


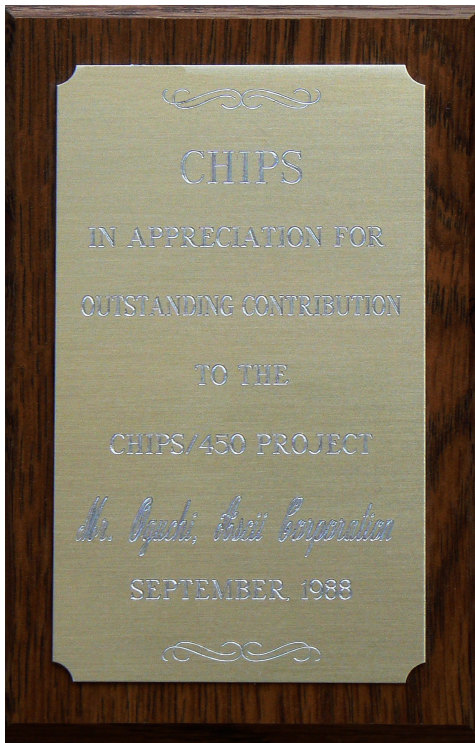


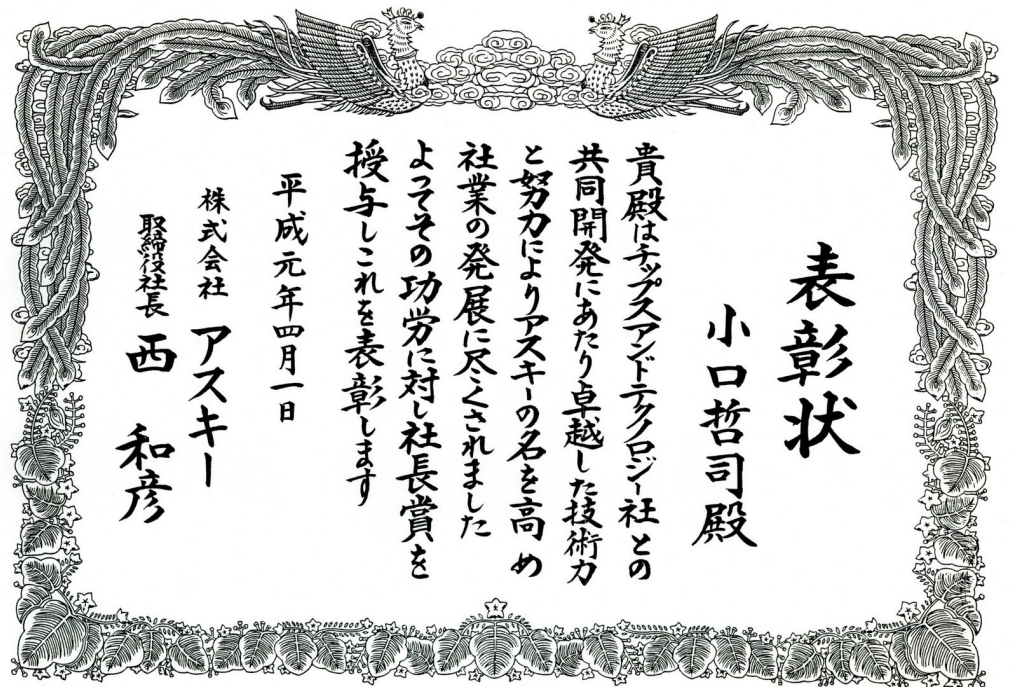
## Development history of Chips and Technologies 82C455, 82C456, and 82C457

Chips & Technologies graphics group started the following IBM VGA graphics LSI design in early 1988 after IBM VGA released in April, 1987.

