Plasma (PDP)
2. PDP discharge & structure theory
PDP is an abbreviation of Plasma Display Panel and means electronic display device that injects gas such as He+Ne+Xe between glasses that are made airtight by front glass, rear glass and partition between them and authorizes voltage to polarity inversion of plate and cathode then radiates neon light then uses it for display.
Plasma Display Panel structure

**Front Glass**
- Protection layer (MgO)
- Dielectric layer
- BUS
- Polarity inversion
- ITO polarity inversion
- Barrier Rib
- Electrode
- W/B

**Back Glass**
- Plasma
- Plasma
- Visible Light
- UV
- Address polarity inversion
- Glass
- Partition

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AC-PDP discharge theory

Visible Light

Scan polarity inversion

Dielectric Layer

Dielectric protection layer (MgO)

partition

Fluorescent substance (R,G,B)

Dielectric Layer

Front Glass Substrate

Sustain polarity inversion

Bus polarity inversion

Pulse type voltage authorization to polarity inversion

Gas Discharge

UV Generate

Visible Luminate

Display

Address polarity inversion

Under Layer

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QAS 365
AC-PDP discharge theory

PDP Cell discharge
the image intensified CCD camera (ICCD)

Ultraviolet ray
X Board

Receiving LOGIC signal from CONTROL B/D and make ADDRESS PULSE (generates Address discharge) by ON/OFF operation, and supplies this waveform to COF (data)

Signal part  |  Power part

X LEFT B/D

<COF Separating>

Lift up lock as shown in narrow.

Pull COF as shown in narrow.

X RIGHT B/D
Z sustain Board

Make SUSTAIN PULSE and ERASE PULSE that generates SUSTAIN discharge in panel by receiving LOGIC signal from CONTROL B/D.

this waveform is supplied to panel through FPC(Z).

*composed with IPM, FET, DIODE, electrolytic capacitor, E/R coil.

<FPC Separating>

Separate the fixed Screw of Z-Board. Pull out Lock as shown in arrow.

Condition in Lock part is pulled as shown in arrow.

Pull FPC Connector as shown in arrow.

* IPM (Intelligent Power Module)
E/R (Energy recovery)
1) This is a path to supply SUSTAIN ,RESET waveform which made from Y SUSTAIN B/D to panel through SCAN DRIVER IC.

2) Supply a wave form that select Horizontal electrode (Y SUSTAIN electrode) sequentially.
   - potential difference is 0V between GND and Vpp of DRIVER IC in SUSTAIN period.
   - being generated potential difference between GND and Vpp only in SCAN period.

* In case of 42” V6 use DRIVER IC IC 8 EA (TOP, BOTTOM: each 4EA)
Y sustain Board / Control Board

**Y sustain B/D**

- Generates SUSTAIN, RESET waveform, Vsc(SCAN) voltage.
  - and supplies it Y DRIVER B/D.
- * Composed with IPM, DIODE, electrolytic capacitor, FET.

**Control Board**

- Creates signal processing (Contour noise, reduction SM,..)
  - and an order of many FET on/off of each DRIVER B/D with
    - R, G, B each 8bit input.
- * Use 3.3V/5V 2 kinds of power.
COF (Chip On Film)

- supply a waveform which made from X B/D to panel and select a output pin that is controlled by COF when be on or off. 96 output pin per IC.
- the more the resolution higher, the less spare space where can set IC on it in B/D. without using IC PACKAGE, we can use a BARE IC , so we can get IC with LOW COST because we do not solder IC on PCB directly, a soldering defect rate decrease.

* composition
1) FPC + Heat /Sink
   ⇒ FPC for COF must have a Low Spec decline with getting damp
2) CHIP resistor + CHIP CAPACITOR
3) BARE IC (STV7610A/WAF) + GOLD WI RE/AL WI RE
4) EPOXY MOLDING

* 42 V6 COF is the same as 42V5.
IPM (Intelligent Power Module)

: composition
HEATSINK, CAPACITOR
DIODE
IC LINEAR
RESISTOR, TRANSISTOR, FETS.

