V_{HEHT} = \frac{I_{HSMOD}}{120\mu2} \times 0.69$$

$$f(HSIZE) = 1 - \frac{V_{HSIZE}}{14.4V}$$

$$g(HSIZE, HSMOD) = 1 - \frac{V_{HSIZE} + V_{HEHT}\left(1 - \frac{V_{HSIZE}}{14.4V}\right)}{14.4V}$$

$$h(I_{HREF}) = 1 - \frac{I_{HREF}}{I_{HREFf\ =\ 70kHz}}$$

Two different modes of operation can be chosen for the EW output waveform via control bit FHMULT:

1. Mode 1

   Horizontal size is controlled via register HSIZE and causes a DC shift at the EWDRV output. The complete waveform is also multiplied internally by a signal proportional to the line frequency [which is detected via the current at HREF (pin 28)]. This mode is to be used for driving EW diode modulator stage which require a voltage proportional to the line frequency.

2. Mode 2

   The EW drive waveform does not track with the line frequency. This mode is to be used for driving EW modulators which require a voltage independent of the line frequency.

Output stage for asymmetric correction waveforms [ASCOR (pin 20)]

This output is designed as a voltage output for superimposed waveforms of vertical parabola and sawtooth. The amplitude and polarity of both signals can be change by registers HPARAL and HPINBAL via the I²C-bus.

Application hint: The TDA4856 offers two possibilities to control registers HPINBAL and HPARAL.

1. Control bit ACD = 1

   The two registers now control the horizontal phase by means of internal modulation of the PLL2 horizontal phase control. The ASCOR output (pin 20) can be left unused, but it will always provide an output signal because the ASCOR output stage is not influenced by the control bit ACD.

2. Control bit ACD = 0

   The internal modulation via PLL2 is disconnected. In order to obtain the required effect on the screen, pin ASCOR must now be fed to the DC amplifier which controls the DC shift of the horizontal deflection. This option is useful for applications which already use a DC shift transformer.

If the tube does not need HPINBAL and HPARAL, then pin ASCOR can be used for other purposes, i.e. for a simple dynamic convergence.

Dynamic focus section [FOCUS (pin 32)]

This section generates a complete drive signal for dynamic focus applications. The amplitude of the horizontal parabola is internally stabilized, thus it is independent of the horizontal frequency. The amplitude can be adjusted via register HFOCUS. Changing horizontal size may require a correction of HFOCUS. To compensate for the delay in external focus amplifiers a 'pre-correction' for the phase of the horizontal parabola has been implemented. The amount of this pre-correction can be adjusted via register HFOCAD. The amplitude of the vertical parabola is independent of frequency and tracks with all vertical adjustments. The amplitude can be adjusted via register VFOCUS.

FOCUS (pin 32) is designed as a voltage output for the superimposed vertical and horizontal parabolas.

B+ control function block

The B+ control function block of the TDA4856 consists of an Operational Transconductance Amplifier (OTA), a voltage comparator, a flip-flop and a discharge circuit. This configuration allows easy applications for differnet B+ control concepts. See also Application Note AN96052: "B+ converter Topologies for Horizontal Deflection and EHT with TDA4855/58".

GENERAL DESCRIPTION

The non-inverting input of the OTA is connected internally to a high precision reference voltage. The inverting input is connected to BIN (pin 5). An internal clamping circuit limits the maximum positive output voltage of OTA.
The output itself is connected to BOP (pin 3) and to the inverting input of the voltage comparator.
The non-inverting input of the voltage comparator can be accessed via BSENS (pin 4).

B+ drive pulses are generated by an internal flip-flop and fed to BDRV (pin 6) via an open-collector output stage.
This flip-flop is set at the rising edge of the signal at HDRV (pin 8). The falling edge of the output signal at BDRV has a defined delay of $t_{d(BDRV)}$ to the rising edge of the HDRV pulse. When the voltage at BSENS exceeds the voltage at BOP, the voltage comparator output resets the flip-flop and, therefore, the open-collector stage at BDRV is floating again.

An internal discharge circuit allows a well defined discharge of capacitors at BSENS. BDRV is active at a LOW-level output voltage (see Fig. 22), thus it requires an external inverting driver stage.

The B+ function block can be used for B+ deflection modulators in many different ways. Two popular application combinations are as follows:

- Boost converter in feedback mode (see Fig. 22)

   In this application the OTA is used as an error amplifier with a limited output voltage range. The flip-flop is set on the rising edge of the signal at HDRV. A reset will be generated when the voltage at BSENS, taken from the current sense resistor, exceeds the voltage at BOP.
   If no reset is generated within a line period, the rising edge of the next HDRV pulse forces the flip-flop to reset. The flip-flop is set immediately after the voltage at BSENS has dropped below the threshold voltage $V_{RESTART(BSENS)}$.

- Buck converter in feed forward mode

   This application uses an external RC combination at BSENS to provide a pulse width which is independent from the horizontal frequency. The capacitor is charged via an external resistor and discharged by the internal discharge circuit. For normal operation the discharge circuit is activated when the flip-flop is reset by the internal voltage comparator. The capacitor will now be discharged with a constant current until the internally controlled stop level $V_{STOP(BSENS)}$ is reached. This level will be maintained until the rising edge of the next HDRV pulse sets the flip-flop again and disables the discharge circuit.
   If no reset is generated within a line period, the rising edge of the next HDRV pulse automatically starts the discharge sequence and resets the flip-flop. When the voltage at BSENS reaches the threshold voltage $V_{RESTART(BSENS)}$, the discharge circuit will be disabled automatically and the flip-flop will be set immediately. This behaviour allows a definition of the maximum duty cycle of the B+ control drive pulse by the relationship of charge current to discharge current.

Supply voltage stabilizer, references, start-up procedures and protection functions

The TDA4857 provides an internal supply voltage stabilizer for excellent stabilization of all internal references. An internal gap reference, especially designed for low-noise, is the reference for the internal horizontal and vertical supply voltages. All internal reference currents and drive current for the vertical output stage are derived from this voltage via external resistors.

If eithr the supply voltage is below 8.3V or no data from the I²C-bus has been received after power-up, the internal soft start and protection functions fo not allow any of those outputs [HDRV, BDRV, VOUT1, VOUT2 and HUNLOCK] to be active.

For supply voltages below 8.3V the internal I²C-bus will not generated an acknowledge and the IC is in standby mode. This is because the internal protection circuit has generated a reset signal for the soft start register SOFTST. Above 8.3V data is accepted and all registers can be loaded. If the register SOFTST has received a set from the I²C-bus, the internal soft start procedure is released, which activates all above mentioned outputs.

If during normal operation the supply voltage has dropped below 8.1 V, the protection mode is activated and HUNLOCK (pin 17) changes to the protection status and is floating. This can be detected by the microcontroller.

This protection mode has been implemented in order to protect the deflection stages and the picture tube during start-up, shut-down and fault conditions. This protection mode can be activated as shown is Table 3.

Table 3 Activation of protection mode

ACTIVATION	RESET
Low supply voltage at pin10	increase supply voltage; reload registers; soft start via I²C-bus
Power dip, below 8.1 V	reload registers; soft start via I²C-bus or via supply voltage
X-ray protection XRAY (pin 2) triggered	reload registers; soft start via I²C-bus
HPLL2 (pin 30) externally pulled to ground	release pin 30

When the protection mode is active, several pins of the TDA4857 are forced into a defined state:

    HDRV (horizontal driver output) is floating
    BDRV (B+ control driver output) is floating
    HUNLOCK (indicates, that the frequency-to-voltage converter is out of lock) is floating (HIGH-level via external pull-up resistor)
    CLBL provides a continuous blanking signal
    The capacitor at HPLL2 is discharged.

If the soft start procedure is activated via the I²C-bus, all of these actions will be performed in a well defined sequence.

Power dip recognition

In standby mode the I²C-bus will only answer with an acknowledge, when data is sent to control register with subaddress 1AH. This register contains the standby and soft start control bit.

If the I²C-bus master transmits data to another register, an aknowledge is given after the chip address and the subaddress; an acknowledge is not given after the data. This indicates that only in soft start mode data can be stored into normal registers.

If the supply voltage dips under 8.1 V the TDA4857 leaves normal operation mode and changes into standby mode. The microcontroller can check this state by sending data into a register with the subaddress 0XH. The acknowledge will only be given on the data if the TDA4857 is active.

Due to this behavior the start-up of the TDA4857 is defined as follows. The first data that is transferred to the TDA4857 must be sent to the control register with subaddress 1AH. Any other subaddress will not lead to an acknowledge. This is a limitation in checking the I²C-busses of the monitor during start-up.

APPLICATION INFORMATION
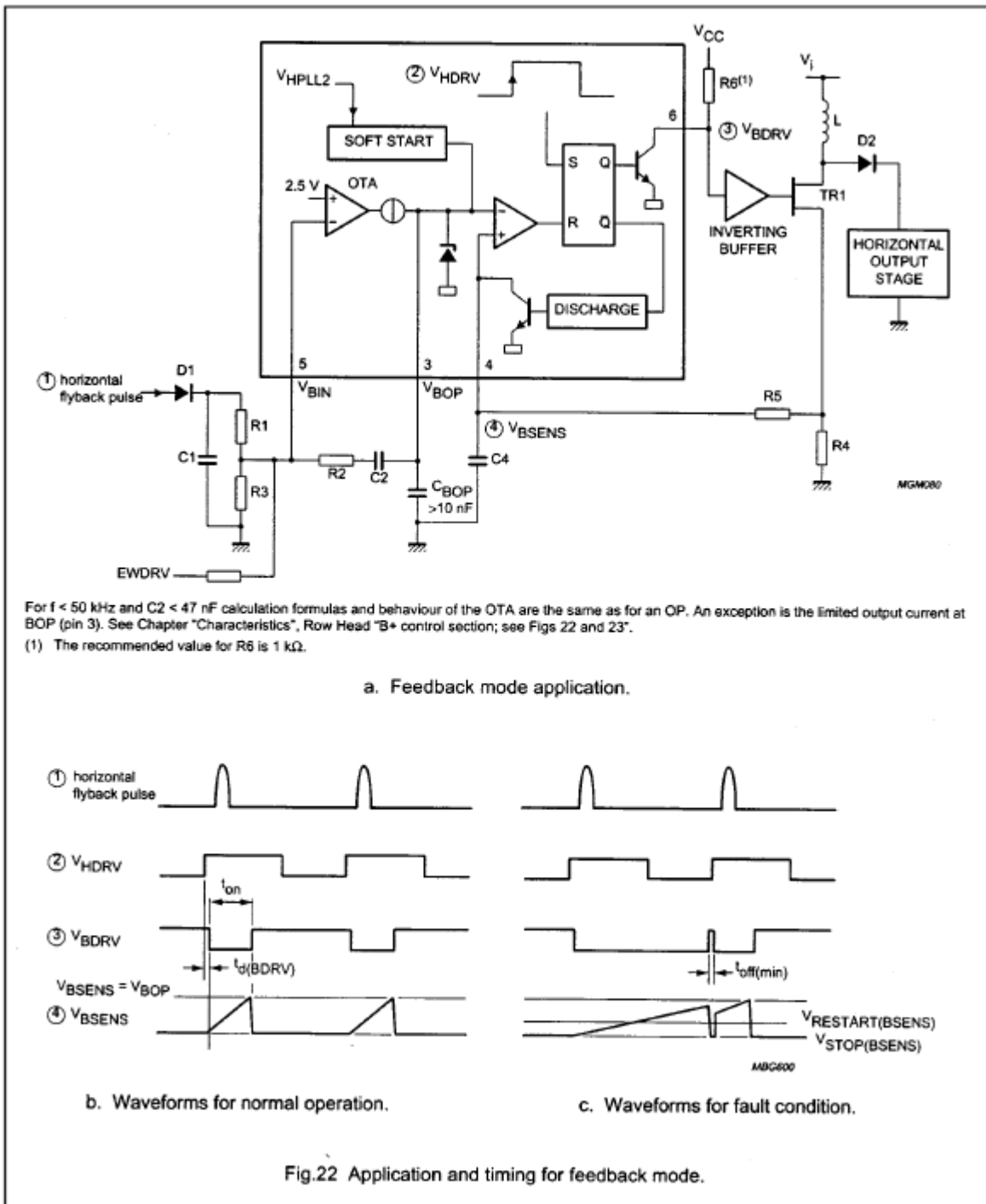
For f < 50 kHz and C2 < 47 nF calculation formulas and behaviour of the OTA are the same as for an OP. An exception is the limited output current at BOP (pin 3). See Chapter "Characteristics", Row Head "B+ control section; see Figs 22 and 23".

(1) The recommended value for R6 is 1 kΩ.

a. Feedback mode application.

b. Waveforms for normal operation.

c. Waveforms for fault condition.

Fig.22 Application and timing for feedback mode.

4. Horizontal drive and power supply output
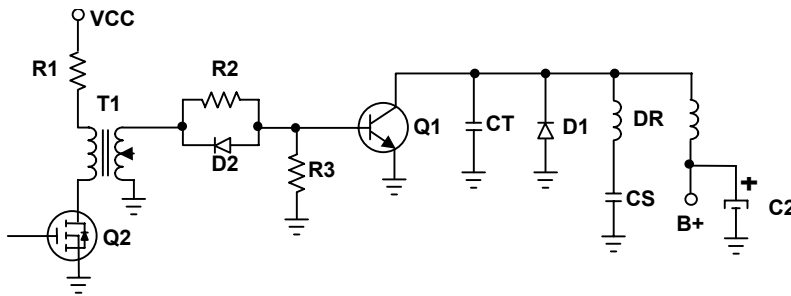
Circuit Diagram
Description of the circuit:

1) R1, T1 and Q2 compose the horizontal driving circuit, and transistor Q1 generates a horizontal output through the driving signal.

$$IB1 = I_{CPMAX} / Q1h_{feMIN}$$
$$I_{B2} = 3I_{B1}$$
$$di/dt = 3.3 \text{ A/}\textsc{us}$$

2) Resistor R2 corrects the current IB1, resistor R3 works as a damping resistor and leak resistor and diode D2 works as a discharging device and polar body.
As long as transistor Q1 is OFF, the discharge is accelerated and the storage time (Tstg) is shortened.

3) H-OUT circuit wavefor

Time 5uS/div
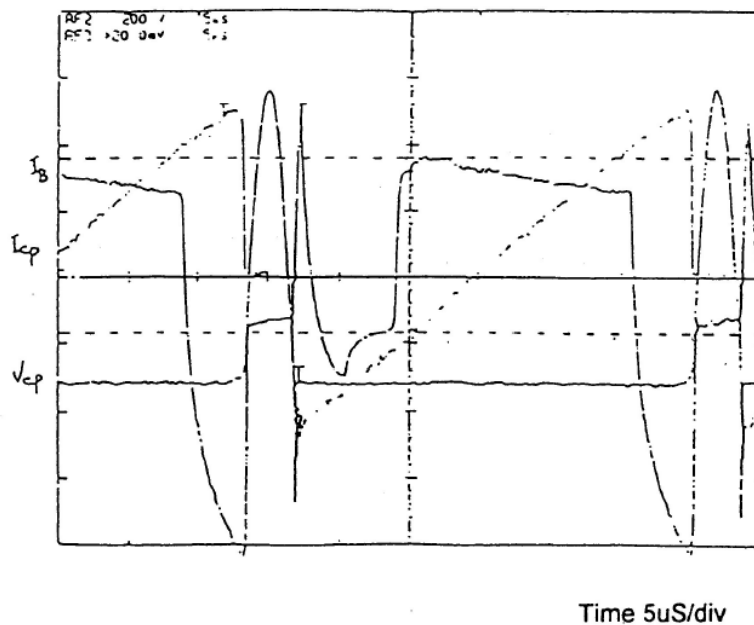
5. Horizontal amplitude control

Circuit Diagram
Circuit Description:
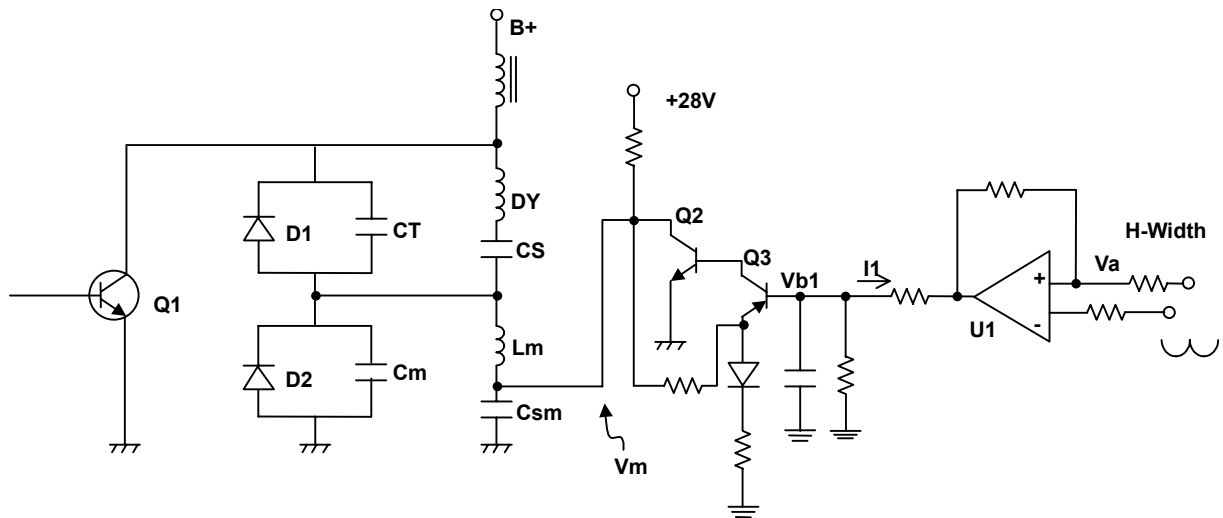
1) Diodes D1 and D2 compose the bipolar modulation circuit, and have the function of controlling the currents of the coils DY(lpp) and Lm(lm) through voltage modulation carried out by utilizing VM.

   B+ = Vm +Vcs   Therefore, Vcs = (ly * Ly)/ts → ly = (Vcs * ts)/Ly, with B+ fixed.