| Product name  | Code name     | Sesame Street Character                                                           | Leading engineer | Function                                                        |
|---------------|---------------|-----------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------|
| <b>82C451</b> | <b>Ernie</b>  |  | Ed Hutchins      | Equivalent with IBM VGA CRT controller LSI                      |
| <b>82C452</b> | <b>Grover</b> |  | Minjhing Hsieh   | Enhanced IBM VGA CRT controller LSI supporting SVGA (800 x 600) |
| <b>82C455</b> | <b>Bert</b>   |  | Tetsuji Oguchi   | World's first IBM VGA flat panel controller LSI                 |



CHIPS  
IN APPRECIATION FOR  
OUTSTANDING CONTRIBUTION  
TO THE  
CHIPS/450 PROJECT  
Mr. OGUCHI, Ascii Corporation  
SEPTEMBER, 1988



ASCII President Prize  
Tetsuji Oguchi  
April, 1 1989  
President Kazuhiko Nishi

## Company Visit

In late 1987, Japanese flat panel manufacturers occupied almost 100% of the worldwide flat panel market share making small size black and white LCD flat panels without backlight which physical size was less than 320 (H) x 200 (V) for mainly portable Japanese word processor installed a low cost heat sensitive paper printer and a 3.5" floppy disk drive.

LCD flat panels with backlight of 640 (H) x 480 (V) physical display size equivalent of display resolution of IBM VGA, did not exist. This meant that the functional verification of IBM VGA flat panel controller LSI we were planning to develop was impossible running in actual IBM PC as well as the VGA lap-top PC (calling a notebook PC nowadays) market itself was none.

We had to kick off a promotional campaign visiting Japanese flat panel vendors and customers to let them recognize that VGA resolution flat panel (640 x 480) creates a big potential market soon in a year.

In December, 1987, I and Keith Angelo, a Chips and Technologies graphics marketing, started visiting Japanese flat panel vendors and customers announcing that we plan to design IBM VGA flat panel controller LSI at Chips and Technologies who already have a working IBM VGA CRT controller core made by reverse engineering by John Kimberly, a Chips and Technologies graphics engineering, and requested to manufacture VGA resolution flat panels and give us the sample panels to demonstrate the working system with IBM VGA flat panel controller LSI (named 82C455 later on) at coming COMDEX Fall (One of largest computer trade shows in the world) held in Las Vegas in November, 1988.

We visited following total 23 flat panel vendors and 8 customers, nook and cranny desperately, as below. As the result, we successfully obtained various kinds of sample flat panels from many manufacturers.

| Flat panel vendors               |                | Customers                      |  |
|----------------------------------|----------------|--------------------------------|--|
| Company name                     | Flat panel     | Company name                   |  |
| Citizen, Tanashi                 | LCD            | Funai Electronics, Daito       |  |
| Kyocera, Ise                     |                | Hitachi, Narashino             |  |
| Kyocera, Yoga                    |                | IBM Japan, Yamato              |  |
| Matsusita Electronics, Kadoma    |                | NEC, Fuchu                     |  |
| Optrex, Tokyo                    |                | NEC Home Electronics, Kawasaki |  |
| Seiko Epson, Toyoshina           |                | Sharp, Yamato Koriyama         |  |
| Seiko Epson, Kawasaki            |                | Sony, Kitashinagawa            |  |
| Seiko Instrument, Matsudo        |                | Tottori Sanyo, Tottori         |  |
| Sharp, Yamato Koriyama           |                |                                |  |
| Stanley Electric, Hadano         |                |                                |  |
| Toshiba, Kawasaki                |                |                                |  |
| Tottori Sanyo, Tottori           |                |                                |  |
| Hitachi, Mobara                  |                | TFT                            |  |
| Optrex, Tokyo                    |                |                                |  |
| Sharp, Tenri                     | TFD            |                                |  |
| Hosiden, Kobe                    | EL             |                                |  |
| Sharp, Tenri                     | Plasma         |                                |  |
| Matsusita Electronics, Takatsuki |                |                                |  |
| Oki, Hachioji                    | Driver         |                                |  |
| Hitachi, Musashi                 |                |                                |  |
| Texas Instrument, Tokyo          |                |                                |  |
| Hitachi, Takasaki                | Color palette  |                                |  |
| Hitachi, Marunouchi              | Panel Planning |                                |  |