: description
Attached at Z B/D and Y B/D, make Sustain waveform.
Sustainer: supply a square wave to panel to make a video.
1. Method of Module used time confirmation and Reset

1-1. With pressing Menu Key of Set, press the IN-Start Key of remote control (for about 5 seconds)

1-2. In the case of 42” KK Module, OSD that is read Option, in the case of 50” KK Module, ODS that is read Temperature indicated.

1-3. When pressing In-Stop button of remote control, initialization is finished

1-4. In the case of 60” KK Module, press the Vol+ Key of Set then press the Menu Key (for about 5 seconds)

1-5. OSD that is read Temperature is indicated

1-6. When pressing In-Stop button of remote control, initialization is finished

2. Method of White Balance adjustment and confirmation

2-1. In the case of KK Model initiated MN-, when pressing ADJ Key of remote control, the confirmation is possible

2-2. In the case of KK Model initiated DN-, when pressing ADJ Key of remote control, the following OSD are showed:

0). Ez Adjust
1). AD 9883A - SET
2). VPX 3226
3). White - Balance → color adjustment
4). DVCO - SET
5). White - Pattern → R,G,B, color confirmation
6). Module Control
7). Temperature Threshold

3. In the case of existed Model when pressing ADJ-Key, Power ON-Key, and IN Start-Key, the confirmation of White-Balance and White-Pattern is possible

3-1. For change and adjustment, use the CH+, CH- and VOL+, VOL- buttons
### LED state indication

<table>
<thead>
<tr>
<th>Power on sign LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>The state MAIN power is off</td>
</tr>
<tr>
<td>red</td>
<td>Power stand-by state (STAND-BY)</td>
</tr>
<tr>
<td>scarlet on-off</td>
<td>The state preparing for working in Power stand-by state</td>
</tr>
<tr>
<td>green</td>
<td>The state of working</td>
</tr>
</tbody>
</table>

### When LED is returning to red with Power on

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>180V is Downed (VS)</td>
<td>Y-SUS, Z-SUS inspection (DC/DC Board inspection)</td>
</tr>
<tr>
<td>75V is Downed (VA)</td>
<td>X-Board inspection</td>
</tr>
<tr>
<td>120V is Downed (VSC)</td>
<td>Y-SUS, (DC/DC Board)</td>
</tr>
<tr>
<td>240V is Downed (V-Setup)</td>
<td>Y-SUS, (DC/DC Board)</td>
</tr>
<tr>
<td>30V is Downed (Audio Line)</td>
<td>VSC-Board, Audio Board</td>
</tr>
<tr>
<td>When FAN doesn’t work</td>
<td>DC / FAN, link connector, 12V, 5V VCC confirmation</td>
</tr>
</tbody>
</table>
Regulation method VR Position such as VS voltage, VA voltage and voltage.

<table>
<thead>
<tr>
<th>PIN No</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>P801</td>
<td>PO</td>
<td>5V-MNT</td>
<td>VS-ON</td>
<td>GND</td>
<td>BY5</td>
<td>RL-ON</td>
<td>A-ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P802</td>
<td>GND</td>
<td>GND</td>
<td>12V</td>
<td>12V</td>
<td>GND</td>
<td>GND</td>
<td>6V</td>
<td>6V</td>
<td>GND</td>
<td>GND</td>
<td>3.4V</td>
<td>3.4V</td>
</tr>
<tr>
<td>P803</td>
<td>GND</td>
<td>12V</td>
<td>GND</td>
<td>3.4V</td>
<td>GND</td>
<td>5V</td>
<td>GND</td>
<td>GND</td>
<td>15V</td>
<td>15V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P804</td>
<td>GND</td>
<td>GND</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
</tr>
<tr>
<td>P805</td>
<td>VS</td>
<td>VS</td>
<td>VS</td>
<td>NC</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>VS</td>
<td>VS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P806</td>
<td>5V</td>
<td>GND</td>
<td>VS</td>
<td>GND</td>
<td>NC</td>
<td>GND</td>
<td>VS</td>
<td>VS</td>
<td>VS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P807</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
</tr>
</tbody>
</table>
No Power