   Such being the case, the horizontal width decreases when Vm ↑ → Vc ↓ → ly ↓

   Inversely, the horizontal width decreases when Vm ↓ → Vcs ↑ → ly ↑

   (B+ = (Vp*2Tr)/(π*Ts), Tr = $\sqrt{LyCt}$, Tm = $\sqrt{LmCm}$)

2) Q2, Q3 and U1 compose the control circuit of H-WIDTH. Of those devices, the transistors Q2 and Q3 compose the Darlington current amplifier, and the operational amplifier U1 composes the emitter-coupled circuit, that stabilizes the voltage and controls the current.

3) The horizontal width broadens when Va ↑ → VbI ↓ → I1 ↑ → I2 ↑ → Vm ↓ →. An inference in the opposite sense is also possible.

Test points for maintenance:

1) C_T = 31 to 37 kHz = 3.2 us
        48 to 64 kHz = 3.0 us
        Cm ÷ 2.8 us

2) V_ACENTER: 31 to 64 kHz = 1.91 to 4.06V
   V_MCENTER: 31 to 64 kHz = 11.6 to 27.4V

6. Blanking and spot killer

Circuit Diagram
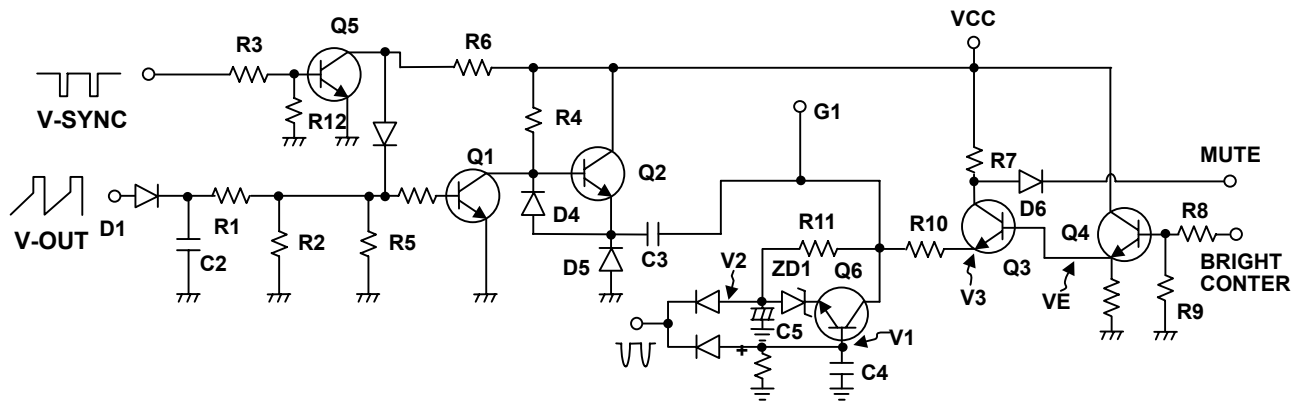
Circuit Description:

1) The vertical blanking circuit is composed of Q1, Q2, Q3 and peripheral circuit.
   The vertical sync pulse applied to R3, R12 connected to Q5 base. Q5 is invert amplifier, then mixed with Q1 base together for vertical retrace compensation time of the blanking pulse.

2) The vertical amplifier output waveform through D1, C2, R1, R2 make waveform forming and clamp. Then applied to Q1 base, the vertical blanking amplifier of Q1, the output connected to buffer Q2, through C3 coupling to G1 control circuit. D4, D5 are for over voltage protect.

3) The Q6 is spot killer protect circuit, in normal power on stage.

   V1 = V2 and ZD1, so Q6 off. The CRT G1 voltage is fixed at $-45 \sim -67 V_{DC}$ with vertical blanking pulse 12Vpp VG1 = $- (V \times R11) / (R10 + R11)$, (V = V1 $-$ V3).

   When power off the voltage V1 > V2, then Q6 turn on pulling VG1 to $-180V$ to protect CRT.

4) When Mute set to lower the Q3 off G1 = $-180V$ screen cut off no picture display, this mute circuit is active, at power ON/OFF and when mode change stage.

5) Q4 bias set up by MCU to control the V_{CE} bias of Q3, then control G1 voltage output.

Test points for maintenance:

1) Check D1, R3 and Q1 collector

2) G1 voltage control range = -45 ~ -67VDC
   G1 off momentary voltage = -180VAC

7. Video amplifier system

LM1269

110 MHz I²C RGB Video Amplifier System with OSD & DACs

General Description

The LM1269 pre-amp is an integrated CMOS CRT pre-amp. The IC is I2C compatible, and allows control of all the parameters necessary to direct setup and adjust the gain and contrast in the CRT display. Brightness and bias can be controlled through the DAC outputs, and is well matched to the LM2479 and LM2480 integrated bias clamp IC.

The LM1269 pre-amp is designed to work in cooperation with the LM246X high gain driver family. Black level clamping of the signal is carried out directly on the AC coupled input signal into the high impedance preamplifier input, thus eliminating the need for the additional black level clamp capacitors.

The IC is packaged in an industry standard 24-lead DIP molded plastic package.

Features

- I²C compatible interface to micro-controller
- 110 MHz bandwidth preamplifier with full video signal parametric control
- 4 external 8-bit DACs for bus controlled Bias and Brightness
- Suitable for use with discrete or integrated clamp, with software configurable Brightness mixer
- Power Save (Green) Mode, 80% power reduction
- Matched to LM246X driver

Applications

- Low end 14", 15", and 17" bus controlled monitors with OSD
- 1024 X 768 displays up to 70 Hz requiring OSD capability
- Very low cost system with LM246X driver

Block and Connection Diagram
Timing Diagrams
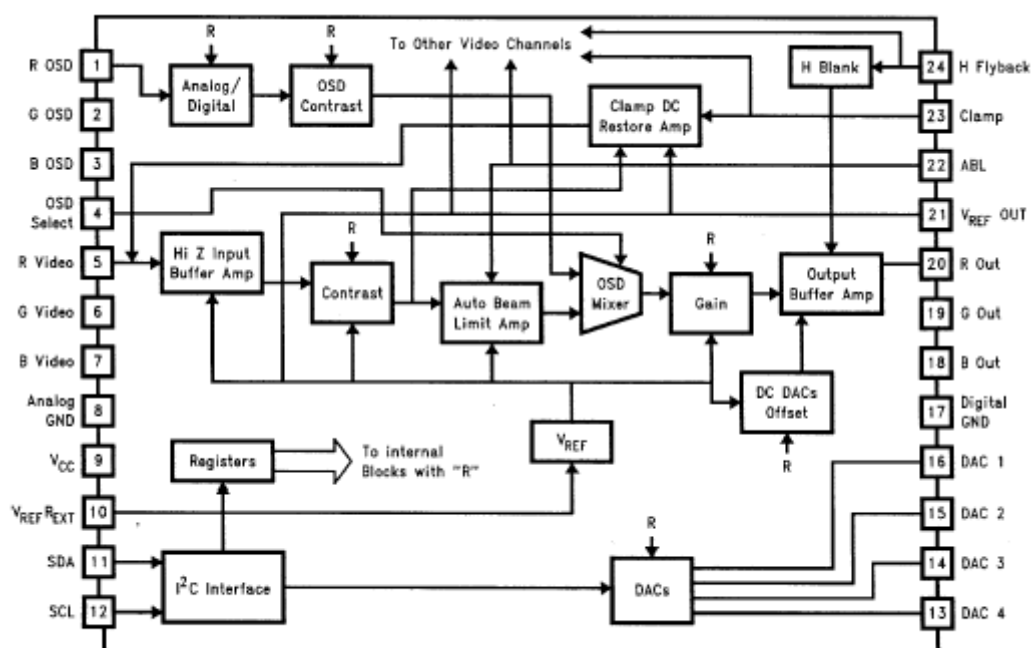
FIGURE 1.

Pin Descriptions

FIGURE 3. OSD Output Skew

*OSD Signal (V_{OSD-l}) = black level and Video input = white level

$\Delta t_{OSD/OSD\ S}$ (OSD output skew) = t_{r-prop}(OSD) – t_{r-prop}(OSD S) and

$\Delta t_{OSD/OSD\ S}$ (OSD output skew) = t_{f-prop}(OSD) – t_{f-prop}(OSD S)
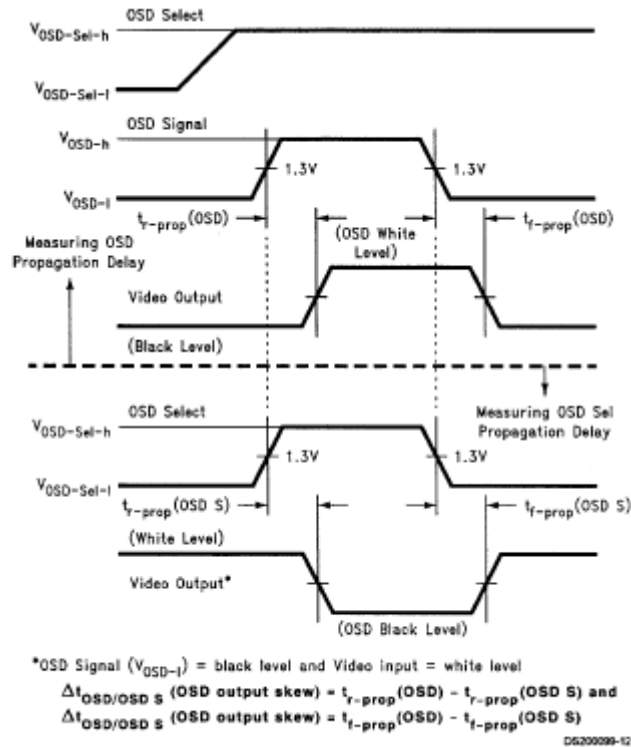
Pin Descriptions

Pin No.	Pin Name	Schematic	Description
1 2 3	Red OSD Input Green OSD Input Blue OSD Input		These inputs accept standard TTL or CMOS input. Each color is either fully on (logic high) or fully off (logic low). Unused pins should be connected to ground with a 47k resistor.
4	OSD Select		This input accepts a standard TTL or CMOS input. H = OSD L = Video Connect to ground with a 47k resistor if not using OSD.

Pin Descriptions

Pin No.	Pin Name	Schematic	Description
5 6 7	Red Video Input Green Video Input Blue Video Input		Video inputs. These inputs **must** be AC coupled with a 0.047 µF cap. DC restoration is done at these inputs. A series resistor of about 33Ω and external ESD protection diodes should also be used for ESD protection.
8	Analog Ground		Ground Pin for the analog circuits of the LM1269.
9	V$_{cc}$		Power supply pin for LM1269.
10	V$_{ref}$ R$_{ext}$		Sets the internal current sources through a 10 kΩ 1% external resistor. Resistor value and accuracy is critical for optimum operation of the LM1269.
11	SDA		The I²C data line. A pull-up resistor of about 2kΩ should be connected between this pin and +5V. A 300Ω resistor should be connected in series with the data line for protection against arcing.
12	SCL		The I²C Clock line. A pull-up resistor of about 2kΩ should be connected between this pin and +5V. A 300Ω resistor should be connected in series with the clock line for protection against arcing.
13 14 15 16	DAC4 DAC3 DAC2 DAC1		DAC outputs for cathode cut-off adjustments and brightness control. DAC 4 can be set to change the outputs of the other three DACs, acting as the brightness control. The DACS are set through the I²C bus.
17	Digital Ground		Ground Pin for the digital circuits of the LM1269.

Function Description

Pin No.	Pin Name	Schematic	Description
18 19 20	Red Video Out Green Video Out Blue Video Out	 * ESD Protection Diode	Video outputs of the LM1269. The ideal driver for this part is the LM246X CRT driver family, which has the necessary gain of 26 dB or 20 V/V.
21	R_{Ref} Out	 * ESD Protection Diode	A 0.1 μF capacitor must be placed close to this pin for decoupling the internal V_{Ref}. This pin may be used for an external voltage reference with proper buffering.
22	ABL	 * ESD Protection Diode	The Auto Beam Limit control reduces the gain of the video amplifier in response to a control voltage proportional to the CRT beam current. The ABL acts identically on all three channels. ABL is required for CRT life and X-ray protection.
23	Clamp Pulse	 * ESD Protection Diode	This input accepts a standard TTL or CMOS input. A positive signal activates the clamp pulse for DC restoration of the video input. The AC coupling capacitors at the video inputs are used for holding the DC correction voltage, eliminating the need for additional capacitors.
24	H Flyback	 * ESD Protection Diode	H flyback is an analog signal input from the monitor horizontal scan. The LM1269 is able to generate an accurate blanking pulse in the video outputs from this input. The horizontal flyback from the monitor must be a clean signal, with no ringing or other noise on the signal.

All functions of the LM1269 are controlled through the I²C Bus. Details on the internal registers are covered in the I²C Interface Registers Section. *Figure 1* shows the block diagram of the LM1269. The I²C signals come in on pins 11 and 12 and go to the I²C Interface. Both the internal blocks with an "R" and the four external DACs are controlled by the I²C Interface. The video and OSD block are shown for the red channel in *Figure 1*. The blocks for both the green and blue channels are not shown; however, they are identical to the red channel.

Proper operation of the LM1269 does require a very accurate reference voltage. This voltage is generated in the V_{Ref} block. To insure an accuate voltage over temperature, an external resistor is used to set the current in the V_{Ref} stage. The external resistor is connected to pin 10. This resistor should be 1% and have a temperature coefficient under 100 ppm/°C. ALL VIDEO SIGNALS MUST BE KEPT AWAY FROM PIN 10. This pin has a very high input impedance and will pick up any high frequency signals routed near it. The board layout shown in *Figure 10* is a good example of trace routing near pin 10. The output of the V_{Ref} stage goes to a number of blocks in the video section and also to pin 21. This pin allows capacitor filtering on the V_{Ref} output and offers an accurate external reference. A buffer must be used with this reference, the maximum current loading should be only 100 µA.

Note: Any noise injected into pin 21 will appear on the video. The voltage reference must be kept very clean for best performance of the LM1269.

The video inputs are pins 5, 6, and 7. Looking at the red channel (pin 5) note that the "Clamp DC Restore Amp" is connected to this pin. Since the video must be AC coupled to the LM1269, the coupling cap is also used to store the reference voltage for DC restoration. The "Clamp DC Re-store Amp" block charges the input capacitor to the correct voltage when the clamp pulse (pin 23) is active. The "Hi Z Input Buffer Amp" buffers the video signal for internal processing. Input impedance to this stage is typically 20 MW. With such a high impedance the DC restoration can appear to be working for a number of minutes after the clamp pulse in removed.

The output of the Buffer Amp goes to the Contrast stage. The 7 bit contrast register (03h) sets the contrast level through the I²C bus. This register controls the Contrast stage in each video channel. Contrast adjustment range is up to –20 dB. Loading all zeros in the contrast register gives –20 dB attenuation. All ones will give no attenuation. The output of this stage is used as the feedback for the DC restoration loop. "Auto Beam Limit Amp" or ABL is the next block in the video path. This is a voltage controlled gain stage which gives no attenuation with 5V at pin 22 and gives about –10 dB attenuation with 2V at pin 2. ABL is covered in more detail later in this section.

Next in the video path is the "OSD Mixer". The OSD Select signal at pin 4 controls this stage, selecting OSD with a high at pin 4, and video with a low at pin 4. Since the DC restoration feedback is at the Contrast output, the video black level will match the OSD black level. The OSD signal is mixed with the video signal at the output of this stage.

The OSD goes through the "OSD Contrast" stage before entering the "OSD Mixer" block. Bits 3 and 4 of register 08h control the OSD contrast giving four video levels for the OSD window. Maximum video level for the OSD window occurs with both bits set to one. Minimum video level will occur with both bits set to a zero. Following the "OSD Mixer" is the "Gain" block. Each video channel has its own independent control of this block so the user can balance the color of the CRT display. Registers 00h, 01h, 02h are used for the gain attenuation. These registers are 7 bits with the maximum attenuation of –10 dB occurring when all zeros are loaded.

The final block in the video path is the "Output Buffer Amp". This stage provides the drive needed for the inputs of a CRT driver. The recommended driver for this pre-amp is one of the LM246X family. Horizontal blanking is also added to the video signal from the "H Blank" stage. This block is covered in more detail below. DC offset of the output is set by the "DC DACs Offset" stage. Bits 0 through 2 in register 08 control this stage. This gives 8 different black levels ranging from 0.75V to 1.55V. When using one of the LM246X CRT driver family it is recommended that the black level be set to 1.25V.

ABL: The Auto Beam Limit control reduces the gain of the video amplifiers in response to a control voltage proportional to the CRT beam current. The ABL acts on all three channels in an identical manner. This is required for CRT life and X-ray protection. The beam current limit circuit application is as shown in Figure 4: when no current is being drawn by the EHT supply, current flows from the supply rail through the ABL resistor and into the ABL input of the IC. The IC clamps the input voltage to a low impedance voltage source (the 5V supply rail).

When current is drawn from the EHT supply, some of the current passing through the ABL resistor goes to the EHT supply, which reduces the current flowing into the ABL input of the IC. When the EHT current is high enough, the current flowing into the ABL input of the IC drops to zero. This current level determines the ABL threshold and is given by:

$$I_{ABL} = \frac{V_S - V_{ABLTH}}{R_{ABL}}$$

Where:

V_S is the external supply (usually the CRT driver supply rail, about 80V)

$V_{ABL\ TH}$ is the threshold ABL voltage of the IC

R_{ABL} is the ABL resistor value

I_{ABL} is the ABL limit

When the voltage on the ABL input drops below the ABL threshold of the pre-amp the gain of the pre-amp reduces, which reduces the beam current. A feedback loop is thus established which acts to prevent the average beam current exceeding I_{ABL}.

H Flyback: H Flyback is an analog signal input from the monitor horizontal scan. The "H Blank" section uses this signal to add
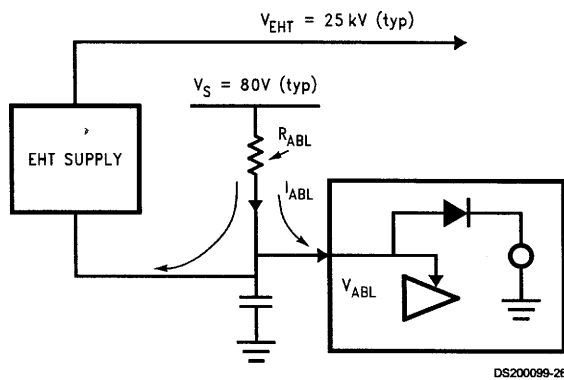
FIGURE 4. ABL

horizontal blanking to the output of video signal. This enables the user to blank at the cathodes during horizontal flyback. An optional capacitor and/or resistor to ground may be needed if noise interferes with the H Flyback signal.