奈良名所観光記念

# 春日大社

奈良に都ができた頃、茨城県鹿島より武甕槌命を白鹿の背にいただき、都の東方霊山と崇める御蓋山の頂き浮雲の峰にお祀りし、国土の安泰と国民の繁栄を祈念したのが始まりです。



Tetsuji Oguchi & Keith Angelo (Graphics marketing at Chips & Technologies)

We enjoyed one day tour bus trip at Nara, a Japanese historical ancient city, at the middle of busy two week business trip to Japanese flat panel vendors and customers on 12/12/1987 (Sat) before starting world's first VGA flat panel controller LSI (82C455) design at Chips & Technologies in San Jose, California, USA.

| Visit Date | Chips & Technologies | ASCII          |
|------------|----------------------|----------------|
| Dec, 1987  | Keith Angelo         | Tetsuji Oguchi |
| Feb, 1989  |                      |                |
| May, 1990  | Bob Conner           |                |
| May, 1991  | Keith Angelo         |                |

### **Extension Registers (XR50 - XR6E) for Flat Panel Control**

I specified and implemented programmable parameter registers for flat panel control (XR50 – XR6E) on 82C455, 82C456, and 82C457.

Concerning the detailed function of each parameter register, refer to "[455 Datasheet.pdf](#)", "[456 Datasheet.pdf](#)", and "[457 Datasheet.pdf](#)" respectively.

| Reg  | Parameter register name               | Bits | Access   | I/O Port  | Initial Reset Value | CRT controller |     |     |     | Flat panel controller |     |     |    |
|------|---------------------------------------|------|----------|-----------|---------------------|----------------|-----|-----|-----|-----------------------|-----|-----|----|
|      |                                       |      |          |           |                     | 82C            |     |     |     | 82C                   |     |     |    |
|      |                                       |      |          |           |                     | 450            | 451 | 452 | 453 | 455                   | 456 | 457 |    |
| XR50 | Panel Format                          | 8    | R/W      | 3B7 / 3D7 | x0xxxxxx            |                |     |     |     |                       |     |     |    |
| XR51 | Display Type                          | 7    |          |           | 00xx010-            |                |     |     |     |                       |     |     |    |
| XR52 | Panel Size                            | 6    |          |           | -xxxx-xx            |                |     |     |     |                       |     |     |    |
| XR53 | Line Graphics Override                | 2    |          |           | -----xx             |                |     |     |     |                       |     |     |    |
| XR54 | Alternate Misc Output                 | 5    |          |           | xx--10-0            |                |     |     |     |                       |     |     |    |
| XR55 | Text Mode 350_A Compensation          |      |          |           | ---1xxxx            |                |     |     |     |                       |     |     |    |
| XR56 | Text Mode 350_B Compensation          |      |          |           | ---1xxxx            |                |     |     |     |                       |     |     | √  |
| XR57 | Text Mode 400 Compensation            |      |          |           | ---1xxxx            |                |     |     |     |                       |     |     |    |
| XR58 | Graphics Mode 350 Compensation        | 7    |          |           | -xx0xxxx            |                |     |     |     |                       |     |     |    |