( It isn’t lighted even in ST-BY)

Confirm if power is supplied and main power s/w is turned
ON confirm the EMI Board Fuse(confirm if it is rated capacity)

Be sure to use the fuse of rated capacity
It’s turned off automatically after 2~3 seconds when power is on.
(LED changes from green to red)

Model name : All models
Main Check : confirm the B+ voltage supplied to each end (such as VS, VA, VSC, V-SETUP)
Content of badness : It is turned off automatically after 2~3 seconds when power is on.
(LED changes from green to red)
measures : change of Y-Board through VS voltage short
COF : CHIP ON FILM

Data COF IC inspection method

R,G,B, R’,G’,B’ each 16 X 6
R”,G”,B”,R’”,G’”,G’” each 16 X 6

R,G,B each 32 items X 3

*, .42” CTRL = 7 X 12
*, .50” CTRL = 11 X 12 X 2
*, .60” CTRL = 11 X 12 X 2

Regarding * pattern (GND) as ANODE,
* pattern (resistance soldering part) as CATHOD,
Practice the diode inspection forward and backward.
As the above, the space charging screen display is allocated for each X Board (XL_TOP, XL_CNT, XL_BOT, XR_TOP, XR_CNT, XR_BOT).

Thus, if the occurring screen problems are limited only to the space X B/D,
For example, regular vertical line or abnormal screen in Data COF IC unit, Data COF unit can be the problems of X B/D.
The inspection method will be explained in next chapter how to inspect when screen display doesn't work at all about each X B/D, giving examples of XL_Top B/D.
When one or many vertical lines are generated irregularly on screen.

1. When one or many lines generate irregularly, it is not the problem of Controller B/D X B/D.
2. In this case, it may be OPEN (or SHORT) generating due to the following.
   - Trouble of panel itself
   - The trouble of DATA COF itself attached to panel
   - OPEN or SHORT of DATA COF FPC attached to panel
Module Trouble Audit Point

In the case of ADD-BAR
One BAR appears and it has a color. (magenta, cyan, yellow)
In the case of RGB conversion, specific color is displayed normally.

In the case of ADD-BAR
Many BARS appear and they have colors. (magenta, cyan, yellow)
In the case of RGB conversion, specific color is displayed normally.

Module exchange

1. X - Board inspection
2. Link connector inspection
3. Control Board inspection
4. Module inspection

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Model name : All models
main Check : confirm if it appears in a line and has specific color when changing to R.G.B
Contents of badness : When ADD BAR appears in a line (specific color, magenta, yellow)
measures : change the module
Model name : All models

main Check : check the 10Ω resistance at the front end of COF IC

Content of badness : When ADD BAR appears at intervals of 2~3cm

measure : change the module
When many ADD BAR appear

Model name : All models
main Check : check the film connection at the front end of COF IC
Content of badness : When many ADD BAR appear
measure : change the module
When specific color and ADD BAR appear

Check the film connector linking X-Board and Control Board

Model name : All models
main Check : Check the film connector linking X-Board and Control Board
Content of badness : When 5~6cm ADD BAR appears (specific color, magenta, cyan, yellow)
measure : change the film connector
When black ADD BAR appears

Check the film connector linking X-Board and Control Board

Model name : ever model
main Check : Check the film linking X-Board and module
Content of badness : When black ADD BAR appears
measure : change the module

Bad work film is torn.
Picture distortion phenomenon

Model name : All Model

main Check : confirm the VSC Board oscillation of VSC Board

Content of badness : OSD is normal and picture is distorted

measures : VSC Board change
Picture is distorted through mosaic phenomenon

Model name : All Model
main Check : Confirm the VSC Board oscillation
Content of badness : Picture is distorted through mosaic phenomenon
measures : change the VSC Board
Picture is distorted

Picture shadow appears (smear)

Model name : All Models
main Check : Confirm the VSC Board oscillation
Content of badness : Picture is distorted through mosaic phenomenon
measures : change the VSC Board
Wrong Discharge SVC Guide

In the case of wrong discharge trouble:
- After image appears like Shadow: It occurs in old Module. It can be solved with VS voltage wrong regulation (about +,- 3~5V)
- VR8501 VS
- VR8401 VA

When it isn’t solved with VS voltage, change the Y-SUS Board.