This feature gives very accurate timing for the horizontal blanking; however, the flyback signal must be very clean. There should be no ringing or other noise on the flyback signal.

R_{LIMIT} is used to limit the input current into the IC to a value of +1 mA during flyback and –100 μA during normal forward scan. For example if an H flyback with a peak of 100V is used, R_{LIMIT} = 100KΩ. The internal input impedance of pin 24 is low to limit the maximum voltage swing at the input to within the supply rail and ground. The IC interface circuit creates a digital signal from this waveform, which is used as the blanking signal at the "Output Buffer Amp". This signal adds blanking to the video output signal. *Figure 5* shows the H flyback waveforms and the location of R_{LIMIT}. A 56 pF capacitor has been added to the H Flyback pin on the demo board for filtering noise on the H Flyback signal.

H Blank: Some customers may still prefer to use a standard logic signal for the horizontal blanking. Pin 24 can be adapted to accept
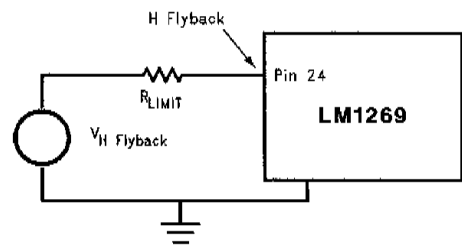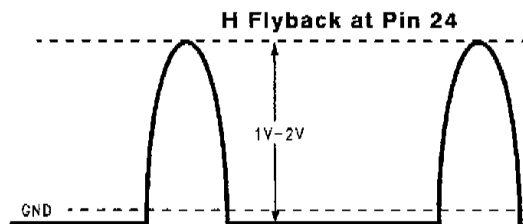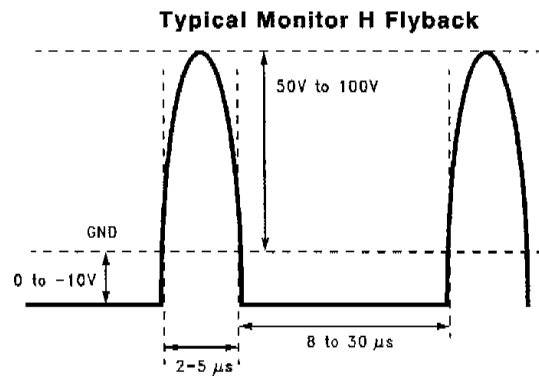
FIGURE 5. H Flyback Input Pulse

a logic input. It is necessary for the current flow into pin 24 to reverse for proper operation. Therefore the logic signal must be AC coupled into pin 24. *Figure 6* shows the recommended circuit for a logic signal input. The blank signal must be a positive pulse.

Power Save Mode: There are two modes of power save:

1. Blanking the video
2. Turning off most of the power for maximum power savings.
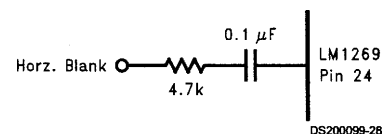
FIGURE 6. Standard Logic H Blank

In the first mode the video is completely blanked. By setting bit-0 in register 90 to a 1 the video will be completely blanked. This gives some power saving since there is no beam current in the monitor. Maximum power saving is obtained in the second mode. Bits 0 and 1 in register 9 should be set to a 1. Bit 1 in register 9 turns off the video output stage of the LM1269, giving a high impedance at the output pin. After bits 0 and 1 of register 9 are set to a 1, the power supplies to the CRT driver and CRT can be turned off.

Note: The 5V supply must remain on for proper operation. Since the LM1269 is a CMOS device its power consumption will be minimal.

External DACs: Four DACs with external outputs are provided in the LM1269. Normally these DACs will be used for color bal-

ance and brightness control. If the brightness control is done at G1, then three DACs would be used for color balance and the last DAC would be used for controlling the G1 voltage.

There is also a provision to set the brightness at the cathodes. DAC 4 can be set to vary the outputs of the other three DACs after the color balance is completed. This is accomplished by adding the output of DAC 4 to the other 3 DACs. Bits 3 and 4 of register 9 are set to a 1 for brightness control at the cathodes. Bit 3 sets the output range of DAC 1-3 to 50% of their full range. Bit 4 adds 50% of DAC 4 to the other three DACs. These two adjustments keeps the overall output voltage of DAC 1-3 in the proper range and still allows brightness control. For either mode of brightness control, the DACs are ideally set to work with the LM2479 or LM2480 for DC restoration at the cathodes of the CRT.

ESD and Arc-Over Protection

The LM1269 incorporates full ESD protection with special consideration given to maximizing arc-over robustness. The monitor designer must still use good circuit design and PCB layout techniques. The human body model ESD susceptibility of the LM1269 is 3.5 kV, however many monitor manufacturers are now testing their monitors to the level 4 of the IEC 801-2 specification which requires the monitor to survive an 8kV discharge. External ESD protection is needed to survive this level of ESD. The LM1269 provides excellent protection against both ESD and arc-over, but this is not a substitute for good PCB layout. *Figure 7* shows the recommended input protection for the LM1269. This provides the best protection against ESD. When this protection is combined with good PCB layout the LM1269 will easily survive the IEC 801-2 level 4 testing (8 kV ESD). It is strongly recommended that the protection diodes be added as shown in *Figure 7*. The 1N4148 diode has a maximum capacitance of 4 pF, which will have little effect on the response of the video system due to the low impedance of the input video.

The ESD cells of the LM1269 also provide good protection against arc-over, however good PCB layout is necessary. The LM1269 should not be exposed directly to the voltages that may occur during arc-over. The main vulnerability of the LM1269 to arc-over is though the ground traces on the PCB. For proper protection all ground connections associated with the LM1269, including the grounds to the bypass capacitors, must have short returns to the ground pins. A significant ground plane should be used to connect all the LM1269 grounds which shows the demo board layout, is an excellent example of an effective ground plane. The list below should be followed to ensure a PCB with good grounding:

All grounds associated with the LM1269 should be connected together through a large ground plane.

CRT driver ground is connected to the video pre-amp group at one point.

CRT and arc protection grounds are connected directly to the chassis or main ground. There is no arc-over current flow from these grounds through the LM1269 grounds.

Input signal traces for SDA, SCL, H Flyback, and Clamp should be kept away from the CRT driver and all traces that could carry the arc current.

Output signal traces of the LM1269 should be kept away from the traces that carry the output signals of the CRT driver. If any one of the above suggestions is not followed the LM1269 may become more vulnerable to arc-over. Improper grounding is by far the most common cause of video pre-amp failure during arc-over.
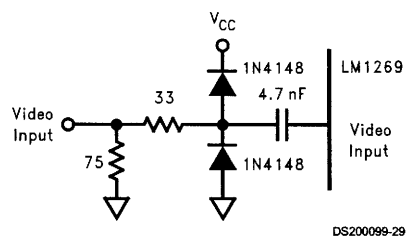
FIGURE 7. Recommended Video Input ESD Protection

8. 9nS Hight Gain CRT Driver

LM2469
Monolothic Triple 9nS High Gain CRT Driver

Gerenral Description

The LM2469 is an integrated high voltage CRT driver circuit designed for use in color monitor applications. The IC contains three high input impedance wide band amplifiers, which directly drive the RGB cathodes of a CRT. Each channel has its gain internally set to –20 and can drive CRT capacitive loads as well as resistive loads present in other applications, limited only by the package's power dissipation. The IC is packaged in an industry standard 9 lead TO-220 molded plastic package.

Features

- Higher gain to match LM126X CMOS preamplifiers

- 0V to 3.75V input range
- Stable with 0-20pF capacitive loads and inductive peaking networks
- Maintains standard LM243X Family Pinout which is designed for easy PCB layout
- Convenient TO-220 staggered lead package style

Applications

- Up to 1024 x 768 at 70Hz
- Pixel clock frequencies up to 75MHz
- Monitors using video blanking

Schematic Diagram
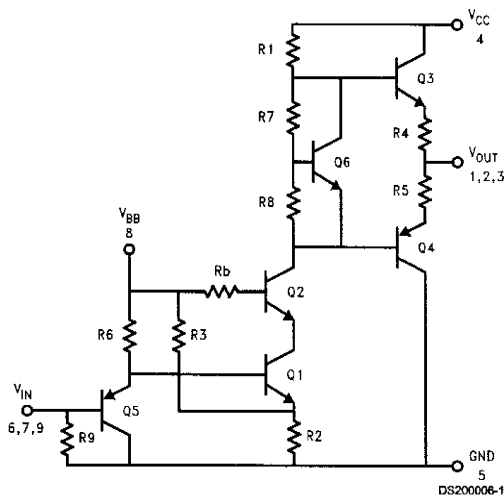
FIGURE 1. Simplified Schematic Diagram (One Channel)

Schematic Diagram
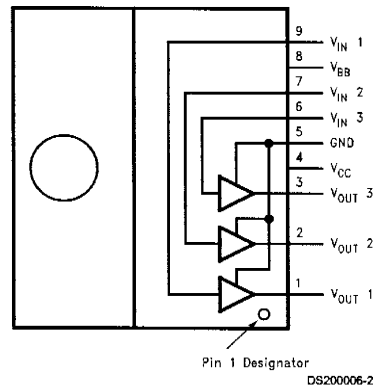
Note: Tab is at GND.

FIGURE 2. Top View
Order Number: LM2469TA
NS package Number: TA09A

THEORY OF OPERATION

The LM2469 is high voltage monolithic three channel CRT driver suitable for color monitor applications. The LM2469 operates with 80V and 12V power supplies. The part is housed in the industry standard 9-lead TO-220 molded plastic power package. The circuit diagram of the LM2469 is shown in Figure 1. The PNP emitter follower, Q5, provides input buffering. Q1 and Q2 form a fixed gain cascode amplifier with resistors R1 AND R2 setting the gain at –20. Emitter followers Q3 and Q4 isolate the high output impedance of the amplifier, decreasing the sensitivity of the device to changes in load capacitance. Q6 provides biasing to the output emitter follower stage to reduce crossover distortion at low signal levels.

Figure 3 shows a typical test circuit for evaluation of the LM2469. This circuit is designed to allow testing of the LM2469 in a 50W environment without the use of an expensive FET probe. In this test circuit, two low inductance resistors in series totaling 4.95KW form a 200:1 wideband, low capacitance probe when connected to a 50W load (such as 50W oscilloscope input). The input signal from the generator is AC coupled to the base of Q5.

APPLICATION HINTS

INTRODUCTION

National Semiconductor (NSC) is committed to provide application information that assists our customers in obtaining the best performance possible from our products. The following information is provided in order to support this commitment. The reader should be aware that the optimization of performance was done using a specific printed circuit board designed at NSC. Variations in performance can be realized due to physical changes in the printed circuit board and the application. Therefore, the designer should know that component value changes might be required in order to optimize performance in a given application. The values shown in this document can be used as a starting point for evaluation purposes. When working with high bandwidth circuits, good layout practices are always critical to achieving maximum performance.

IMPORTANT INFORMATION

The LM2469 performance is targeted for the VGA (640 x 480) to (1024 x 768, 70Hz refresh) resolution market. It is designed to be a replacement for discrete CRT drivers. The application circuits shown in this document to optimize performance and to protect against damage from CRT arc-over are designed specifically for the LM2469. If another member of the LM246X family is used, pleased refer to its datasheet.

POWER SUPPLY BYPASS

Since the LM2469 is a wide bandwith amplifier, proper power supply bypassing is critical for optimum performance. Improper power supply bypassing can result in large overshoot, ringing or oscillation. A 0.1uF capacitor should be connected from the supply pin, V_{CC} to ground, as close to the supply and ground pins as is practical. Additionally, a 10uF to 100uF electrolytic capacitor should be connected from the supply pin to ground. The electrolytic capacitor should also be placed reasonably close to the LM2469's supply and ground pins. A 0.10uF capacitor should be

connected from the bias pin (V_{bb}) to the ground, as close as is practical to the part.

ARC PROTECTION

During normal CRT operation, internal arcing may occasionally occur. Spark gaps, in the range of 200V, connected from the CRT cathodes to CRT ground will limit the maximum voltage, but to a value that is much higher than allowable on the LM2469. This fast, high voltage, high energy pulse can damage the LM2469 output stage. The application circuit shown in Figure 4 is designed to help clamp the voltage at the output of the LM2469 to a safe level. The clamp diodes, D1 and D2, should have a fast transient response, high peak current rating, low series impedance and low shunt capacitance. FDH400 or equivalent diodes are recommended. Do not use 1N4148 diodes for the clamp diodes. D1 and D2 should have short, low impedance connections to V_{CC} and ground respectively. The cathode of D1 should be located very close to a separately decoupled bypass capacitor (C3 in Figure 4). The ground connection of D2 and the decoupling capacitor should be very close to the LM2469 ground. This will significantly reduce the high frequency voltage transients that the LM2469 would be subjected to during an arcover condition. Resistor R2 limits the arcover current that is seen by the diodes while R1 limits the current into the LM2469 as well as the voltage stress at the outputs of the device. R2 should be a 1/2W solid carbon type resistor. R1 can be a 1/4W metal or carbon film type resistor. Having large value resistors for R1 and R2 would be desirable, but has the effect of increasing rise and fall times. Inductor L1 is critical to reduce the initial high frequency voltage levels that the LM2469 would be subjected to. The inductor will not only help protect the device, but will also help optimize rise and fall times as well as minimize EMI. For proper arc protection, it is important to not omit any of the arc protection components shown in Figure 4.
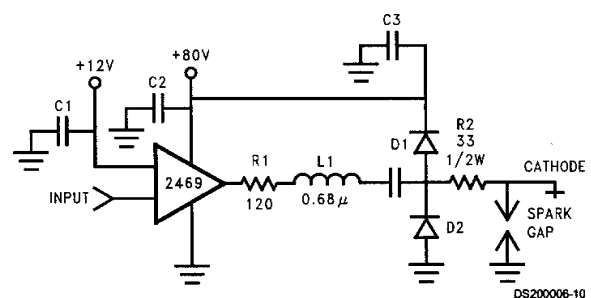
FIGURE 4. One Video Channel of the LM2469 with the Recommended Arc Protection Circuit

OPTIMIZING TRANSIENT RESPONSE

Referring to Figure 4, there are three components (R1, R2 and L1) that can be adjusted to optimize the transient response of the application circuit. Increasing the values of R1 and R2 will slow the circuit down while decreasing overshoot. Increasing the value of L1 will speed up the circuit as well as increase overshoot. It is very important to use inductors with very high self-resonant frequencies, preferably above 300MHz. Ferrite core inductors from J.W. Miller Magnetics (part #78FR39K) were used for optimizing the performance of the device in the NSC application board. The values shown in Figure 4 can be used as a good starting point for the evaluation of the LM2469. Using variable resistors for R1 and the parallel resistor will simplify finding the values needed for optimum performance in a given application. Once the optimum values are determined, the variable resistors can be replaced with fixed values.

Effect of Load Capacitance

Figure 13 shows the effect of increased load capacitance on the speed of the device. This demonstrates the importance of knowing the load capacitance in the application. Note that the fall time stayed fairly constant while the rise time increased approximately 1.8% per pF.

Effect of Offset

Figure 11 shows the variation in rise and fall times when the output offset of the device is varied from 40VDC to 50VDC. The rise time shows a maximum variation relative to the center data point (45VDC) of less than 1.3%. The fall time shows a variation of about 3.9% relative to the center data points.

THERMAL CONSIDERATIONS

Figure 10 shows the performance of the LM2469 video amplifiers in the test circuit shown in Figure 3 as a function of case temperature. The figure shows that the rise time of the LM2469 increases by approximately 9% as the case temperature increases from 30°C to 100°C. This corresponds to a speed degradation of 1.3% for very 10°C rise in case temperature.

Figure 9 shows the maximum power dissipation of the LM2469 vs. Frequency when all three channels of the device are driving an 8pF load with a $40V_{p-p}$ signal alternating one pixel on, one pixel off. The graph assumes a 72% active time (device operating at the specified frequency) which is typical in a monitor application. The other 28% of the time the device is assumed to be sitting at the black level (65V in this case). This graph gives the designer the information needed to determine the heat sink requirement for his application. The designer should note that if the load capacitance is increased, the AC component of the total power dissipation will also increase.

The LM2469 case temperature must be maintained below 100°C. If the maximum expected ambient temperature is 70°C and the maximum power dissipation is 3.85W (from Figure 9, 50MHz bandwith), then a maximum heat sink thermal resistance can be calculated:

$$R_{TH} = \frac{100°C - 70°}{3.85W} = 7.8°C / W$$

This example assumes a capacitive load of 8pF and no resistive load.

TYPICAL APPLICATION

The typical application of the LM2469 is shown in Figure 5 & 6. Used in conjunction with an LM126X and an LM2479/2480 bias clamp, a complete video channel from monitor input to CRT cathode can be achieved. Performance is ideal for 1024 x 768 resolution displays with pixel clock frequencies up top 75MHz. Figure 6 are the schematic for the NSC demonstration board that can be used to evaluate the LM126X/246X/2480 combination in a monitor.

PC Board Layout Considerations

For optimum performance, an adequate ground plane, isolation between channels, good supply bypassing and minimizing unwanted feedback are necessary. Also, the length of the signal traces from the preamplifier to the LM2469 and from the LM2469 to the CRT cathode should be as short as possible. The following references are recommended:

Ott, Henry W., "Noise Reduction Techniques in Electronic Systems", John Wiley & Sons, New York, 1976.

"Video Amplifier Design for Computer Monitors", National Semiconductor Application Note 1013.

Pease, Robert A., "Troubleshooting Analog Circuits", Butterworth-Heinemann, 1991.

Because of its high small signal bandwith, the part may oscillate in a monitor if feedback occurs around the video channel through the chassis wiring. To prevent this, leads to the video amplifier input circuit should be shielded, and input wiring should be spaced as far as possible from output circuit wiring.

NSC Demonstration Board

Figure 7 shows the routing and component placement on the NSC LM126X/246X demonstration board. The schematic of the board is shown in Figure 6. This board provides a good example of a layout that can be used as a guide for future layouts. Note the location of the following components:

- C16, C19 – V_{CC} bypass capacitor, located very close to pin 4 ground pins.
- C17, C20 – V_{BB} bypass capacitors, located close to pin 8 and ground.
- C46, C47, C48 – V_{CC} bypass capacitors near LM2469 V_{CC} clamp diodes. Very important for arc protection.