| XR59 | Graphics Mode 400 Compensation        |      |          |           | -xx0xxxx            |                |     |     |     |                       |     |     |    |
| XR5A | Flat Panel Vertical Display Start 400 | 8    |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR5B | Flat Panel Vertical Display End 400   |      |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR5C | Weight Control Clock A                | 6    |          |           | --xxxxxx            |                |     |     |     |                       |     |     | -- |
| XR5D | Weight Control Clock B                |      |          |           | --xxxxxx            |                |     |     |     |                       |     |     |    |
| XR5E | ACDCLK Control                        | 8    |          |           | xxxxxxxx            |                |     |     |     | √                     |     | √   |    |
| XR5F | Power Down Mode Refresh               |      |          |           | --                  | xxxxxxxx       | --  | --  | --  | --                    |     |     | √  |
| XR60 | Blink Rate Control                    |      |          |           | 1000011             |                |     |     |     |                       |     |     |    |
| XR61 | Text Color Mapping Control            | 7    |          |           | -xxxxxxx            |                |     |     |     |                       |     |     |    |
| XR62 | Text Color Shift Parameter            | 8    |          |           | xxxxxxxx            |                |     |     |     |                       |     |     | -- |
| XR63 | Graphics Color Mapping Control        |      |          |           | 000xxxxx            |                |     |     |     |                       |     |     |    |
| XR64 | Alternate Vertical Total              |      |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR65 | Alternate Overflow                    |      |          |           | xxx--xxx            |                |     |     |     |                       |     |     |    |
| XR66 | Alternate Vertical Sync Start         | 8    |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR67 | Alternate Vertical Sync End           | 4    |          |           | ----xxxx            |                |     |     |     |                       |     |     | √  |
| XR68 | Alternate Vertical Display Enable End | 8    |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR69 | Flat Panel Vertical Display Start 350 |      |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR6A | Flat Panel Vertical Display End 350   |      |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR6B | Flat Panel Vertical Overflow 2        |      |          |           | xxxxxxxx            |                |     |     |     |                       |     |     |    |
| XR6C | Weight Control Clock C                | 6    |          |           | --xxxxxx            |                |     |     |     |                       |     |     | -- |
| XR6D | FRC & External Palette Control        | 8    |          |           | 0100011             |                |     |     |     |                       | --  |     | √  |
| XR6E | Polynomial FRC Control                |      | 10111101 |           |                     |                |     |     |     | --                    |     |     |    |

