

Driver ICs for Character Display LCD Controller

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1. Introduction

In our highly information-oriented society, we have come to rely on electronic display devices. They serve as means of communication and man-machine interfaces in many fields, from general to industrial.

In many kinds of display devices, the liquid crystal display (abbreviated as LCD) is used in a wide range of fields due to its merits of small size, light weight, thin form and low power dissipation. It maintains its position as a next generation general use device, which will succeed LED and CRT displays.

For meeting such market needs, Fuji Electric has continued to produce a series of ICs for LCDs (abbreviated as LCD-IC).

This paper will introduce the production series of driver ICs for character display controllers of small size LCDs (abbreviated as small size LCD-IC) which are chiefly used as display devices in stationary telephones, cellular phones, facsimiles, radio pagers, printers, copying machines, etc.

2. Outline of Products

Fuji Electric has been already mass-producing single chip small size LCD-ICs which have the faculty to drive various LCDs without any additional components. This time, a new production series to meet market needs for a variety of display capacities and low power dissipation have been provided. An outline will be introduced here.

2.1 Features

The principal characteristics of 6-type small size LCD-ICs, now under mass production, are compared in Table 1. These types of IC chips are shown in Figs. 1 through 4.

Within these types of ICs, "FCS2314AK" is produced for LCD panels used in electronic devices like stationary telephones, printers, facsimiles and copying machines. It can display as many as 20 characters per line and its power supply voltage is specified to the 5V system.

Other types of ICs are produced for LCD panels

used in hand-held information terminals like cellular phones, PHS (personal handyphone system) and radio pagers, and their power supply voltage is specified to meet the low voltage of the 3V system, driven by a battery. In addition, to eliminate an external power supply circuit, each IC has a charge pump for generating the voltage required to drive an LCD. Among these ICs, "FCS2326K" and "FCS2327K" have achieved low power dissipation and high performance, described below.

2.1.1 Low power dissipation

The ICs for hand-held information terminals are provided with a stand-by mode for low power dissipation, in which a source current to a power supply for driving an LCD is blocked when display is not

Fig.1 Photograph of the FC2306K chip

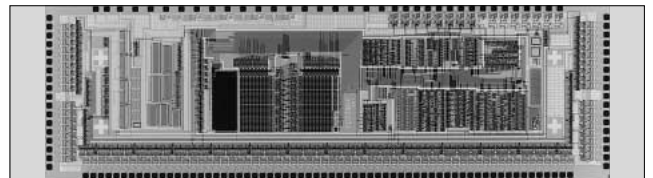


Fig.2 Photograph of the FCS2314AK chip

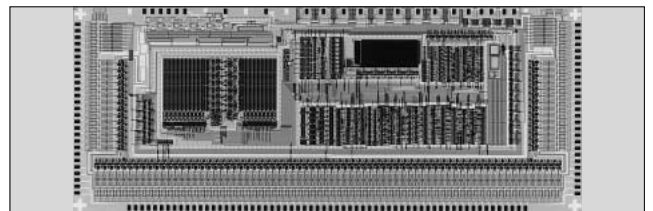
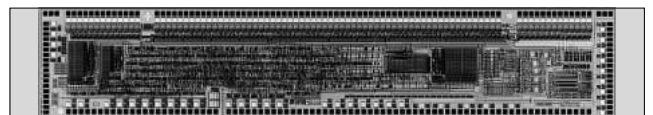


Fig.3 Photograph of the FCS2326K chip



Fig.4 Photograph of the FCS2327K chip



required. But “FC2326K” and “FCS2327K” are designed to accelerate lower power dissipation with the characteristics described below.

- (1) Lower frequency oscillator circuit
- (2) Built-in power supply circuit with low power dissipation for driving an LCD
- (3) Addition of a sleep mode in which the oscillator is paused while a stand-by

These functions greatly help to lengthen battery life of hand-held devices.

2.1.2 High performance

LCD-ICs for hand-held devices generally have an icon (a kind of pictograph) displaying function which

can be controlled independently of the display characters and are used for indicating remaining battery capacity of hand-held information terminals. But “FCS2326K” and “FCS2327K” have achieved increased display capacity and better visibility by realizing more icons (116 bits) and double height characters (Fig. 5).

Moreover, adopting asynchronous access (Fig. 6) to an MPU realizes a high speed interface. Many types of optionally available interfaces allow reduction of additional components and facilitated use.