The routing of the LM2469 video outputs to the CRT is very critical to achieving optimum performance. It shows the routing and component placement from pin 3 of the LM2469 to the blue cathode. Note that the components are placed so that they almost line up from the output pin of the LM2469 to the blue cathode pin of the CRT connector. This is done to minimize the length of the video path between these two components. Note also that D8, D9, R24, and D6 are placed to minimize the size of the video nodes that they are attached to. This minimizes parasitic capacitance in the video path and also enhances the effectiveness of the protection diodes. The anode of protection diode D8 is connected directly to a section of the ground plane that has a short and direct path to the LM2469 ground pins. The cathode of D9 is connected to V_{CC} very close to decoupling capacitor C48 which is connected to the same section of the ground plane as D8. The diode placement and routing is very important for minimizing the voltage stress on the LM2469 video outputs during an arc over event. Lastly, notice that S3 is placed very close to the blue cathode and is tied directly to the ground under the CRT connector.

7-45
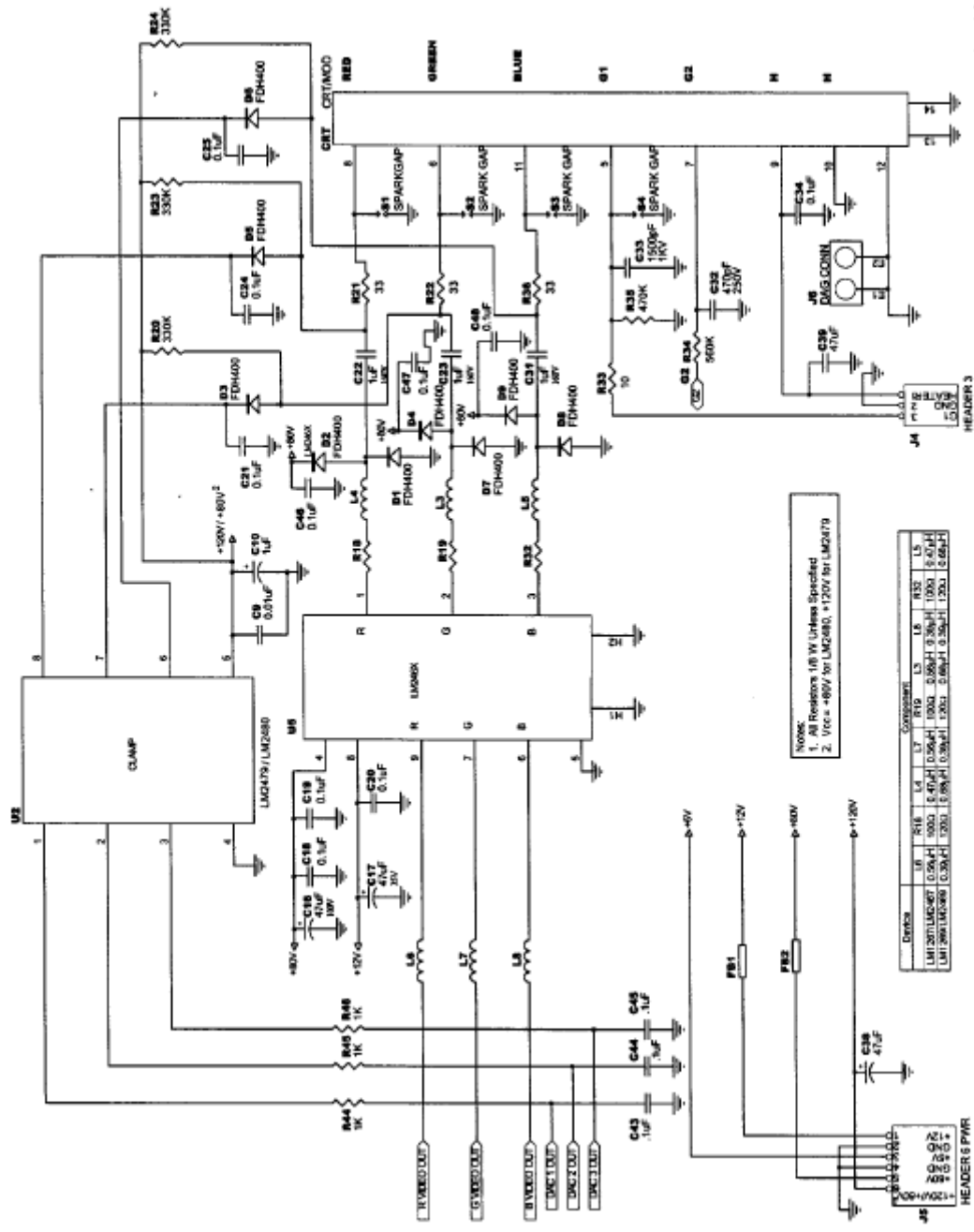
FIGURE 6. LM126X/246X Demonstration Board Schematic (continued)

9. Bias Clamp

LM2480
80V Triple Bias Clamp

General Description

The LM2480 driver is an integrated 80V triple bias clamp circuit for DC recovery of each of the AC coupled outputs of a CRT driver. It is well matched with the DAC outputs of the LM126/x family of pre-amplifiers. Each amplifier has its gain internally set to –18. The IC is package.

Features

- Wide range integrated triple bias clamp

- High input impedance
- Single supply operation
- Matched to the LM126X family of preamplifiers

Recommended Applications

- CRT monitor requiring DC restoration at the cathodes

Block Diagrams
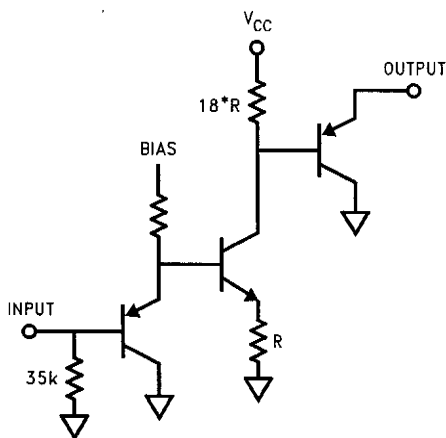
20008301

FIGURE 1. Simplified Schematic (One Channel)

Package Pinout

20008302
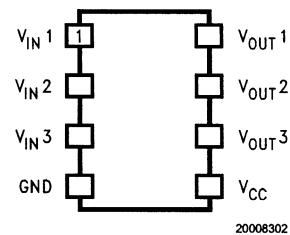
FIGURE 2. LM2480 Package Pinout
Order Number LM2480NA
NS Package Number: N08E

Typical Performance Characteristics

(VCC = +80V), Test Circuit – Figure 3 unless otherwise specified.

20008304
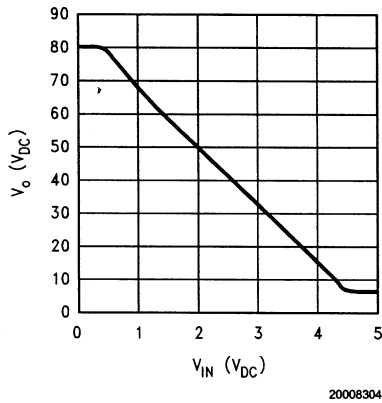
THEORY OF OPERATION

The circuit diagram of the LM2480 is shown in Figure 1. The DC clamp circuit amplifies the input signal by −18 and the gain is set by the resistor ratio of 18R and R. The output requires pull-up resistor to 80V. Figure 2 shows the test circuit used for evaluation of the LM2480 Clamp Amplifier. A high impedance voltmeter (100MW) is used for DC measurements at the output. The DC transfer function is shown in Figure 4.

APPLICATION HINTS

Power Supply Bypass

The LM2480 should have proper power supply bypassing for optimum performance. A 0.1mF capacitor should be connected from the supply pin, V_{CC} to ground, as close to the supply and ground pins as is practical. Additionally, a 1.0mF electrolytic capacitor should be connected from the supply pin to ground. The electrolytic capacitor should also be placed reasonably close to the LM2480's supply and ground pins.

Application Circuit

The application circuit shown in Figure 5 is designed to help clamp the voltage at the output of the driver to the desired level. Capacitor C_4 stabilizes the entire node at the anode of the clamp diode, D_3, by creating a low impedance at high frequencies. Figure 5 also shows the standard application circuit topology when used with an LM246X CRT driver. It shows all the components necessary to optimize performance as well as to protect against damage from a CRT arc event. No additional components are required to protect the LM2480 from arc damage.

20008307
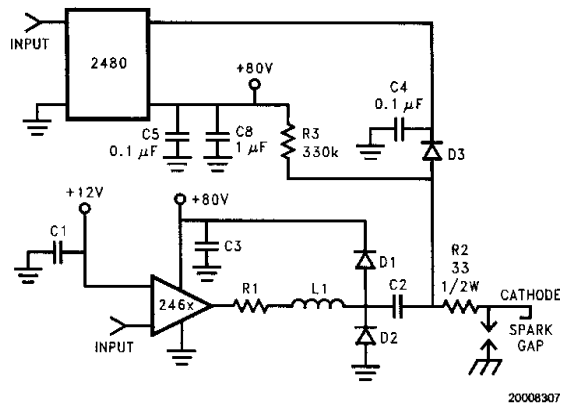
FIGURE 5. One Channel of the LM2480 and LM246X Application Circuit

Demonstration Hardware

National Semiconductor has designed a demonstration neckboard for the LM126X, LM246X, and the LM2480 chipset. To obtain demonstration board contact the National Semiconductor Sales Office in your region.

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10. On Screen Display

MTV030
On-Screen Display with Auto-Sizing Controller

FEATURES

- Horizontal SYNC input up to 150 kHz.
- On-chip PLL circuitry up to 150MHz.
- Minimum timing measurement among HFLB, VFLB, RIN, GIN and BIN for auto sizing.
- Full screen self-test pattern generator.
- Programmable Hor. resolutions up to 1524 dots per line.
- Full-screen display consists of 15 (rows) by 30 (columns)
- Two font size 12×16 or 12×18 dot matrix per character.
- True totally 512 mask ROM fonts including 496 standard fonts and 16 multi-color fonts.
- Double character height and/or width control.
- Programmable positioning for display screen center.
- Character bordering, shadowing and blinking effect.
- Programmable character height (18 to 71 lines) control.
- Row to row spacing control to avoid expansion distortion.
- 4 programmable windows with multi-level operation.
- Shadowing on windows with programmable shadow width/height/color.
- Programmable adaptive approach to handle H, V sync collision automatically by hardware.
- Software clears bit for full-screen erasing.
- Fade-in/fade-out or blending-in/blending-out effects.
- 5-channel/8-bit PWM D/A converter output.
- Compatible with SPI bus or I²C interface with slave address 7AH/7BH (slave address is mask option).
- 16-pin, 20-pin or 24-pin PDIP package.

GENERAL DESCRIPTION

MTV030 is designed for monitor applications to display built-in characters or fonts onto monitor screen. The display operation occurs by transferring data and control information from the micro-controller to RAM through a serial data interface. It can execute full-screen display automatically, as well as specific functions such as character background, bordering, shadowing, blinking, double height and width, font by font color control, frame positioning, frame size control by character height and row to row spacing, horizontal display resolution, full-screen erasing, fade-in/fade-out effect, ndowing effect, shadowing on window and full-screen self-test pattern generator.

MTV030 provides true 512 fonts including 496 standard fonts and 16 multi-color fonts and 2 font sizes, 12x16 or 12x18 for more efficacious applications. So each one of the 512 fonts can be displayed at the same time. The full OSD menu is formed by 15 rows x 30 columns, which can be positioned anywhere on the monitor screen by changing vertical or horizontal delay. The auto sizing video measurement module measure the timing relationship among HFLB, VFLB, and R, G, BIN at the speed related to the OSD resolution. MCU can get the measurement data, active video, front porth and back porth, through I²C bus read/write operation to keep the appropriate display size and center.

BLOCK DIAGRAM
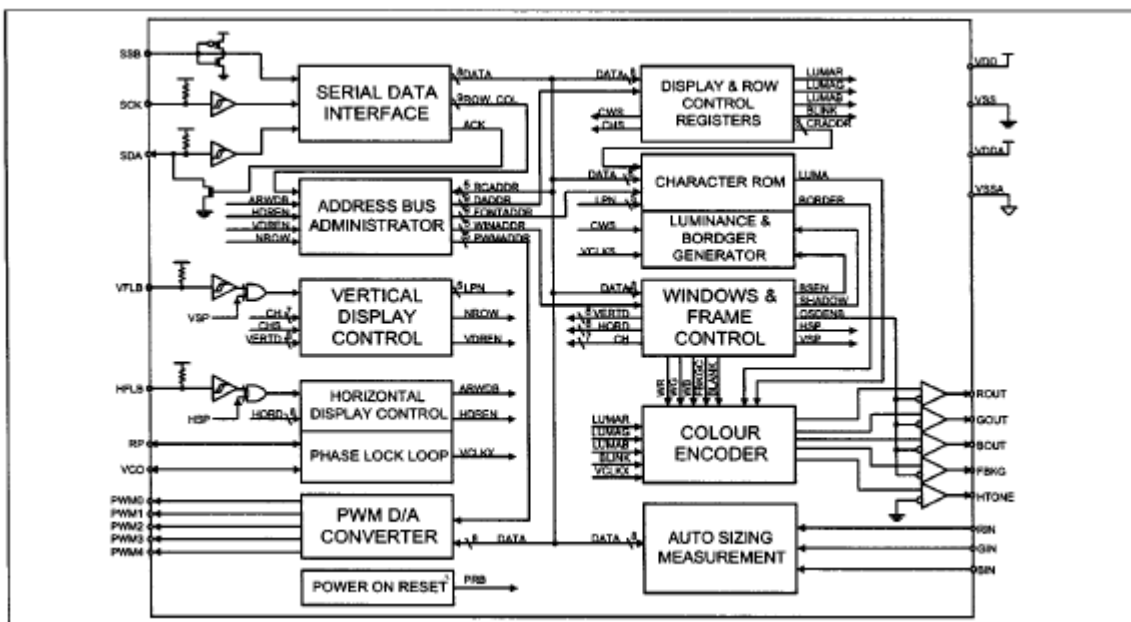
1.0 CONNECTION DIAGRAM

* MTV030N16 is used in this Model.
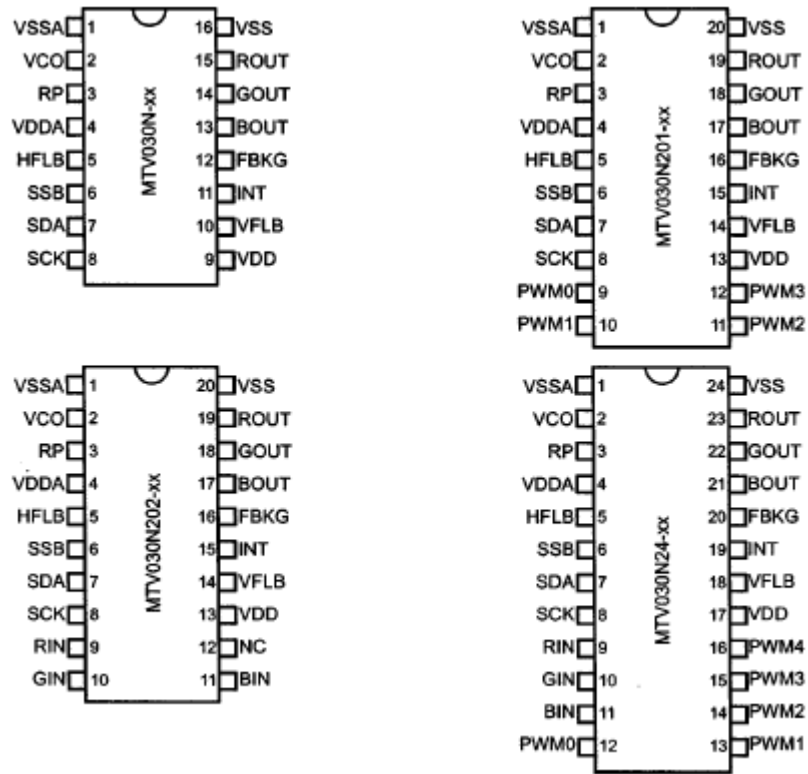
2.0 PIN DESCRIPTIONS

Name	I/O	Pin No.				Descriptions
		N16	N201	N202	N24	
VSSA	-	1	1	1	1	**Analog ground.** This ground pin is used to internal analog circuitry.
VCO	I/O	2	2	2	2	**Voltage Control Oscillator.** This pin is used to control the internal oscillator frequency by DC voltage input from external low pass filter.
RP	I/O	3	3	3	3	**Bias Resistor.** The bias resistor is used to regulate the appropriate bias current for internal oscillator to resonate at specific dot frequency.
VDDA	-	4	4	4	4	**Analog power supply.** Positive 5 V DC supply for internal analog circuitry. And a 0.1µF decoupling capacitor should be connected across to VDDA and VSSA.
HFLB	I	5	5	5	5	**Horizontal input.** This pin is used to input the horizontal synchronizing signal. It is a leading edge triggered and has an internal pull-up resistor.