XR50 to XR6C were implemented on 82C455.

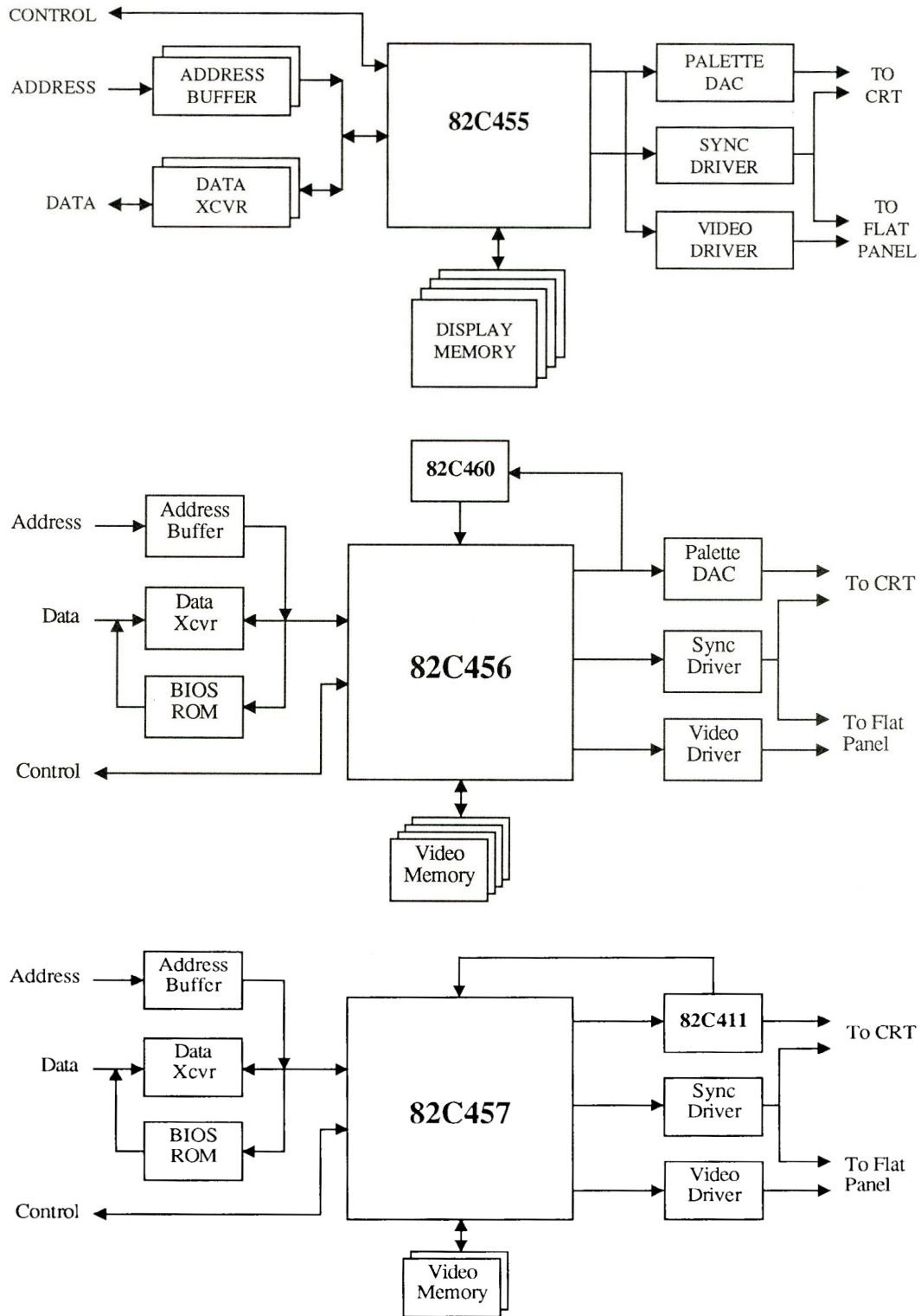
XR6D (FRC & External Palette Control) was newly implemented on 82C456.

XR6E (Polynomial FRC Control) was newly implemented on 82C457.