2.1.3 Easy packaging design

- (1) Configuring common/segment signal driver circuits with bi-directional shift registers allows a

Table 1 Principal characteristics of small size LCD-ICs

Items \ Types	FC2306K	FCS2314AK	FC2316K	FCS2326K	FCS2327K
Display capacity (characters × lines)	16 × 2	20 × 2	16 × 4	12 × 2	12 × 3
Duty	1/18	1/8, 1/16	1/34	1/18	1/26
Number of LCD driving output terminals	COM : 18 SEG : 80	COM : 16 SEG : 100	COM : 34 SEG : 80	COM : 18 SEG : 62	COM : 26 SEG : 60
Power supply voltage (V)	2.7 to 5.5	4.5 to 5.5	2.7 to 5.5	2.4 to 3.6	2.7 to 3.6
LCD driving voltage (V)	3.0 to 11.0	3.0 to 5.5	3.0 to 11.0	3.0 to 7.0	3.0 to 11.0
DDRAM (bits) (Maximum characters)	64 × 8 (64)	80 × 8 (80)	64 × 8 (64)	24 × 8 (24)	36 × 8 (36)
CGROM (characters)	240	240	240	240	240
CGRAM (bits)	512	512	512	160	160
PGRAM (bits)	10	—	20	112	72
Interface (bits)	4/8	4/8	4/8	1/4/8	1/4/8
Number of instructions	12	11	12	15	15
RVLCD	Built-in	Built-in	Built-in	Built-in	Built-in
Oscillator frequency (kHz)	250	270	250	33	50
Charge pump	Built-in	—	Built-in	Built-in	Built-in
Electronic variable resistor	—	—	—	Built-in	Built-in
Low current power supply for LCD	—	—	—	Built-in	Built-in
Stand-by mode	Provided	Not Provided	Provided	Provided	Provided
Sleep mode	Not Provided	Not Provided	Not Provided	Provided	Provided
Consumption current (μA)	450 (typ.)	1,500 (typ.)	500 (typ.)	100 (max.)	140 (max.)
Aspect ratio of chip size	1 : 3.14	1 : 2.42	1 : 3.25	1 : 4.64	1 : 5.00

Fig.5 Example of double height character display

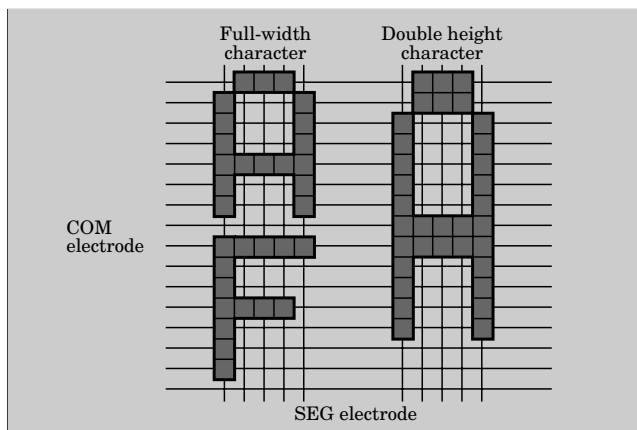
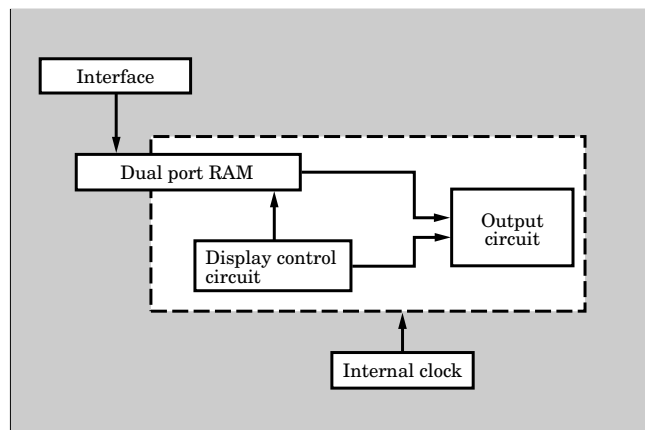


Fig.6 Conceptual rendering of asynchronous access



freer layout of ICs and LCDs, as shown in Fig. 7.

- (2) High density packaging is achieved by using gold bump electrode construction applicable for COG (chip on glass) and TAB (tape automated bonding) mounting. Especially in COG mounting, easier handling and higher density packaging are realized by adopting a method (Fig. 8) to efficiently determine an operation mode of the IC through

the utilization of ITO (indium tin oxide) wiring.

- (3) A chip form desirable for a smaller mounting area (not including the LCD part) has been decided by increasing the aspect ratio of the chip size.