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Flicker is bad

VSC Board

Model name : All Models
main Check : check the VSC Board
Content of badness : When wrong discharge appears in specific color
measures : change the VSC Board
Wrong Discharge SVC Guide

1. **phenomenon**: ① spot wrong discharge of low Gray pattern (animation dark screen wrong discharge)
   ② when pattern (Channel) changing, hit spot wrong discharge

2. **Trouble improvement SVC plan**
   (1) ROM Data change -- addition of Safe wave form
   ▶ Version: 50KK_DN05G
   ▶ Checksum: 4A05
   (file name: 50KK_DN05G_Checksum_4A05_1,2,3,4,5_new_safe.hex)

   (2) Vsetup voltage regulation
   ▶ present 240V → change 260 ~ 265V

3. **Reliance inspection of second item SVC countermeasure contents**
   ▶ measure condition: normal temperature / Full White / Vsetup=265V / improvement ROM
   ▶ a standard of judgment: regarding normal temperature(25℃) as standard, below 69℃

<table>
<thead>
<tr>
<th>sDCDC Board</th>
<th>Y – SUS Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>PC2 IC</td>
</tr>
<tr>
<td>HS3 FET</td>
<td>IC 6</td>
</tr>
<tr>
<td>HS5 FET</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>60</td>
</tr>
<tr>
<td>67</td>
<td>48</td>
</tr>
<tr>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

   ▶ assurance test of high temperature reliance (market returned products n=2unit)

<table>
<thead>
<tr>
<th>condition</th>
<th>result</th>
</tr>
</thead>
<tbody>
<tr>
<td>55℃, 24hr</td>
<td>No problems in spot progress and reliance</td>
</tr>
</tbody>
</table>
1. The causes of wrong discharge

- The above wave form shows Set Up / Down generating wall charge in Panel.
- The wall charge generated through Set Up / Down wave plays important role in address discharge.
- If Vs voltage is lower than specified value in label of Panel,
  - Roll-off of Set Down wave form becomes slack
  - the amount of wall charge decreases
  - the screen gets dark and SET OFF after all.
- If Vs voltage is higher than specified value in label of Panel,
  - Roll-off of Set Down wave form is situated behind
  - the amount of wall charge increases
  - screen gets bright due to failing to express dark graduation accordingly, wrong discharge phenomenon occurs
2. countermeasure

- Regulate the $V_a$, $V_s$, $-V_y$, $V_{set-up}$ voltage exactly with multi-meter referring to the voltage notation attached on right above of the Panel.
BARS appears at regular intervals

Model name : All Models
main Check : Confirm the control board and Micom version
Content of badness : BARS appear at regular intervals or OSD works normally
measures : change the Module control board
BARS appears at regular intervals

Module Control Board

Model name : All Models
main Check : control board and VSC connect cable check
Content of badness : BARS appears at regular intervals and mosaic phenomenon appears
measures : change the Module control board
Y-Sustain Board

- **Role of Y Board**

- **Set-up**: It is the process of charge form in internal wall and initial reset. It affects greatly wall charge form part.

- **Scan**: It is also called address section, confirms if there is X part data. (It is the section that determines existence of operation in sustain section due to the first discharge.

- **Sustain**: It is for PDP Module brightness and graduation form. (ex. If it has more Sustain, it gets brighter and it indicates graduation and luminance.)
Y-Sustain Board

A2 wave form

Scan polarity inversion (Y)

Common sustain polarity inversion (Z)

Data polarity inversion (Y)

< Set up state >
the stage swelling the voltage gradually and increasing the amount of wall charge

< Set down stage>
the state sagging the voltage gradually and decreasing the formed wall charge in uniform cost without discharge

< Scan stage >
the stage preparing for Scan, having uniform cost of wall charge in discharge space