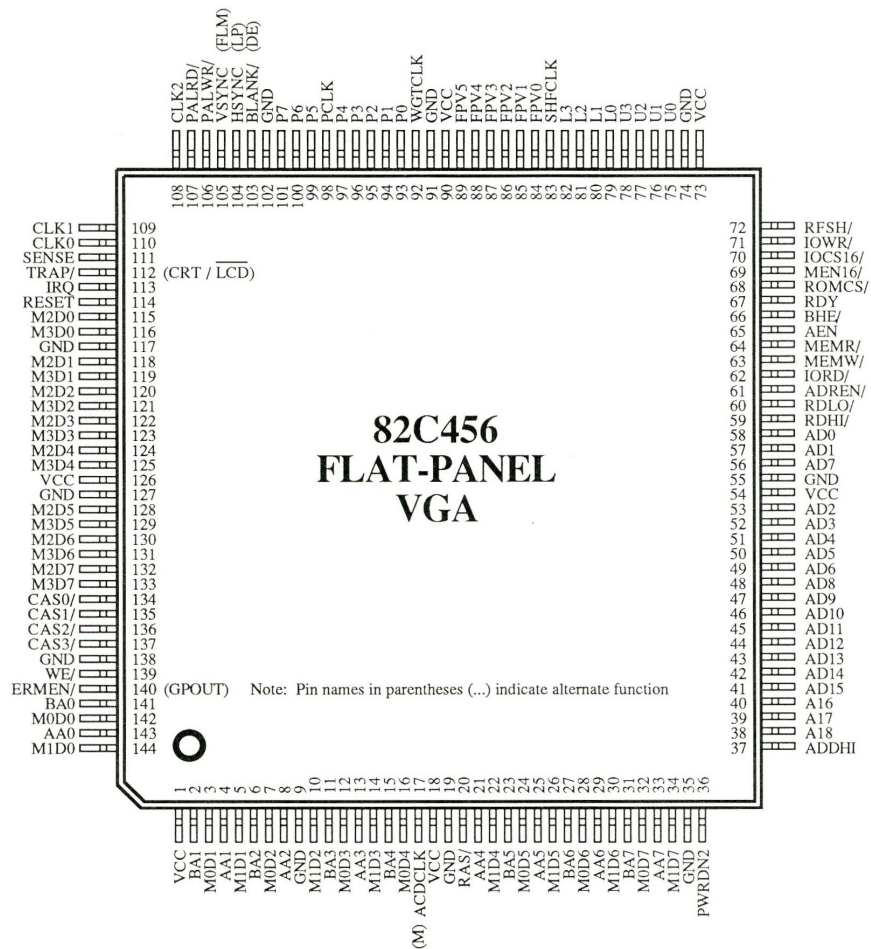
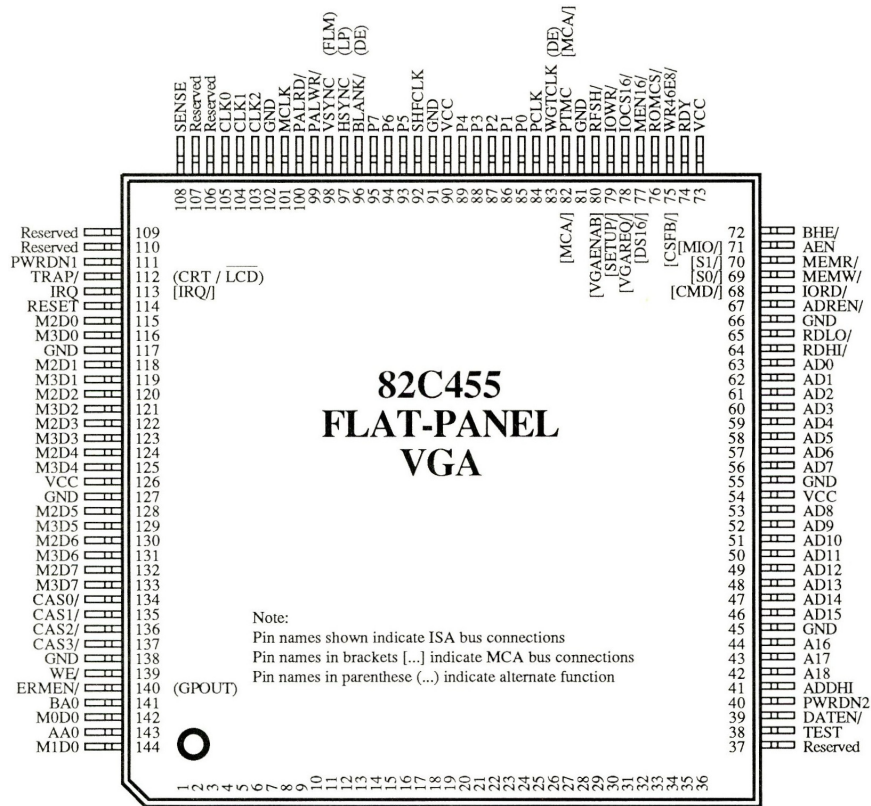
Concerning FRC (Frame Rate Control) as well as Dithering, I made an [evaluation software](#) written in 8086 assembly language and then implemented the related logic.