Name	I/O	Pin No.				Descriptions
		N16	N201	N202	N24	
SSB	I	6	6	6	6	**Serial interface enable.** It is used to enable the serial data and is also used to select the operation of I²C or SPI bus. If this pin is left floating, I²C bus is enabled, otherwise the SPI bus is enabled.
SDA	I	7	7	7	7	**Serial data input.** The external data transfer through this pin to internal display registers and control registers. It has an internal pull-up resistor.
SCK	I	8	8	8	8	**Serial clock input.** The clock-input pin is used to syn-chronize the data transfer. It has an internal pull-up resistor.
RIN	I	-	-	9	9	**Red video input.** It is used for auto sizing measurement and this signal is came from video pre-amp red output.
GIN	I	-	-	10	10	**Green video input.** It is used for auto sizing measurement and this signal is came from video pre-amp green output.
BIN	I	-	-	11	11	**Blue video input.** It is used for auto sizing measurement and this signal is came from video pre-amp blue output.
NC	-	-	-	12	-	No connection.
PWM0	O	-	9	-	12	**Open-Drain PWM D/A converter 0.** The output pulse width is programmable by the register of Row 15, column 23.
PWM1	O	-	10	-	13	**Open-Drain PWM D/A converter 1.** The output pulse width is programmable by the register of Row 15, column 24.
PWM2	O	-	11	-	14	**Open-Drain PWM D/A converter 2.** The output pulse width is programmable by the register of Row 15, column 25.
PWM3	O	-	12	-	15	**Open-Drain PWM D/A converter 3.** The output pulse width is programmable by the register of Row 15, column 26.
PWM4	O	-	-	-	16	**Open-Drain PWM D/A converter 4.** The output pulse width is programmable by the register of Row 15, column 27.
VDD	-	9	13	13	17	**Digital power supply.** Positive 5 V DC supply for internal digital circuitry and a 0.1uF decoupling capacitor should be connected across to VDD and VSS.
VFLB	I	10	14	14	18	**Vertical input.** This pin is used to input the vertical synchronizing signal. It is leading triggered and has an internal pull-up resistor.
INT	O	11	15	15	19	**Intensity color output.** 16-color selection is achievable by combining this intensity pin with R/G/B output pins.
FBKG	O	12	16	16	20	**Fast Blanking output.** It is used to cut off external R, G, B signals of VGA while this chip is displaying character or windows.
BOUT	O	13	17	17	21	**Blue color output.** It is a blue color video signal output.
GOUT	O	14	18	18	22	**Green color output.** It is a green color video signal output.
ROUT	O	15	19	19	23	**Red color output.** It is a red color video signal output.
VSS	-	16	20	20	24	**Digital ground.** This ground pin is used to internal digital circuitry.

REPLACEMENT PARTS LIST

The components specified for Model DPlus74SB/DPlus74SB-BK

*** CRT BOARD ***

Part No. for NPG	Part No. for NMV	DESCRIPTION	LOCATION	Q'TY	ALT	REMARK
HC006002	79PQ1104	BEAD 3.5X4.7/T	B201	1		
HC005003	79PQ1594	BEAD 3.5X8/T	B202	1		
80000561	79PQ1232	BEAD 3.5x6x0.8/T	B203	1		
80000561	79PQ1232	BEAD 3.5x6x0.8/T	B204	1		
GE210352	79PQ0245	PLASTIC PEI/T 0.01u/50V J	C202	1		
GE210352	79PQ0245	PLASTIC PEI/T 0.01u/50V J	C203	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C205	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C206	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C207	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C209	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C210	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C211	1		
GA410575	79PQ0213	ELECT NP/T 1u/100V M	C212	1		
GAA10575	79PQ1744	ELECT 85oC/A 1u/100V M	C213	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C230	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C231	1		
GA410575	79PQ0213	ELECT NP/T 1u/100V M	C232	1		
GAA10575	79PQ1744	ELECT 85oC/A 1u/100V M	C233	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C250	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C251	1		
GA410575	79PQ0213	ELECT NP/T 1u/100V M	C252	1		
GAA10575	79PQ1744	ELECT 85oC/A 1u/100V M	C253	1		
GB656052	79PQ1087	CERAMIC SL/T 56P/50V J	C270	1		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C272	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C273	1		
GB7102F3	79PQ0234	CERAMIC Y5P(B)/T 1000P/500V K	C274	1		
GB7222F3	79PQ1717	CERAMIC Y5P(B)/T 2200P/500V K	C275	1		
GAA10575	79PQ1744	ELECT 85oC/A 1u/100V M	C277	1		
GB7102F3	79PQ0234	CERAMIC Y5P(B)/T 1000P/500V K	C278	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C279	1		
GB618152	79PQ2233	CERAMIC SL/T 180P/50V J	C27A	1		
GB618152	79PQ2233	CERAMIC SL/T 180P/50V J	C27E	1		
GB7102F3	79PQ0234	CERAMIC Y5P(B)/T 1000P/500V K	C280	1		
GA310555	79PQ0196	ELECT 85oC/T 1u/50V M	C282	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C283	1		
GB7102F3	79PQ0234	CERAMIC Y5P(B)/T 1000P/500V K	C284	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C287	1		
GF210462	79PQ0253	MEF CAP BOX 0.1u/63V J	C288	1		
GF210452	79PQ0752	MEF CAP BOX 0.1u/50V J	C288	OR		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C289	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C290	1		
GB622152	79PQ0230	CERAMIC SL/T 220P/50V J	C292	1		
72000623	---	NM17S CRT BOARD (M)	CRT BOARD	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D203	1		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D212	1		

80000051	79PQ0017	DIODE/T 1/2W 1SS82	D212	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D212	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D212	OR		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D213	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D213	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D213	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D213	OR		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D214	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D214	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D214	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D214	OR		
EJ044148	79PQ0065	DIODE "T" 1N4148	D215	1		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D232	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D232	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D232	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D232	OR		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D233	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D233	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D233	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D233	OR		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D234	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D234	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D234	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D234	OR		
EJ044148	79PQ0065	DIODE "T" 1N4148	D235	1		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D252	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D252	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D252	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D252	OR		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D253	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D253	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D253	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D253	OR		
80000451	79PQ0043	DIODE/T 1/2W 1SS83	D254	1		
80000051	79PQ0017	DIODE/T 1/2W 1SS82	D254	OR		
80001211	79PQ0724	DIODE/T 1/2W BAV21 (PHILIPS)	D254	OR		
80004711	79PQ1755	ROHM DIODE 1SS244	D254	OR		
EJ044148	79PQ0065	DIODE "T" 1N4148	D255	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D270	1		
R0319110	---	JUMPER WIRE AI/T 7.5mm	J1	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J10	1		
R0319110	---	JUMPER WIRE AI/T 7.5mm	J11	1		
R0319110	---	JUMPER WIRE AI/T 12.5mm	J12	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J2	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J3	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J4	1		
R0319110	---	JUMPER WIRE AI/T 12.5mm	J6	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J7	1		
R0319110	---	JUMPER WIRE AI/T 7.5mm	J8	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J9	1		
HB013100	79PQ1277	PACKING COIL /T 10uH K(EC24)	L203	1		
HB013278	79PQ1752	PACKING COIL /T 0.27uH K(EC24)	L210	1		

HB013129	79PQ1751	PACKING COIL /T 1.2uH K(EC24)	L211	1		
HB013278	79PQ1752	PACKING COIL /T 0.27uH K(EC24)	L230	1		
HB013828	79PQ1278	PACKING COIL /T 0.82uH K(EC24)	L231	1		
HB013278	79PQ1752	PACKING COIL /T 0.27uH K(EC24)	L250	1		
HB013129	79PQ1751	PACKING COIL /T 1.2uH K(EC24)	L251	1		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q201	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q201	OR		
FA040562	79PQ0739	CARBON 1/8W(T) 5% 5.6Kohm	R201	1		
FA040105	79PQ0085	CARBON 1/8W(T) 5% 1Mohm	R202	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R203	1		
FA040562	79PQ0739	CARBON 1/8W(T) 5% 5.6Kohm	R204	1		
FA040221	79PQ1255	CARBON 1/8W(T) 5% 220ohm	R205	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R206	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R207	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R208	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R209	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R210	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R211	1		
FB247509	79PQ0168	METAL 1/4W(T) 1% 75ohm	R213	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R214	1		
FA240820	79PQ1737	CARBON 1/4W(T) 5% 82ohm	R215	1		
FA040105	79PQ0085	CARBON 1/8W(T) 5% 1Mohm	R216	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R217	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R230	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R231	1		
FB247509	79PQ0168	METAL 1/4W(T) 1% 75ohm	R233	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R234	1		
FA240820	79PQ1737	CARBON 1/4W(T) 5% 82ohm	R235	1		
FA040105	79PQ0085	CARBON 1/8W(T) 5% 1Mohm	R236	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R237	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R250	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R251	1		
FB247509	79PQ0168	METAL 1/4W(T) 1% 75ohm	R253	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R254	1		
FA240820	79PQ1737	CARBON 1/4W(T) 5% 82ohm	R255	1		
FA040105	79PQ0085	CARBON 1/8W(T) 5% 1Mohm	R256	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R257	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R271	1		
FA040333	79PQ0106	CARBON 1/8W(T) 5% 33Kohm	R272	1		
FA040681	79PQ0120	CARBON 1/8W(T) 5% 680ohm	R273	1		
FA040681	79PQ0120	CARBON 1/8W(T) 5% 680ohm	R274	1		
FA040560	79PQ1532	CARBON 1/8W(T) 5% 56ohm	R275	1		
FA330101	79PQ0145	CARBON 1/2W(T) 5% 100ohm	R276	1		
FA240334	79PQ1034	CARBON 1/4W(T) 5% 330Kohm	R277	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R278	1		
FB241002	79PQ0161	METAL 1/4W(T) 1% 10Kohm	R279	1		
FA040154	79PQ0091	CARBON 1/8W(T) 5% 150Kohm	R27A	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R282	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R283	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R284	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R285	1		
GAA22675	79PQ1268	ELECT 85oC/A 22u/100V M	C276	1		

GB9332H8	79PQ1381	CERAMIC Z5V(F)/T 3300P/1KV Z	C285	1		
GB8472H5	79PQ2450	CERAMIC Z5U(E)/T 4700/1KV M	C286	1		
R0224070	---	SINGLE PIN 1P L=14mm 2.36mm	CRT GND	1		
12600112	---	HEAT SINK (VIDEO)	FOR U204	1		
14000041	---	SCREW (P-#2CBRITS*3*8*15BF)	FOR U204	1		
HB000008	79PQ0276	CHOKE COIL 100uH 8X10	L201	1		
HB000008	79PQ0276	CHOKE COIL 100uH 8X10	L202	1		
15201381	---	LABEL (S.NO.)	LABEL(S/N)	1		
80001991	79PQ0732	RESISTOR FUSEABLE 1/4W 47 ohm J	R218	1		
80001991	79PQ0732	RESISTOR FUSEABLE 1/4W 47 ohm J	R238	1		
80001991	79PQ0732	RESISTOR FUSEABLE 1/4W 47 ohm J	R258	1		
R0224132	---	XH-BASE PIN 9P P=2.5mm	S201	1		
R0224129	---	BASE PIN 6P+HOUSING P=2.5mm	S202	1		
R0224130	---	BASE PIN 7P+HOUSING P=2.5mm	S203	1		
80002391	---	SIGLE PIN L=15.5mm D=1.57mm	TP-G2	1		
80010871	79PQ1729	IC LM1269	U201	1		
80016551	79PQ2472	OSD IC MTV030N-046 FOR E70,E75	U202	1		
80010891	79PQ1731	IC LM2480	U203	1		
80010881	79PQ1730	IC LM2469	U204	1		
80005711	79PQ1363	IN CHANGE ISDW02S41 CRT SOCKET	CRT SOCKET	1		

*** MAIN BOARD ***

80007631	---	GROMMET (2.0)		11		
80007641	---	GROMMET (1.6)		2		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B101	1		
80000561	79PQ1232	BEAD 3.5x6x0.8/T	B103	1		
R0319110	---	JUMPER WIRE AI/T 10mm	B104	1		
R0319110	---	JUMPER WIRE AI/T 10mm	B107	1		
80000561	79PQ1232	BEAD 3.5x6x0.8/T	B108	1		
80000561	79PQ1232	BEAD 3.5x6x0.8/T	B109	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B301	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B302	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B303	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B304	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B305	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B306	1		
HC006002	79PQ1104	BEAD 3.5X4.7/T	B307	1		
HC005002	79PQ2082	BEAD 3.5X4.7/T P=5mm	B31A	1		
GB8103F5	79PQ1660	CERAMIC Z5U(E)/T 0.01u/500V M	C106	1		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C108	1		
GA322645	79PQ1659	ELECT 85oC/T 22u/35V M	C109	1		
GB747153	79PQ0238	CERAMIC Y5P(B)/T 470P/50V K	C110	1		
GE233252	79PQ0247	PLASTIC PEI/T 0.0033u/50V J	C111	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C112	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C113	1		
GF233262	79PQ0256	MEF CAP BOX 0.0033u/63V J	C115	1		
GF233252	---	MEF CAP BOX 0.0033u/50V J	C115	OR		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C116	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C118	1		
GAH22675	79PQ1983	ELECT CAP 105oC/T 22u/100V M TK	C119	1		
GAJ22675	---	ELECT CAP 105oC/T 22u/100V M PF	C119	OR		
GAH10825	79PQ1985	ELECT CAP 105oC/T 1000u/16V M TK	C121	1		

GAJ10825	79PQ2343	ELECT CAP 105oC/T 1000u/16V M PF	C121	OR		
GB7101H3	79PQ1089	CERAMIC Y5P(B)/T 100P/1KV K	C127	1		
GA347725	79PQ0851	ELECT 85oC/T 470u/16V M	C136	1		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C137	1		
GAH47725	79PQ1986	ELECT CAP 105oC/T 470u/16V M TK	C139	1		
GAJ47725	---	ELECT CAP 105oC/T 470u/16V M PF	C139	OR		
GB747153	79PQ0238	CERAMIC Y5P(B)/T 470P/50V K	C141	1		
GE210352	79PQ0245	PLASTIC PEI/T 0.01u/50V J	C142	1		
GA322555	79PQ0202	ELECT 85oC/T 2.2u/50V M	C143	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C145	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C150	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C301	1		
GB7331H3	79PQ0237	CERAMIC Y5P(B)/T 330P/1KV K	C304	1		
GE210452	79PQ0915	PLASTIC PEI/T 0.1u/50V J	C306	1		
GA310745	79PQ0848	ELECT 85oC/T 100u/35V M	C308	1		
GA347555	79PQ0208	ELECT 85oC/T 4.7u/50V M	C309	1		
GF215252	79PQ2238	MEF CAP BOX 0.0015u/50V J	C312	1		
GF215262	---	MEF CAP BOX 0.0015u/63V J	C312	OR		
GA347655	79PQ1267	ELECT 85oC/T 47u/50V M	C313	1		
GF210452	79PQ0752	MEF CAP BOX 0.1u/50V J	C314	1		
GF210462	79PQ0253	MEF CAP BOX 0.1u/63V J	C314	OR		
GF210252	79PQ0748	MEF CAP BOX 0.001u/50V J	C315	1		
GF210262	79PQ0749	MEF CAP BOX 0.001u/63V J	C315	OR		
GE247352	79PQ2236	PLASTIC PEI/T 0.047u/50V J	C316	1		
GE210452	79PQ0915	PLASTIC PEI/T 0.1u/50V J	C317	1		
GE233252	79PQ0247	PLASTIC PEI/T 0.0033u/50V J	C320	1		
GE233252	79PQ0247	PLASTIC PEI/T 0.0033u/50V J	C327	1		
GA347455	79PQ0207	ELECT 85oC/T 0.47u/50V M	C328	1		
GA347725	79PQ0851	ELECT 85oC/T 470u/16V M	C330	1		
GB9103F8	79PQ1271	CERAMIC Z5V(F)/T 0.01u/500V Z	C331	1		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C335	1		
GA310555	79PQ0196	ELECT 85oC/T 1u/50V M	C336	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C337	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C338	1		
GA322555	79PQ0202	ELECT 85oC/T 2.2u/50V M	C339	1		
GA310555	79PQ0196	ELECT 85oC/T 1u/50V M	C340	1		
GB7471F3	79PQ0854	CERAMIC Y5P(B)/T 470P/500V K	C341	1		
GE247352	79PQ2236	PLASTIC PEI/T 0.047u/50V J	C343	1		
GA347585	79PQ0746	ELECT 85oC/T 4.7u/250V M	C344	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C346	1		
GE210252	79PQ1272	PLASTIC PEI/T 0.001u/50V J	C347	1		
GE222352	79PQ0246	PLASTIC PEI/T 0.022u/50V J	C348	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C350	1		
GA310555	79PQ0196	ELECT 85oC/T 1u/50V M	C352	1		
GB633152	79PQ0232	CERAMIC SL/T 330P/50V J	C353	1		
GA347645	79PQ0212	ELECT 85oC/T 47u/35V M	C354	1		
GE210452	79PQ0915	PLASTIC PEI/T 0.1u/50V J	C358	1		
GF215452	79PQ1098	MEF CAP BOX 0.15u/50V J	C360	1		
GF215462	79PQ1587	MEF CAP BOX 0.15u/63V J	C360	OR		
GE210452	79PQ0915	PLASTIC PEI/T 0.1u/50V J	C361	1		
GF282252	79PQ2312	MEF CAP BOX 0.0082u/50V J	C362	1		
GF282262	79PQ1941	MEF CAP BOX 0.0082u/63V J	C362	OR		

GE247352	79PQ2236	PLASTIC PEI/T 0.047u/50V J	C364	1		
GF210352	79PQ0751	MEF CAP BOX 0.01u/50V J	C365	1		
GF210362	79PQ0252	MEF CAP BOX 0.01u/63V J	C365	OR		
GF256252	79PQ2239	MEF CAP BOX 0.0056u/50V J	C366	1		
GF256262	---	MEF CAP BOX 0.0056u/63V J	C366	OR		
GA347635	79PQ0211	ELECT 85oC/T 47u/25V M	C368	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C372	1		
GE210252	79PQ1272	PLASTIC PEI/T 0.001u/50V J	C401	1		
GF222452	79PQ0756	MEF CAP BOX 0.22u/50V J	C403	1		
GF222462	79PQ0255	MEF CAP BOX 0.22u/63V J	C403	OR		
GAH47725	79PQ1986	ELECT CAP 105oC/T 470u/16V M TK	C404	1		
GAJ47725	---	ELECT CAP 105oC/T 470u/16V M PF	C404	OR		
GE233252	79PQ0247	PLASTIC PEI/T 0.0033u/50V J	C407	1		
GAH10825	79PQ1985	ELECT CAP 105oC/T 1000u/16V M TK	C408	1		
GAJ10825	79PQ2343	ELECT CAP 105oC/T 1000u/16V M PF	C408	OR		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C409	1		
GE222252	79PQ1661	PLASTIC PEI/T 0.0022u/50V J	C40A	1		
GA310745	79PQ0848	ELECT 85oC/T 100u/35V M	C410	1		
GE222252	79PQ1661	PLASTIC PEI/T 0.0022u/50V J	C413	1		
GA347485	79PQ0850	ELECT 85oC/T 0.47u/250V M	C428	1		
GA310655	79PQ0198	ELECT 85oC/T 10u/50V M	C604	1		
GB710253	79PQ0233	CERAMIC Y5P(B)/T 1000P/50V K	C605	1		
GA310555	79PQ0196	ELECT 85oC/T 1u/50V M	C701	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C702	1		
GA310725	79PQ0199	ELECT 85oC/T 100u/16V M	C703	1		
GA322555	79PQ0202	ELECT 85oC/T 2.2u/50V M	C704	1		
GB633052	79PQ0231	CERAMIC SL/T 33P/50V J	C705	1		
GB633052	79PQ0231	CERAMIC SL/T 33P/50V J	C706	1		
GB610152	79PQ0229	CERAMIC SL/T 100P/50V J	C707	1		
GB610152	79PQ0229	CERAMIC SL/T 100P/50V J	C708	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C709	1		
GA347555	79PQ0208	ELECT 85oC/T 4.7u/50V M	C710	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C715	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C716	1		
GB910358	79PQ0242	CERAMIC Z5V(F)/T 0.01u/50V Z	C724	1		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C725	1		
GA347625	79PQ0210	ELECT 85oC/T 47u/16V M	C726	1		
EJAC0207	79PQ2476	DIODE "T" 2A/1KV RL207	D101	1		
EJAC0207	79PQ2476	DIODE "T" 2A/1KV RL207	D102	1		
EJAC0207	79PQ2476	DIODE "T" 2A/1KV RL207	D103	1		
EJAC0207	79PQ2476	DIODE "T" 2A/1KV RL207	D104	1		
EJA20003	79PQ0066	DIODE/T 1A BA159	D105	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D106	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D107	1		
EJAC0017	79PQ0068	DIODE/T 1A 1N4936	D108	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D109	1		
EJA20003	79PQ0066	DIODE/T 1A BA159	D116	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D117	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D119	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D124	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D127	1		
EJAC0017	79PQ0068	DIODE/T 1A 1N4936	D131	1		