< Scan stage >
the stage other line Scanned Nothing happens

< Sustain stage >
surface charge occurs between Y polarity inversion and Z polarity inversion by the voltage authorized to Z polarity inversion and wall charge of Z polarity inversion part

< Sustain stage >
surface charge occurs between Y polarity inversion and Z polarity inversion by the voltage authorized to Z polarity inversion and wall charge of Z polarity inversion part

< Erase stage >
the stage swelling the voltage gradually and dissipating all the wall charge

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Flicker is bad

Model name : All Models
main Check : VS, V-SETUP, confirmation of voltage
Content of badness : when there is wrong discharge effect and picture doesn't appear
measures : change the Y-Board

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- 79 -
Model name : All Models

main Check : VS, V-SETUP, confirmation of voltage

Content of badness : when there is wrong discharge effect and picture doesn’t appear

measures : change the Y-Board
Flicker is bad

Confirm the voltage

Model name : MN-42PZ90

main Check : confirm if 15V line supplied to module control board sags (about 8~9V)

Content of badness : when there is wrong discharge effect and picture doesn’t appear

measures : change the Y-Board and Z-Board at the same time
The screen isn't displayed at all Scan FPC wise.

1) If the screen isn't displayed Scan FPC wise, it may be the problems between relevant Scan FPC and Y DRV B/D
2) Check if the connector of Scan FPC corresponding to the part that isn't displayed is connected well with Y DRV B/D
3) Check if the Clock, Data signal of relevant Scan FPC input signal of Y DRV B/D is shorted with +5V or Ground.
4) Check if the output buffer of Y B/D related to relevant Scan Drive IC works normally.
5) Check if the signals are authorized well to relevant Scan Drive IC.
6) Check if the relevant Scan Drive IC Failed.
7) Check the PCB pattern.

※ examples of display type of screen

- Normal part
- The part that isn’t displayed at all
Model name : All models

main Check : check the Y-Driver board connection state of module or an alien substance

Content of badness : horizontal BAR

measures : Remove the alien substance of Y-Driver board and module connection film
Model name : All models

main Check : check the SCAN Driver IC of Y-Driver board and port

Content of badness : horizontal BAR

measures : change the Y-Driver board
Insert to Z-Board and X-Board linking connector is bad

Picture is dark and wrong discharge (phenomenon)

Model name : MN-42PZ90
main Check  : Check the B+ terminal and cable connected to Z-Board
Content of badness : picture is dark and has too much noise
measures   : check the Z-Board and connector
Picture is dark and wrong discharge (phenomenon)  Picture is dark and wrong discharge (phenomenon)

Model name : All models
main Check : Check the B+ terminal and cable connected to Z-Board
Content of badness : picture is dark and has too much noise
measures : check the Z-Board and connector
ISM Mode (Image Sticking Minimization Mode)

Apart from above proposal, this module has equipped with special method which minimizing image sticking phenomenon. When in fixed pattern display mode, module decreases the brightness over 10 minutes with small step. Below Figure show that the brightness decrease step is so small that user do not catch whether it is performed or not.

The basis of evaluation for ISM Mode in module was operating, the brightness decrease about 80% less than its initial value at the white window pattern (1/25 of full white pattern)

ISM operational conditions
1. Minimum pattern deviation detect size is no less than 0.36% of total screen size and it will stay more than 3 minutes.
2. Regardless of the time, it will not operate where the pattern deviation size is below 0.36%.
Generation of After-image such as Letters and Logo in screen

After-image remains due to watching same image for a long time (letters and others)

There is ISM Mode as an after-image prevention function, so it is programmed to make dark the screen in the case of long time freeze picture. But it is for the whole animation screen, so it can't prevent partial letters and logo after-image. Therefore pay attention not to display same image for a long time especially take notice not to display same image continually when displaying at the stores. (Take notice it is dealt with compensation when after-image generates)

Press the ADJ Key of remote control and connect to SVC Mode, Select WHITE at HEAT RUN then make HEAT RUN as much time as generation time of after-image. (when the after-image is intense, it can’t be recovered)
Matters connected with after-image prevention

When using change function

When using inversion function
Method to separate Back covers