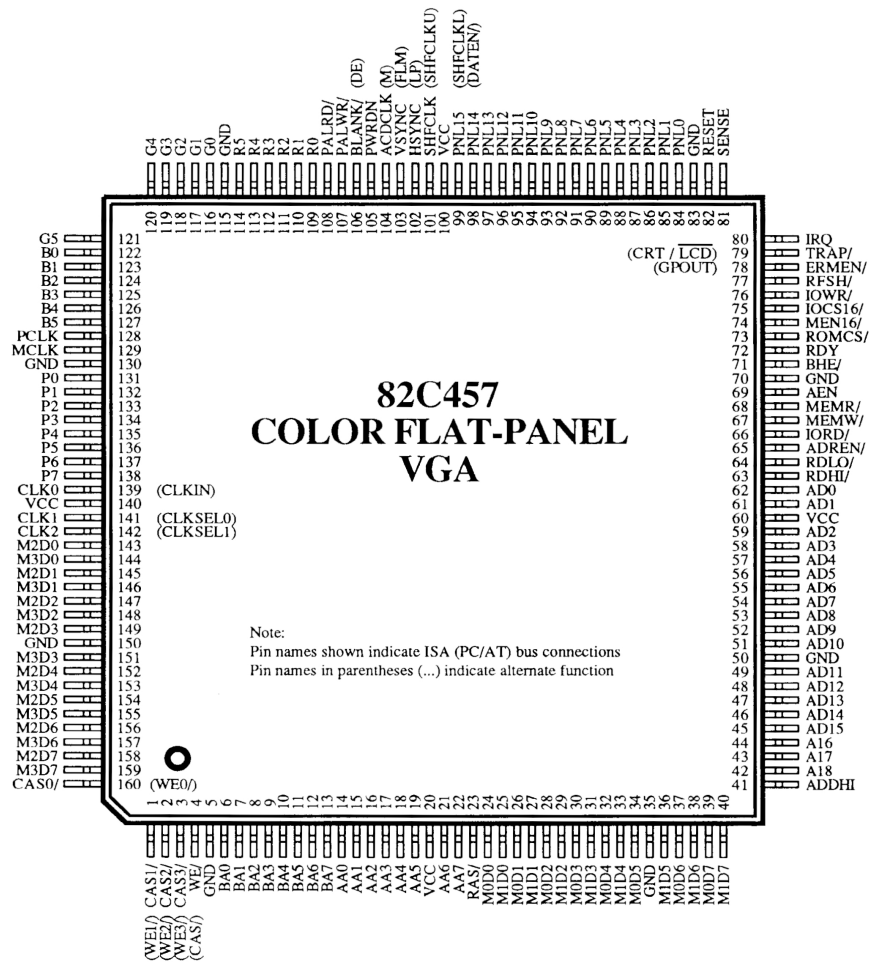
# Difference between 82C455, 82C456, and 82C457

## (1) System Block Diagram



(2) Pin Connection





Because 82C455/456/457 were made by Toshiba CMOS gate array, I was able to easily enhance the function updating the pin function and the connection unlike NEC  $\mu$ PD7220/72120 which logic and mask layout design were done manually by hand, not by computer. It is known that such handicraft industry-wise manual LSI design makes hard to change even small logic and pin function due to the time consuming work.

|                                      | <a href="#">82C455</a>                                                      | <a href="#">82C456</a>                                  | <a href="#">82C457</a>                 |
|--------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------|
| <b>Year</b>                          | 1988                                                                        | 1989                                                    | 1990                                   |
| <b>Exhibited at COMDEX Las Vegas</b> | Nov, 1988                                                                   | Nov, 1989                                               | Nov, 1990                              |
| <b>Package</b>                       | 144 pin plastic QFP                                                         |                                                         | 160 pin plastic QFP                    |
| <b>Gate Array</b>                    | <a href="#">Toshiba CMOS gate array TC110G 51</a> (51k gates)<br>1.5 micron |                                                         |                                        |
| <b>Color information feedback</b>    | None<br>(Quasi Black and white)                                             | <a href="#">82C460</a><br>(Color-based Black and white) | <a href="#">82C411</a><br>(True color) |

COMDEX (COMputer Dealer's Exhibition) Fall in Las Vegas was one of the largest computer trade shows in the world held in November from 1979 to 2003.