EJAC0017	79PQ0068	DIODE/T 1A 1N4936	D132	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D303	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D304	1		
EJA05819	79PQ1644	DIODE STKY/T 1A/40V 1N5819	D305	1		
EJAC0017	79PQ0068	DIODE/T 1A 1N4936	D310	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D311	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D312	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D313	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D318	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D319	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D320	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D321	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D322	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D323	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D324	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D325	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D327	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D328	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D329	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D331	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D332	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D333	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D334	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D336	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D337	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D338	1		
R0319110	---	JUMPER WIRE AI/T 10mm	D339	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D340	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D341	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D343	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D345	1		
EJAC0018	79PQ1251	DIODE/T 1A 1N4937	D403	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D601	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D604	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D605	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D60A	1		
EJA05819	79PQ1644	DIODE STKY/T 1A/40V 1N5819	D702	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D703	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D704	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D705	1		
EJA05819	79PQ1644	DIODE STKY/T 1A/40V 1N5819	D706	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D709	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D70A	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D70F	1		
EJ044148	79PQ0065	DIODE "T" 1N4148	D710	1		
R0319110	---	JUMPER WIRE AI/T 20mm	J1	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J10	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J100	1		
R0319110	---	JUMPER WIRE AI/T 15mm	J101	1		
R0319110	---	JUMPER WIRE AI/T 10mm	J102	1		
R0319110	---	JUMPER WIRE AI/T 20mm	J103	1		
R0319110	---	JUMPER WIRE AI/T 12.5mm	J104	1		

R0319110	---	JUMPER WIRE AI/T 7.5mm	J105	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J106	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J107	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J108	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J109	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J11	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J110	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J112	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J113	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J114	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J116	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J117	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J118	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J119	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J12	1	
EJ044148	79PQ0065	DIODE "T" 1N4148	J120	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J121	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J123	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J124	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J125	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J126	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J128	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J129	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J13	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J130	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J131	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J132	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J133	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J134	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J135	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J136	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J137	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J138	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J139	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J14	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J140	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J141	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J142	1	
EJ044148	79PQ0065	DIODE "T" 1N4148	J143	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J144	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J145	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J146	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J15	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J16	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J17	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J18	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J19	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J2	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J20	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J21	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J22	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J23	1	

R0319110	---	JUMPER WIRE AI/T 7.5mm	J24	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J25	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J26	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J27	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J28	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J29	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J3	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J30	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J31	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J32	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J33	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J34	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J35	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J36	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J37	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J38	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J39	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J4	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J40	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J41	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J42	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J43	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J44	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J45	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J46	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J47	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J48	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J49	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J50	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J51	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J52	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J53	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J54	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J55	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J56	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J58	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J59	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J61	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J62	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J64	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J65	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J66	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J67	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J68	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J69	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J7	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J70	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J71	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J73	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J74	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J75	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J76	1	

R0319110	---	JUMPER WIRE AI/T 12.5mm	J77	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J78	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J79	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J8	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J80	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J81	1	
R0319110	---	JUMPER WIRE AI/T 15mm	J82	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J83	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J84	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J85	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J86	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J87	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J88	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J89	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J9	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J90	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J91	1	
R0319110	---	JUMPER WIRE AI/T 20mm	J92	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J93	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J94	1	
R0319110	---	JUMPER WIRE AI/T 10mm	J95	1	
R0319110	---	JUMPER WIRE AI/T 17.5mm	J96	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	J97	1	
80000561	79PQ1232	BEAD 3.5x6x0.8/T	J98	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	J99	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	JP1	1	
R0319110	---	JUMPER WIRE AI/T 12.5mm	JP2	1	
R0319110	---	JUMPER WIRE AI/T 20mm	JP6	1	
R0319110	---	JUMPER WIRE AI/T 7.5mm	L308	1	
JB000761	---	N1702 MAIN BOARD PCB V01	MAIN PCB	1	
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q105	1	
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q105	OR	
EAA23285	79PQ2475	TR NPN KSC2328A TO-92(T)	Q106	1	
EAA32055	---	TR NPN KTC2305-Y TO-92L/T	Q106	OR	
EAA22355	79PQ0058	TR NPN 2SC2235Y TO-92(T) (TOSHIBA)	Q106	OR	
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q107	1	
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q107	OR	
EBA09281	79PQ1247	TR PNP KSA 928A TO-92(T) (SAMSUNG)	Q108	1	
EBA10205	79PQ1685	TR PNP 2SA1020Y TO-92(T)	Q108	OR	
80002631	79PQ0997	TR PNP KTA1273-Y TO-92L/T	Q108	OR	
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q110	1	
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q110	OR	
EBA04230	79PQ0061	TR PNP BF423 TO-92(T)(T.P.)	Q112	1	
EAA23690	79PQ0059	TR NPN PH2369 TO-92(T) (PHILIPS)	Q301	1	
EAA40020	79PQ0812	TR NPN 2SC4002 TO-92(T) (SANYO)	Q303	1	
EBA04230	79PQ0061	TR PNP BF423 TO-92(T)(T.P.)	Q305	1	
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q306	1	
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q306	OR	
EFA29610	79PQ1249	TR 2SK2961 FET TOSHIBA	Q308	1	
EBA10157	79PQ0735	TR PNP 2SA1015GR TO-92(T) (T.P.S.)	Q310	1	
EBA07336	79PQ0062	TR PNP 2SA733P TO-92(T) (N.P.S.)	Q310	OR	
EBA09281	79PQ1247	TR PNP KSA 928A TO-92(T) (SAMSUNG)	Q317	1	

EBA10205	79PQ1685	TR PNP 2SA1020Y TO-92(T)	Q317	OR		
80002631	79PQ0997	TR PNP KTA1273-Y TO-92L/T	Q317	OR		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q320	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q320	OR		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q321	1		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q321	OR		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q323	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q323	OR		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q324	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q324	OR		
EBA07336	79PQ0062	TR PNP 2SA733P TO-92(T) (N.P.S.)	Q325	1		
EBA10157	79PQ0735	TR PNP 2SA1015GR TO-92(T) (T.P.S.)	Q325	OR		
EBA07336	79PQ0062	TR PNP 2SA733P TO-92(T) (N.P.S.)	Q326	1		
EBA10157	79PQ0735	TR PNP 2SA1015GR TO-92(T) (T.P.S.)	Q326	OR		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q327	1		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q327	OR		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q329	1		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q329	OR		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q401	1		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q401	OR		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q603	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q603	OR		
EBA10157	79PQ0735	TR PNP 2SA1015GR TO-92(T) (T.P.S.)	Q604	1		
EBA07336	79PQ0062	TR PNP 2SA733P TO-92(T) (N.P.S.)	Q604	OR		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q605	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q605	OR		
EAA18157	79PQ0734	TR NPN 2SC1815GR TO-92(T) (T.P.S.)	Q606	1		
EAA09456	79PQ0056	TR NPN 2SC945P TO-92(T) (N.P.S.)	Q606	OR		
EBA07336	79PQ0062	TR PNP 2SA733P TO-92(T) (N.P.S.)	Q701	1		
EBA10157	79PQ0735	TR PNP 2SA1015GR TO-92(T) (T.P.S.)	Q701	OR		
EBA07336	79PQ0062	TR PNP 2SA733P TO-92(T) (N.P.S.)	Q703	1		
EBA10157	79PQ0735	TR PNP 2SA1015GR TO-92(T) (T.P.S.)	Q703	OR		
EAA12133	79PQ0057	TR NPN 2SC1213AC TO-92(T)	Q704	1		
EAA20015	---	TR NPN KSC2001Y TO-92(T) (SAMSUNG	Q704	OR		
EAA02005	---	TR NPN KTC200-Y TO-92(T) (KEC)	Q704	OR		
FA330684	79PQ0156	CARBON 1/2W(T) 5% 680Kohm	R101	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R102	1		
FA240330	79PQ1645	CARBON 1/4W(T) 5% 33 ohm	R104	1		
FA240564	79PQ0328	CARBON 1/4W(T) 5% 560Kohm	R107	1		
FA240334	79PQ1034	CARBON 1/4W(T) 5% 330Kohm	R108	1		
FA040470	79PQ0322	CARBON 1/8W(T) 5% 47ohm	R109	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R110	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R112	1		
FA040272	79PQ0100	CARBON 1/8W(T) 5% 2.7Kohm	R113	1		
FA330104	79PQ0826	CARBON 1/2W(T) 5% 100Kohm	R114	1		
FA040470	79PQ0322	CARBON 1/8W(T) 5% 47ohm	R115	1		
FA240271	79PQ0132	CARBON 1/4W(T) 5% 270ohm	R116	1		
FA240390	79PQ1372	CARBON 1/4W(T) 5% 39ohm	R117	1		
FA240203	79PQ0128	CARBON 1/4W(T) 5% 20Kohm	R118	1		
FA040224	79PQ0097	CARBON 1/8W(T) 5% 220Kohm	R119	1		
FA330104	79PQ0826	CARBON 1/2W(T) 5% 100Kohm	R120	1		
FA040223	79PQ0096	CARBON 1/8W(T) 5% 22Kohm	R121	1		

FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R129	1		
FA040223	79PQ0096	CARBON 1/8W(T) 5% 22Kohm	R130	1		
R0319110	---	JUMPER WIRE AI/T 15mm	R131	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R132	1		
FB245491	79PQ2445	METAL 1/4W (T) 1%5.49Kohm	R135	1		
FB242702	79PQ1052	METAL 1/4W(T) 1% 27Kohm	R136	1		
R0319110	---	JUMPER WIRE AI/T 10mm	R150	1		
FA040153	79PQ0090	CARBON 1/8W(T) 5% 15Kohm	R154	1		
FA040104	79PQ0084	CARBON 1/8W(T) 5% 100Kohm	R155	1		
FA330159	79PQ0149	CARBON 1/2W(T) 5% 1.5ohm	R156	1		
FB240470	79PQ0160	METAL 1/4W(T) 1% 47ohm	R158	1		
FA330333	79PQ1039	CARBON 1/2W(T) 5% 33Kohm	R159	1		
FA330333	79PQ1039	CARBON 1/2W(T) 5% 33Kohm	R160	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R161	1		
80000561	79PQ1232	BEAD 3.5x6x0.8/T	R162	1		
FA240472	79PQ0137	CARBON 1/4W(T) 5% 4.7Kohm	R163	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R167	1		
FA040104	79PQ0084	CARBON 1/8W(T) 5% 100Kohm	R168	1		
FB910010	79PQ0345	METAL 1/4W(T) 5% 1ohm	R169	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R173	1		
FB244702	79PQ0339	METAL 1/4W(T) 1% 47Kohm	R174	1		
FB910010	79PQ0345	METAL 1/4W(T) 5% 1ohm	R177	1		
FA240242	79PQ1032	CARBON 1/4W(T) 5% 2.4Kohm	R178	1		
FA330102	79PQ0146	CARBON 1/2W(T) 5% 1Kohm	R182	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R301	1		
FA040561	79PQ0119	CARBON 1/8W(T) 5% 560ohm	R303	1		
FA040225	79PQ0098	CARBON 1/8W(T) 5% 2.2Mohm	R305	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R306	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R307	1		
FA330561	79PQ0155	CARBON 1/2W(T) 5% 560ohm	R308	1		
FA040224	79PQ0097	CARBON 1/8W(T) 5% 220Kohm	R30C	1		
FA040224	79PQ0097	CARBON 1/8W(T) 5% 220Kohm	R30E	1		
FA040220	79PQ1528	CARBON 1/8W(T) 5% 22ohm	R30G	1		
FA330470	79PQ2266	CARBON 1/2W(T) 5% 47ohm	R30L	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R30M	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R30N	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R30P	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R30Q	1		
FA240332	79PQ1033	CARBON 1/4W(T) 5% 3.3Kohm	R30T	1		
FA240472	79PQ0137	CARBON 1/4W(T) 5% 4.7Kohm	R30U	1		
FA040302	79PQ1529	CARBON 1/8W(T) 5% 3Kohm	R30V	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R30W	1		
FA240223	79PQ0741	CARBON 1/4W(T) 5% 22Kohm	R30X	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R30Y	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R310	1		
FB910010	79PQ0345	METAL 1/4W(T) 5% 1ohm	R313	1		
FB910010	79PQ0345	METAL 1/4W(T) 5% 1ohm	R314	1		
FA040105	79PQ0085	CARBON 1/8W(T) 5% 1Mohm	R315	1		
FA040106	79PQ2068	CARBON 1/8W(T) 5% 10Mohm	R317	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R318	1		
FA040104	79PQ0084	CARBON 1/8W(T) 5% 100Kohm	R31C	1		
FA240102	79PQ0125	CARBON 1/4W(T) 5% 1Kohm	R31E	1		

FA240113	79PQ2080	CARBON 1/4W(T) 5% 11Kohm	R31F	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R31H	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R31J	1		
FB242202	79PQ1051	METAL 1/4W(T) 1% 22Kohm	R31N	1		
FA040332	79PQ0321	CARBON 1/8W(T) 5% 3.3Kohm	R31P	1		
FB241181	79PQ2219	METAL 1/4W(T) 1% 1.18Kohm	R31Q	1		
FB242701	79PQ0336	METAL 1/4W(T) 1% 2.7Kohm	R31R	1		
FB241202	79PQ0831	METAL 1/4W(T) 1% 12Kohm	R31U	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R31X	1		
FA240474	79PQ2038	CARBON 1/4W(T) 5% 470Kohm	R321	1		
FA040122	79PQ0086	CARBON 1/8W(T) 5% 1.2Kohm	R322	1		
FA330182	79PQ2214	CARBON 1/2W(T) 5% 1.8Kohm	R325	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R330	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R331	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R332	1		
FA040152	79PQ0089	CARBON 1/8W(T) 5% 1.5Kohm	R338	1		
FA040224	79PQ0097	CARBON 1/8W(T) 5% 220Kohm	R339	1		
FA040104	79PQ0084	CARBON 1/8W(T) 5% 100Kohm	R340	1		
FA240472	79PQ0137	CARBON 1/4W(T) 5% 4.7Kohm	R343	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R345	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R347	1		
FB245602	79PQ1059	METAL 1/4W(T) 1% 56Kohm	R349	1		
FB910010	79PQ0345	METAL 1/4W(T) 5% 1ohm	R351	1		
FA040154	79PQ0091	CARBON 1/8W(T) 5% 150Kohm	R353	1		
R0319110	---	JUMPER WIRE AI/T 10mm	R355	1		
FB241502	79PQ1048	METAL 1/4W(T) 1% 15Kohm	R357	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R359	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R360	1		
FB242002	79PQ0835	METAL 1/4W(T) 1% 20Kohm	R361	1		
FA040244	79PQ1708	CARBON 1/8W(T) 5% 240Kohm	R363	1		
FA040274	79PQ0102	CARBON 1/8W(T) 5% 270Kohm	R364	1		
FA330154	79PQ1710	CARBON 1/2W(T) 5% 150Kohm	R365	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R368	1		
FA040152	79PQ0089	CARBON 1/8W(T) 5% 1.5Kohm	R371	1		
FA040104	79PQ0084	CARBON 1/8W(T) 5% 100Kohm	R373	1		
FA040224	79PQ0097	CARBON 1/8W(T) 5% 220Kohm	R374	1		
FA040104	79PQ0084	CARBON 1/8W(T) 5% 100Kohm	R375	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R377	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R379	1		
FA040752	79PQ0122	CARBON 1/8W(T) 5% 7.5Kohm	R382	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R383	1		
FA330150	79PQ1709	CARBON 1/2W(T) 5% 15ohm	R385	1		
FA040623	79PQ2212	CARBON 1/8W(T) 5% 62Kohm	R386	1		
FA040132	79PQ0399	CARBON 1/8W(T) 5% 1.3Kohm	R387	1		
FB241372	79PQ0833	METAL 1/4W(T) 1% 13.7Kohm	R389	1		
FA040562	79PQ0739	CARBON 1/8W(T) 5% 5.6Kohm	R390	1		
FA240154	79PQ0325	CARBON 1/4W(T) 5% 150Kohm	R392	1		
FA240224	79PQ0130	CARBON 1/4W(T) 5% 220Kohm	R393	1		
R0319110	---	JUMPER WIRE AI/T 10mm	R397	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R401	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R402	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R403	1		