Fig.7 Layout example of ICs and display devices

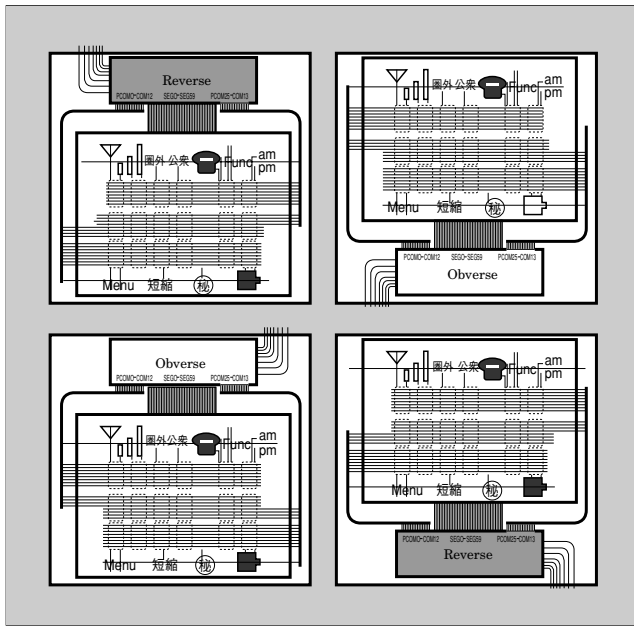


Fig.8 Example of determining operation mode with ITO

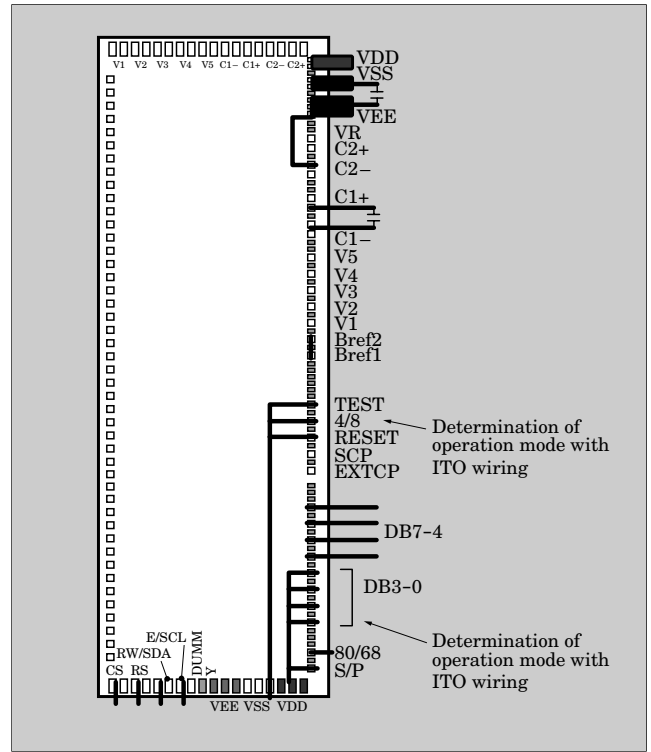


Fig.9 Circuit configuration of the FCS2327K

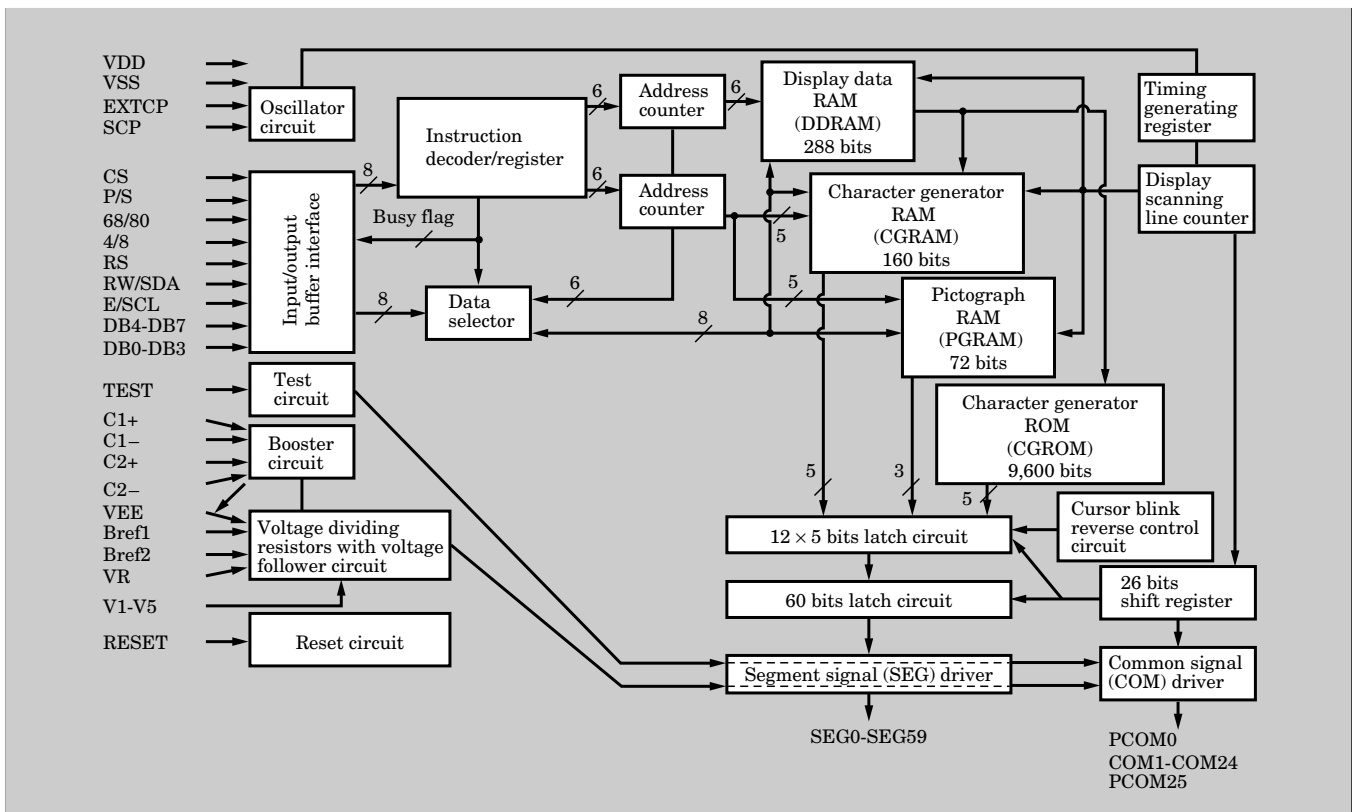


Fig.10 Power supply circuit for the driving LCD

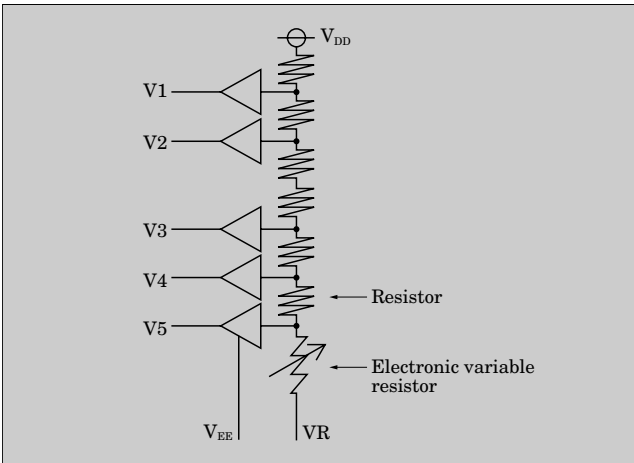
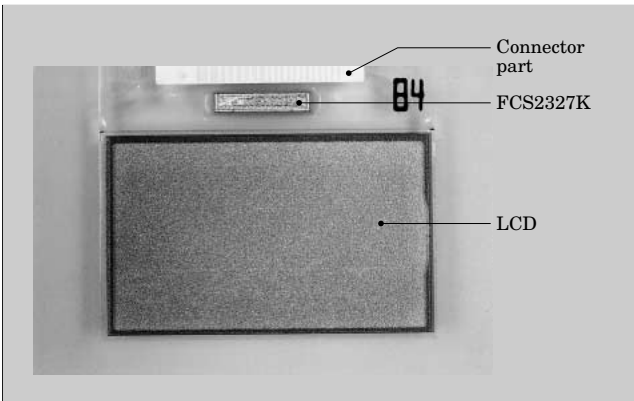


Fig.11 Module mounted with the FCS2327K



2.2 Circuit configuration

As a typical example of driver ICs for the LCD controller, the circuit configuration of “FCS2327K” is

shown in Fig. 9.

This IC consists of an interface circuit to the MPU, a control circuit for various display modes or data, ROM/RAM parts for storing display data and a driver circuit for LCD panels.

For realizing low power dissipation, as shown in Fig. 10, the power supply circuit for driving the LCD is configured with a voltage follower circuit. Voltages divided with high resistance are transformed into impedance, and a 5-bit electronic variable resistor adjusts display contrast.

2.3 Application example

An LCD panel capable of displaying 12 characters × 3 lines with “FCS2327K” is shown in Fig. 11 as an application example.

From an externally supplied 3V single power source, the desired LCD driving voltage is generated with the built-in charge pump of this IC and an additional capacitor. It drives the LCD panel through the built-in circuits of the voltage dividing resistor for the LCD driving power supply and the built-in electronic variable resistor for adjusting display contrast.

3. Conclusion

Six types of small size LCD-ICs manufactured by Fuji Electric for displaying characters have been introduced.

As the LCD meets a variety of working environments and multimedia, the market is expected to further expand in the future. Accordingly, lower power dissipation, higher performance and lower cost will be required.

Fuji Electric will promote the manufacture of distinctive LCD-ICs for meeting such market needs.





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