FB242501	79PQ2221	METAL 1/4W(T) 1% 2.5Kohm	R410	1		
FB248201	79PQ1121	METAL 1/4W(T) 1% 8.2Kohm	R411	1		
FB242501	79PQ2221	METAL 1/4W(T) 1% 2.5Kohm	R412	1		
FB248201	79PQ1121	METAL 1/4W(T) 1% 8.2Kohm	R413	1		
FA330331	79PQ0150	CARBON 1/2W(T) 5% 330ohm	R414	1		
FA330229	79PQ1541	CARBON 1/2W(T) 5% 2.2ohm	R417	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R604	1		
FA040222	79PQ0095	CARBON 1/8W(T) 5% 2.2Kohm	R608	1		
FA240222	79PQ0129	CARBON 1/4W(T) 5% 2.2Kohm	R609	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R610	1		
FA040473	79PQ0115	CARBON 1/8W(T) 5% 47Kohm	R611	1		
FA040912	79PQ0323	CARBON 1/8W(T) 5% 9.1Kohm	R612	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R613	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R701	1		
R0319110	---	JUMPER WIRE AI/T 15mm	R702	1		
R0319110	---	JUMPER WIRE AI/T 7.5mm	R703	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R704	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R706	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R707	1		
FA040183	79PQ1016	CARBON 1/8W(T) 5% 18Kohm	R709	1		
FA040563	79PQ0820	CARBON 1/8W(T) 5% 56Kohm	R70A	1		
FA240152	79PQ2439	CARBON 1/4W(T)5%1.5Kohm	R70E	1		
FA040331	79PQ1020	CARBON 1/8W(T) 5% 330ohm	R70F	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R710	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R712	1		
FA040471	79PQ0113	CARBON 1/8W(T) 5% 470ohm	R714	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R716	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R717	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R718	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R719	1		
FA040102	79PQ0082	CARBON 1/8W(T) 5% 1Kohm	R71F	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R720	1		
FA040222	79PQ0095	CARBON 1/8W(T) 5% 2.2Kohm	R722	1		
FB243481	79PQ0337	METAL 1/4W(T) 1% 3.48Kohm	R723	1		
R0319110	---	JUMPER WIRE AI/T 20mm	R724	1		
FA040183	79PQ1016	CARBON 1/8W(T) 5% 18Kohm	R725	1		
FA040223	79PQ0096	CARBON 1/8W(T) 5% 22Kohm	R726	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R727	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R728	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R729	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R730	1		
FA040472	79PQ0114	CARBON 1/8W(T) 5% 4.7Kohm	R733	1		
FA040822	79PQ0123	CARBON 1/8W(T) 5% 8.2Kohm	R735	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R736	1		
FA040223	79PQ0096	CARBON 1/8W(T) 5% 22Kohm	R737	1		
R0319110	---	JUMPER WIRE AI/T 7.5mm	R738	1		
R0319110	---	JUMPER WIRE AI/T 20mm	R739	1		
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R73A	1		
FA040471	79PQ0113	CARBON 1/8W(T) 5% 470ohm	R740	1		
FA040822	79PQ0123	CARBON 1/8W(T) 5% 8.2Kohm	R741	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R742	1		
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R743	1		

FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R761	1	
FA040101	79PQ0081	CARBON 1/8W(T) 5% 100ohm	R762	1	
FA330621	79PQ2441	CARBON 1/2W(T) 5% 620ohm	R768	1	
FA040471	79PQ0113	CARBON 1/8W(T) 5% 470ohm	R771	1	
R0319110	---	JUMPER WIRE AI/T 5mm	VR102	1	
R0319110	---	JUMPER WIRE AI/T 5mm	VR103	1	
EKA01201	79PQ0077	ZEN DIODE 1/2W(T) HZS12A2 (HITACHI)	ZD102	1	
EKC01201	79PQ0816	ZEN DIODE 1/2W(T) BZX79F12 (PHLIPS)	ZD102	OR	
EKA0180B	79PQ0078	ZEN DIODE 1/2W(T) HZS 18-2 (HITACHI)	ZD106	1	
EKC0180B	79PQ0817	ZEN DIODE 1/2W(T) BZX79F18 (PHILIPS)	ZD106	OR	
EKA00507	79PQ0075	ZEN DIODE 1/2W(T) HZS5C2 (HITACHI)	ZD701	1	
EKC00507	79PQ0814	ZEN DIODE 1/2W(T) BZX79F5V1 (PHILIP	ZD701	OR	
EKA00507	79PQ0075	ZEN DIODE 1/2W(T) HZS5C2 (HITACHI)	ZD702	1	
EKC00507	79PQ0814	ZEN DIODE 1/2W(T) BZX79F5V1 (PHILIP	ZD702	OR	
EKA00507	79PQ0075	ZEN DIODE 1/2W(T) HZS5C2 (HITACHI)	ZD703	1	
EKC00507	79PQ0814	ZEN DIODE 1/2W(T) BZX79F5V1 (PHILIP	ZD703	OR	
EKA00507	79PQ0075	ZEN DIODE 1/2W(T) HZS5C2 (HITACHI)	ZD704	1	
EKC00507	79PQ0814	ZEN DIODE 1/2W(T) BZX79F5V1 (PHILIP	ZD704	OR	
EKA00601	79PQ2477	ZEN DIODE 1/2W(T) HZS6A2 HITACHI	ZD705	1	
EKA00607	79PQ0292	ZEN DIODE 1/2W(T) HZS6C2 (HITACHI)	ZD706	1	
EKC00607	79PQ0815	ZEN DIODE 1/2W(T) BZX79F6V2 (PHILIP	ZD706	OR	
HC006002	79PQ1104	BEAD 3.5X4.7/T	B309	1	
HC006002	79PQ1104	BEAD 3.5X4.7/T	B32A	1	
GB7102H3	79PQ0235	CERAMIC Y5P(B)/T 1000P/1KV K	C334	1	
GE210352	79PQ0245	PLASTIC PEI/T 0.01u/50V J	C363	1	
EJA00018	79PQ1526	DIODE 1A UF4006	D31A	1	
EJA00160	79PQ1250	DIODE STKY/T 1A/60V SB160	D330	1	
EJAE0001	79PQ0069	DIODE/T 1A SR106	D330	OR	
EJA00160	79PQ1250	DIODE STKY/T 1A/60V SB160	D346	1	
EJAE0001	79PQ0069	DIODE/T 1A SR106	D346	OR	
FA040154	79PQ0091	CARBON 1/8W(T) 5% 150Kohm	R319	1	
FB242742	79PQ2454	MATAL 1/4W (T)5% 27.4Kohm	R344	1	
FB245361	79PQ2224	METAL 1/4W (T) 1%5.36Kohm	R348	1	
FA240102	79PQ0125	CARBON 1/4W(T) 5% 1Kohm	R350	1	
FB243302	79PQ1053	METAL 1/4W(T) 1% 33Kohm	R35E	1	
FB242493	79PQ2498	METAL 1/4W(T) 1% 249Kohm	R366	1	
FB245490	79PQ2269	METAL 1/4W(T) 1% 549ohm	R388	1	
FA040103	79PQ0083	CARBON 1/8W(T) 5% 10Kohm	R705	1	
R0319110	---	JUMPER WIRE AI/T 5mm	VR307	1	
14000051	---	SCREW (#2CBRITS*4*8*15BF)	AC SOCKET	2	
80000991	79PQ1233	BEAD WBR6H-3T-R7K-B5	B102	1	
GJ033404	79PQ2481	SAFETY X-CAP 0.33u/275V M(ISKRA)	C101	1	
GJ033407	---	SAFETY X-CAP 0.33u/275V M(OKAYA)	C101	OR	
GJ033405	---	SAFETY X-CAP 0.33u/275V M(PHILIPS)	C101	OR	
GJ033409	---	SAFETY X-CAP 0.33u/275V M(PILKOR)	C101	OR	
GJ033406	---	SAFETY X-CAP 0.33u/275V M(EPCOS)	C101	OR	
GJC102E5	79PQ1982	SAFETY Y-CAP/D 1000P/400V M	C102	1	
GJH102E5	79PQ0274	SAFETY Y-CAP/S 1000P/400V M	C103	1	
GJH102E5	79PQ0274	SAFETY Y-CAP/S 1000P/400V M	C104	1	
GKA227E5	79PQ1103	POWER ELECT 85oC 220u/400V M	C105	1	
GAI10775	79PQ1984	ELECT 105oC/A 100u/100V M TK	C120	1	
80011091	---	ELECT LOW ESR 100u/100V M 10X30(10	C120	OR	

GA310815	79PQ1658	ELECT 85oC/T 1000u/10V M	C122	1		
GAI10775	79PQ1984	ELECT 105oC/A 100u/100V M TK	C138	1		
80011091	---	ELECT LOW ESR 100u/100V M 10X30(10	C138	OR		
GJH102E5	79PQ0274	SAFETY Y-CAP/S 1000P/400V M	C146	1		
GJH102E5	79PQ0274	SAFETY Y-CAP/S 1000P/400V M	C154	1		
GFC622J2	79PQ1987	PLASTIC PPS/A 6200P/2KV J	C318	1		
GFB22482	79PQ0889	PLASTIC MPP/A 0.22u/250V J	C325	1		
GFA15482	79PQ0262	PLASTIC MPE/A 0.15u/250V J	C329	1		
GFA10572	79PQ2451	PLASTIC MPE/A 1u/100V J	C333	1		
GFA10582	79PQ0261	PLASTIC MPE/A 1u/250V J	C333	OR		
GFB15482	79PQ0265	PLASTIC MPP/A 0.15u/250VJ	C351	1		
GFD47482	79PQ2271	PLASTIC MPPS/A 0.47u/250V J (MYLAR)	C373	1		
GB210458	79PQ0228	CERAMIC Y5V/T 0.1u/50V Z	C712	1		
80003561	79PQ1238	DIODE 600V/1.6A RG2A SANKEN	D110	1		
80003581	---	DIODE 600V/2A UF2005 CHENMKO	D110	OR		
12800021	79PQ1335	HEAT SINK 22.5*56.5*1.3t	D111	1		
80011291	79PQ2036	DIODE/A 3A/400V RG4	D111	1		
80003551	79PQ1237	DIODE 200V/1.6A RG2Z SANKEN	D112	1		
80003571	---	DIODE 200V/2A UF2003 CHENMKO	D112	OR		
80003551	79PQ1237	DIODE 200V/1.6A RG2Z SANKEN	D113	1		
80003571	---	DIODE 200V/2A UF2003 CHENMKO	D113	OR		
EJ044148	79PQ0065	DIODE "T" 1N4148	D115	1		
80003551	79PQ1237	DIODE 200V/1.6A RG2Z SANKEN	D118	1		
80003571	---	DIODE 200V/2A UF2003 CHENMKO	D118	OR		
EJ044148	79PQ0065	DIODE "T" 1N4148	D126	1		
14300071	---	SCREW (PL-CPTS*3*8*15BF)	D307	1		
80016491	79PQ2437	DIODE/A BY329X-1500S	D307	1		
80001171	---	DIODE/A 5TUZ47C (TOSHIBA)	D307	OR		
80009541	79PQ1631	DIODE FAGOR FUF5406 (A+K)	D308	1		
80001131	79PQ0794	DIODE/A 2A/600V RG4A	D308	OR		
80009261	79PQ1958	DIODE/A RP3F(A+K) SANKEN	D316	1		
80010981	---	DIODE TOSHIBA 3TH41(A+K)	D316	OR		
80011471	---	DIODE FUJI ERD07-15L(A+K)	D316	OR		
EJ000215	79PQ2487	DIODE 0.1A/1400V PR 1400	D326	1		
80003561	79PQ1238	DIODE 600V/1.6A RG2A SANKEN	D335	1		
80001521	79PQ0799	FUSE 3.15A/250V 50T T3.15A	F101	1		
18000481	---	EDGE SADDLE (BLACK) (SB-31B)	FOR CHASSING	2		
18000561	---	MINI CLIP (WC-15A)	FOR FBT H.S	1		
R0180028	79PQ1198	FUSE HOLDER 5X20mm	FOR FUSE	2		
80000781	---	SINGLE PIN L=12.0 D=1.5	FOR TH101	2		
JD010040	79PQ1105	IC SOCKET 40P	FOR U701	1		
12300121	---	PLATE SHIELDING (IC)	FOR U701	1		
12300241	---	PLATE SHIELDING (EEPROM)	FOR U702	1		
HA030010	79PQ0275	EMI FILTER COIL 20.45X10.2X10	G2,G4 WIRE	2		
80003511	---	WIRE GND 70mm Y/G 1015 18AWG	L100	1		
80000111	79PQ0019	LINE FILTER ET24 10mH MIN	L101	1		
HB000015	79PQ0277	LINE FILTER UU10.5 1mH	L102	1		
80009291	79PQ1630	H-CENTER CHOKE	L301	1		
HB000019	79PQ0279	CHOKE COIL 130uH 18X20	L304	1		
15201381	---	LABEL (S.NO.)	LABEL(S/N)	1		
80000131	79PQ0021	LED L-59GH/1GYC	LED701	1		
18000331	---	CABLE CLIP(WC-13T)	LW101	1		

JD512001	79PQ0290	AC SOCKET 3P	P101	1		
12800032	---	HEAT SINK 40*12*50 B	Q101	1		
14000041	---	SCREW (P-#2CBRITS*3*8*15BF)	Q101	1		
EF202500	79PQ1248	FET N 2SK2545 TO-220F TOSHIBA	Q101	1		
80000901	79PQ0789	FET N FS7KM-12 600V/7A TO-220F	Q101	OR		
80000981	79PQ0791	FET N 2SK2645-01/MR TO-220F	Q101	OR		
EF211180	79PQ0315	FET N 2SK1118 TO-220F	Q101	OR		
EB307720	79PQ1246	TRPNP KSB772 TO-126	Q104	1		
80000201	79PQ0024	TR PNP 2SB1273 S/R	Q104	OR		
80002451	79PQ1165	TR PNP 2SB1274 S/R (SANYO)	Q104	OR		
80017001	79PQ2474	TR NPN BU2527AX(PHILIPS)TO-3P	Q307	1		
14000041	---	SCREW (P-#2CBRITS*3*8*15BF)	Q307	1		
EF206301	79PQ0064	FET N YTAF630 TO-220F	Q313	1		
80008141	79PQ2260	TR NPN 2SD1763 TO-220F	Q318	1		
14000041	---	SCREW (P-#2CBRITS*3*8*15BF)	Q318	1		
EA243705	---	TR NPN KTC4370A-Y TO-220F	Q318	OR		
12800041	---	HEAT SINK 23*17*25	Q319	1		
14000041	---	SCREW (P-#2CBRITS*3*8*15BF)	Q319	1		
EF206301	79PQ0064	FET N YTAF630 TO-220F	Q319	1		
EF206301	79PQ0064	FET N YTAF630 TO-220F	Q322	1		
FB560248	79PQ1714	MOF 2W/M(A) 5% 0.24ohm	R105	1		
FB570563	79PQ1656	MOF 2W/M(B) 5% 56Kohm	R106	1		
FC110158	79PQ0847	WOUND RES 2W(A) 5% 0.15ohm	R111	1		
FB560103	79PQ1652	MOF 2W/M(A) 5% 10Kohm	R125	1		
80002031	79PQ0911	FUSEABLE RES 1/2W(A)M 0.22ohm	R157	1		
80002031	79PQ0911	FUSEABLE RES 1/2W(A)M 0.22ohm	R175	1		
FB560222	79PQ0840	MOF 2W/M(A) 5% 2.2Kohm	R302	1		
80011181	79PQ1977	RESISTOR FUSEABLE 1/2W/A(M) 22ohm	R304	1		
FB710829	79PQ2447	MOF 3W/M(A) 5% 8.2ohm	R309	1		
FB710109	79PQ2230	MOF 3W/M(A) 5% 1ohm	R311	1		
FB470270	79PQ0170	MOF 1W/M(A) 5% 27ohm	R312	1		
FB560331	79PQ1066	MOF 2W/M(A) 5% 330ohm	R316	1		
FB480100	79PQ0341	MOF 1W/M(B) 5% 10ohm	R31A	1		
FB560151	79PQ2075	MOF 2W/M(A) 5% 150ohm	R335	1		
FB560182	79PQ2228	MOF 2W/M(A) 5% 1.8Kohm	R354	1		
FC030508	79PQ0188	WOUND RES 1W/(A) 5% 0.5ohm	R394	1		
FB470109	79PQ0742	MOF 1W/M(A) 5% 1ohm	R421	1		
FB470339	79PQ0171	MOF 1W/M(A) 5% 3.3ohm	R422	1		
FB470100	79PQ0340	MOF 1W/M(A) 5% 10ohm	R606	1		
80003751	79PQ1239	RELAY 12V 6P GSA-SS-212DM(GOOD-S	RL101	1		
80003761	---	RELAY 12V 6P OSA-SS-212DM5(OEG)	RL101	OR		
80010001	79PQ1636	RELAY RUDH-SH-112D 400ohm (GOOD	RL301	1		
R0224301	---	BASE PIN 1.55 P=5/7.5 2P	S102	1		
R0224308	---	BASE PIN 2.36mm P=8/10 4P	S301	1		
R0224130	---	BASE PIN 7P+HOUSING P=2.5mm	S702	1		
80011281	79PQ2064	CERAMIC SPARK CAPS 1KV +1500V~90	SG301	1		
JC800121	79PQ2453	SW POWER DC 30V 0.1A SPUN19H606	SW101	1		
80011071	79PQ2370	LEVER SW JLS1301	SW301	1		
80000251	79PQ0028	TACT SW 1P 100G+-50	SW701	1		
80000251	79PQ0028	TACT SW 1P 100G+-50	SW702	1		
80000251	79PQ0028	TACT SW 1P 100G+-50	SW703	1		
80000251	79PQ0028	TACT SW 1P 100G+-50	SW704	1		

80000251	79PQ0028	TACT SW 1P 100G+-50	SW705	1	
80000251	79PQ0028	TACT SW 1P 100G+-50	SW706	1	
80000251	79PQ0028	TACT SW 1P 100G+-50	SW707	1	
80011211	79PQ2206	POWER X'FM ERL35 500uH FE700+	T101	1	B Ver.
80000281	79PQ0030	H.DRIVE X'FM 4.5mH EI-19	T302	1	
80000801	79PQ0311	THERMISTOR NTCR SCK054 13.3mm	TH101	1	
80005821	79PQ1365	THERMISTOR PTCR 4.5ohm	TH102	1	
R0224074	---	SINGLE PIN L=11.5 D=1.0	TP-1	1	
R0224077	---	BASE PIN 1P 1.55mm	TPC	1	
DD002600	79PQ0050	IC LINEAR KA3842A 8P	U101	1	
80010251	79PQ2205	OP AMP LM358 / KIA358	U301	1	
80012941	79PQ2208	PHILIPS IC TDA 4857	U302	1	
12800282	---	HEAT SINK 44*27*50	U401	1	
14000041	---	SCREW (P-#2CBRITS*3*8*15BF)	U401	1	
80001041	79PQ0793	IC TDA8172 (N.S,SGS)	U401	1	
80016251	79PQ2435	E70, E75 MCU MASK	U701	1	
80016261	---	N1702 MTP WT62P2	U701	OR	
80009941	79PQ2277	ATMEL E²ROM AT24C08B	U702	1	
80010311	---	MICROCHIP E²ROM 24LC08	U702	OR	
80016501	---	CATALYST EEROM CAT24WC08P	U702	OR	
80010801	---	NM17S WIRE A'SSY	WIRE ASSY	1	
EM012004	79PQ1735	X'TAL 49U 12MHz	X701	1	
GED622M2	79PQ1988	PLASTIC PPN/A 6200P/800V J	C319	1	
GFD274E2	79PQ2079	PLASTIC 378/A 0.27u/400V J (PILKOR)	C332	1	
GFD27482	---	PLASTIC PMM/A 0.27u/250V J (MYLAR)	C332	OR	
GFA10382	79PQ0860	PLASTIC MPE/A 0.01u/250V J	C345	1	
GFB68482	79PQ0267	PLASTIC MPP/A 0.68u/250V J	C355	1	
GFB24482	79PQ2241	PLASTIC MPP/A 0.24u/250V J	C356	1	
80005801	---	DY WIRE	DY WIRE	1	
80011061	79PQ2179	N0701F LINEARITY CHOKE 76uH	L302	1	
HB000019	79PQ0279	CHOKE COIL 130uH 18X20	L303	1	
80010401	79PQ1702	N0701F LINEARITY COIL	L307	1	
12600371	---	HEAT SINK (FBT) TCO	Q307	1	
FB470119	79PQ2073	MOF 1W/M(A) 5% 1.1ohm	R415	1	
80009121	---	WIRE 6P-2P	ROTATION WIRE	1	
R0224611	---	BASE PIN 3P+HOUSING P=2.5mm	S701	1	
80015631	79PQ2286	T301 FBT DV17H1 MERITON	T301	1	
80009691	79PQ1632	N0501 D.F X'FM EI-19(1:7.5)	T303	1	

*** SET ASSY *** DPlus74SB (White Cabinet)

AC0M05MM	79PQ2629	CRT BOARD INSERT			
AM0M05MM	79PQ2630	MAIN BOARD INSERT			A,B
AM0M06MM	79PQ2631	MAIN BOARD INSERT			R
14000071	---	SCREW (PL-CPTS*3*8*15BF)	BRACKET CORD	1	
80016931	79PQ2473	N1702 SINGNAL CABLE	CABLE	1	
17000921	---	CRT BARRIER	CRT UPPER DEG	1	
80016351	79PQ2471	DEGAUSSING COIL N1702	DEGUESSING CO	1	
14000021	---	SCREW (#2CBRITS*4*12*15BF)	FOR BACK	2	
17000841	79PQ2430	CUSHION PIECE (SPONG)	FOR BACK	1	
14000021	---	SCREW (#2CBRITS*4*12*15BF)	FOR CHASSIS	2	
12000651	---	BRACKET(CORD)	FOR CHASSIS	1	

14600191	---	SCREW SPECIAL (5*25*WASHER=16)	FOR CRT	4		
18000371	---	FIXED CABLE CLIP(GL-115A)	FOR DEGUES	2		
14300031	---	SCREW (PL-CPIMS*4*10*15BF)	FOR EMI GROUN	1		
18000061	---	ANODE CLAMPER	FOR FBT WIRE	2		
18000321	---	EDGE SADDLE(SB-31)	FOR FBT WIRE	1		
14000071	---	SCREW (PL-CPTS*3*8*15BF)	FOR GROUND	2		
14000071	---	SCREW (PL-CPTS*3*8*15BF)	FOR MPCB	8		
18000581	---	PCB SUPPORT	FOR MPCB	4		
18000551	---	EXTENDING SHIFT	FOR P/W SW	1		
12300721	---	PLATE SHIELDING (VIDEO)	FOR VIDEO BOAR	1		
80000031	---	GND WIRE 18AWG L=130mm	GND WIRE2	1		
80016941	---	WIRE GND 1015 18AWG L=200mm BLAC	GND WIRE3	1		
80016881	---	N1702 TCO WIRE L=660mm	TCO WIRE	1		
17000322	---	CABLE TIES(GT-80M)	TIE	10		
12000641	79PQ2424	CHASSIS BASE		1		
15200031	79PQ0961	LABEL (REV.)		1		
80001631	79PQ0703	POWER CORD 3P 1.8 NON-SHIELD COL	POWER CORD	1		A
80001651	79PQ0869	POWER CORD 3P 1.8M EUROPE	POWER CORD	1		B
80002931	79PQ2243	POWER CORD 3P 1.8M AUSTRALIA N-S	POWER CORD	1		R
---	---	CARTON BOX DP74(A VER.)		1		A
13201781	79PQ2640	CARTON BOX DP74(B/R VER.)		1		B,R
---	---	OWNERS MANUAL DP74 A VER		1		A
15501051	79PQ2641	OWNERS MANUAL DP74 B/R VER		1		B,R
80015091	79PQ2285	MITSUBISHI CRT M41LRY61X22	CRT	1		A,B
JG071301	79PQ2499	CRT M41LRY61X22R MITSUBISHI	CRT	1		R
17000831	---	CRT PAD (T=2.5mm) O.D=16, I.D=6.8	FOR CRT	4		
17000981	---	MALAR SHEET (MIT. TUBE)	FOR CRT	1		
10102331	79PQ2642	CABINET FRONT ASSY,(MC-0807)		1		
10102271	79PQ2643	CABINET BACK (MITSUBISHI) (PC+ABS),(MC-0807)		1		
80016891	---	E75 MITSUBISHI CRT GND WIRE	GND WIRE	1		
11000991	79PQ2466	REVOLVING STAND ASSY		1		
13400841	79PQ2484	POLYLON(B)		1		
13400851	79PQ2485	POLYLON(T)		1		
13700021	79PQ0958	BAG POLYETHYLENE (270*370)		1		
13700031	79PQ2252	BAG POLYETHYLENE (150*370)		1		
13700071	79PQ0959	PE BAG (500*480*850+WARNING)		1		
15200541	79PQ2616	LABEL WARNING (29KV)		1		
15201331	79PQ2633	LABEL WARNING(28Kv,1000uA)		1		
15201621	79PQ2486	LABEL CARTON (NE)		1		B.R
19700081	79PQ2644	INSTRUCTION CD-ROM FE771		1		B,R
---	---	NAME PLATE INSTRUCTION DP74A		1		A
15001491	79PQ2645	NAME PLATE INSTRUCTION DP74B/R		1		B,R
15200281	79PQ0962	LABEL,SERIAL BARCODE (A)		1		A
15201651	79PQ2646	LABEL SERIAL BARCODE(B)		1		B,R
15200491	79PQ0966	LABEL (MANUFACTURE, NPG)		1		
15200241	79PQ2634	LABEL (D8,CYAN)		1		

*** SET ASSY ***   DPlus74SB-BK(BLACK Cabinet)

AC0M05MM	79PQ2629	CRT BOARD INSERT				
AM0M05MM	79PQ2630	MAIN BOARD INSERT				
14000071	---	SCREW (PL-CPTS*3*8*15BF)	BRACKET CORD	1		
80016931	79PQ2473	N1702 SINGNAL CABLE	CABLE	1		

17000921	---	CRT BARRIER	CRT UPPER DEG	1		
80016351	79PQ2471	DEGAUSSING COIL N1702	DEGUESSING CO	1		
14000021	---	SCREW (#2CBRITS*4*12*15BF)	FOR BACK	2		
17000841	79PQ2430	CUSHION PIECE (SPONG)	FOR BACK	1		
14000021	---	SCREW (#2CBRITS*4*12*15BF)	FOR CHASSIS	2		
12000651	---	BRACKET(CORD)	FOR CHASSIS	1		
14600191	---	SCREW SPECIAL (5*25*WASHER=16)	FOR CRT	4		
18000371	---	FIXED CABLE CLIP(GL-115A)	FOR DEGUES	2		
14300031	---	SCREW (PL-CPIMS*4*10*15BF)	FOR EMI GROUN	1		
18000061	---	ANODE CLAMPER	FOR FBT WIRE	2		
18000321	---	EDGE SADDLE(SB-31)	FOR FBT WIRE	1		
14000071	---	SCREW (PL-CPTS*3*8*15BF)	FOR GROUND	2		
14000071	---	SCREW (PL-CPTS*3*8*15BF)	FOR MPCB	8		
18000581	---	PCB SUPPORT	FOR MPCB	4		
18000551	---	EXTENDING SHIFT	FOR P/W SW	1		
12300721	---	PLATE SHIELDING (VIDEO)	FOR VIDEO BOAF	1		
80000031	---	GND WIRE 18AWG L=130mm	GND WIRE2	1		
80016941	---	WIRE GND 1015 18AWG L=200mm BLAC	GND WIRE3	1		
80016881	---	N1702 TCO WIRE L=660mm	TCO WIRE	1		
17000322	---	CABLE TIES(GT-80M)	TIE	10		
12000641	79PQ2424	CHASSIS BASE		1		
15200031	79PQ0961	LABEL (REV.)		1		
80001631	79PQ0703	POWER CORD 3P 1.8 NON-SHIELD COL	POWER CORD	1		
80016891	---	E75 MITSUBISHI CRT GND WIRE	GND WIRE	1		
13201871	79PQ2647	CARTON BOX DP74(A VER.)		1		
15501101	79PQ2648	OWNERS MANUAL DP74 A VER		1		
80015091	79PQ2285	MITSUBISHI CRT M41LRY61X22	CRT	1		
17000831	---	CRT PAD (T=2.5mm) O.D=16, I.D=6.8	FOR CRT	4		
17000981	---	MALAR SHEET (MIT. TUBE)	FOR CRT	1		
10102531	79PQ2649	CABINET FRONT ASSY,(MC-0735)		1		
10102521	79PQ2650	CABINET BACK (MITSUBISHI) (PC+ABS),(MC-0735),BK		1		
11001021	79PQ2651	REVOLVING STAND ASSY(MC-0735)		1		
13700021	79PQ0958	BAG POLYETHYLENE (270*370)		1		
13700031	79PQ2252	BAG POLYETHYLENE (150*370)		1		
13700071	79PQ0959	PE BAG (500*480*850+WARNING)		1		
15001481	79PQ2652	NAME PLATE INSTRUCTION DP74A		1		
15201331	79PQ2633	LABEL WARNING(28Kv,1000uA)		1		
15201541	79PQ2632	LABEL WARNING(28Kv)		1		
13400751	79PQ2427	POLYLON(B)		1		
13400741	79PQ2426	POLYLON(T)		1		
15201641	79PQ2653	LABEL,SERIAL BARCODE (A)		1		
15200491	79PQ0966	LABEL (MANUFACTURE, NPG)		1		

9. BLOCK DIAGRAM

SMPS

KA3842

SYSTEM ARCHITECTURE

MCU/E²PROM/DDC

WT6232+24LC08

H/HV

V

MOTHER BOARD

I²C

KEY-BOARD

HORIZONTAL AND VERTICAL

SYNC PROCESSOR

TDA 4857

H
V
EW-OUT & HOUT / V.GEOMETRY

DYNAMIC FOCUSING

VERT OUT
TDA 8172

DC-DC
B+

HOR
DEFLECT-STAGE

D.F   EH.T.

RGB OUT
LM2469

CUT-OFF

R G B

OSD
MTV-030

R
G
B
FBLK

RGB PREAMP

LM1269

LM2480
CUT-OFF
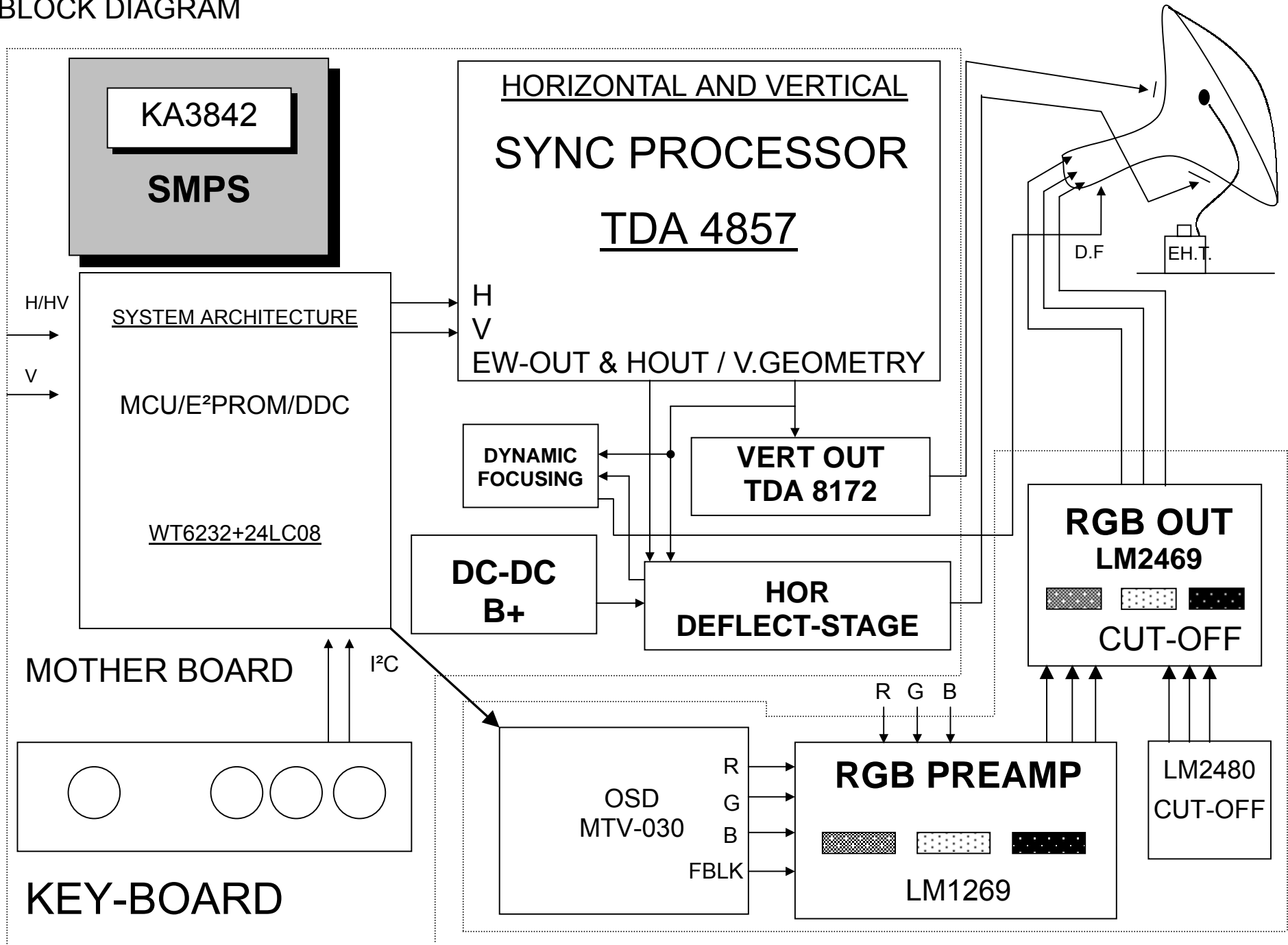
MODEL	FE771SB/Dplus74SB	FE770/FE770M	FE770/FE770M
CRT	MITSUBISHI M41LRY61X22	LG M41QEE903X03	SAMSUNG M41QCJ761X172 (DFX)
R30H	NC	750k 1/4W	750k 1/4W
R30J	NC	750k 1/4W	750k 1/4W
R319	150k	68k	120k
R31L	NC	51k 1/4W 1/4W	51k 1/4W 1/4W
R31T	390k 1/4W 1%	169k 1/4W 1%	133k 1/4W 1%
R344	27.4k 1/4W 1%	25.5k 1/4W 1%	25.5k 1/4W 1%
R348	5.36k 1/4W 1%	5.49k 1/4W 1%	5.49k 1/4W 1%
R350	1k 1/4W	4.7k 1/4W	4.7k 1/4W
R35E	33k 1/4W 1%	39k 1/4W 1%	39k 1/4W 1%
R358	470k	330k	330k
R366	240k 1/4W 1%	150k 1/4W 1%	169k 1/4W 1%
R367	NC	1M 1/2W	1M 1/2W
R380	NC	1M 1/2W	1M 1/2W
R381	NC	1M 1/2W	1M 1/2W
R388	549 1/4W 1%	510 1/4 1%	430 1/4W 1%
R415	1.1 1W	1.2 1W	1.2 1W
R705	10K	NC	NC
C319	6200P 800V PPN	5600P 800V PPN	5600P 800V PPN
C321	NC	0.01u 1kV 25V	0.01u 1kV 25V
C322	NC	J.W	J.W
C332	.3u 400V MPPS	.3u 400V MPPS	.3u 400V MPPS
C334	1000P / 1kV Y5P	1000P / 1kV Y5P	1000P / 1kV Y5P
C345	.01u 250V MPE	.01u 250V MPE	0.022u 250V MPE
C356	.24u 250V MPP	.27u 250V MPP	.27u 250V MPP
C357	NC	1000P 1kV Y5P	1000P 1kV Y5P
C363	0.01u PEI	NC	NC
C367	NC	NC	0.01u PEI
D31A	UF4006	J.W	J.W
D326	NC	BA159	BA159
D330	SB160/SR160	1N4937	1N4937
D346	SB160/SR160	J.W	J.W
B309	3.5X4.7/T	J.W	J.W
B32A	3.5X4.7/T	J.W	J.W
L302	76uH	130uH	76uH
L303	130uH	130uH	130uH
L307	80010401	80010401	80010401
Q307	12600251	12600251	12600251
T301	80015631	80009281	80009281
T303	80015651	80015651	80015651
S701	R0224611	R0224611	R0224611
JP701	NC	J.W	J.W
VR307	J.W	100k	100k
CRT	80015091	JG072301	80013481
G2	NC	80013121	80013121

SCHEMATIC DIAGRAM (FE770/FE770M/FE771SB/DPlus74SB)