

On-screen display for camcorders

BU2848FS/BU2870FS/BU2873FS

The BU2848FS, BU2870FS and BU2873FS series ICs are fabricated using a CMOS process, and are designed for displaying character data on camcorder and television screens. The ICs are controlled by serial data from a microcontroller, and display patterns and data such as the date on the camcorder viewfinder. The characters are displayed in a 12×18 bit matrix, so Chinese characters can also be displayed. The display format is 12 lines×24 characters. There is no space between characters, so two or more characters can be joined to form icons.

The ICs are available in small SSOP packages and are suitable for high-density mounting in camcorders.

●Series

Part No.	No. of Characters
BU2873FS	64
BU2848FS	128
BU2870FS	256

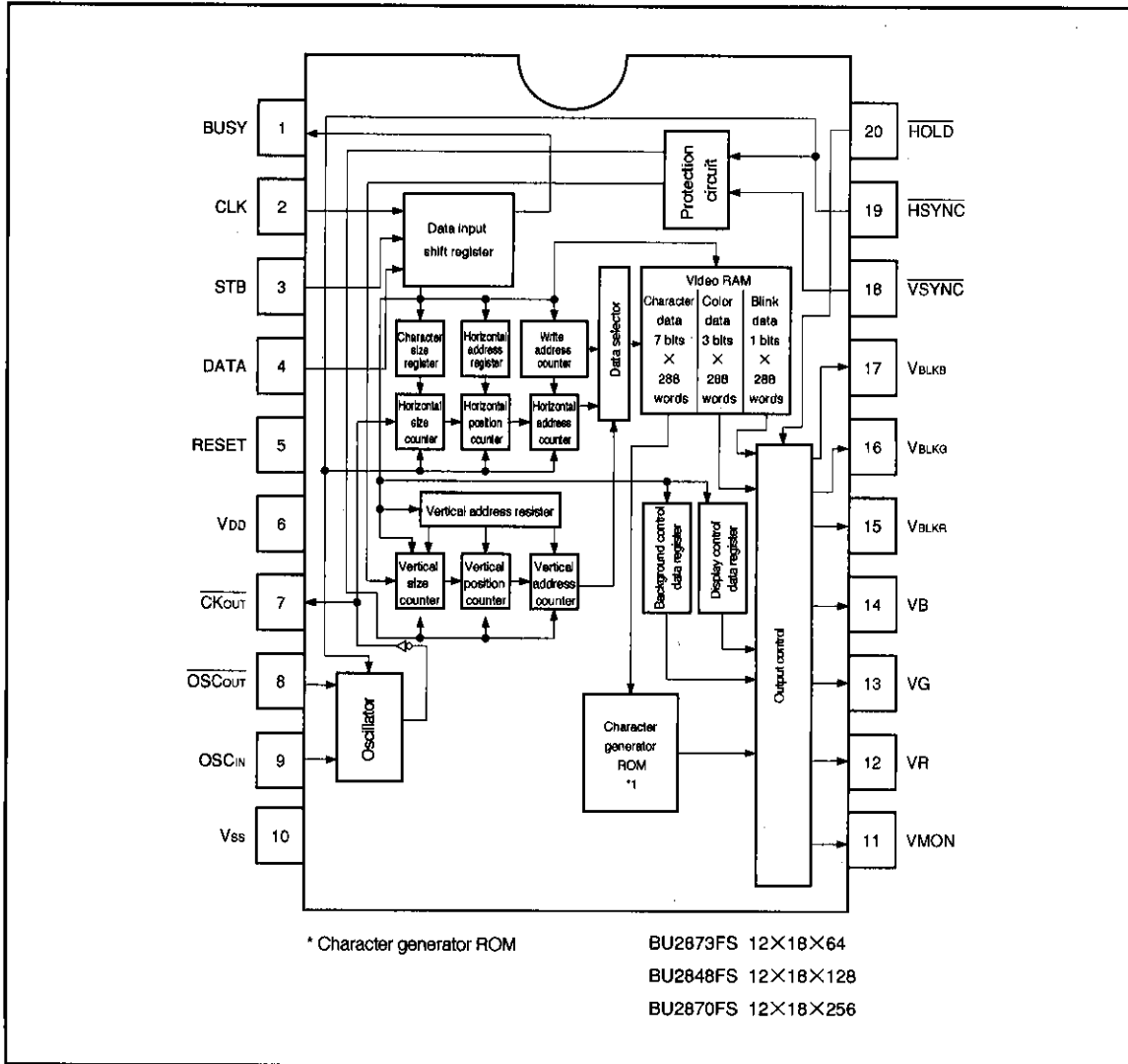
●Applications

Camcorders and televisions

●Features

- 1) 12 line×24 character display.
- 2) 64, 128, or 256 character types depending on the model.
- 3) Three-system monochrome output.
- 4) Character size can be selected as 1H/dot or 2H/dot.
- 5) Background can be selected on a per screen basis: none, border, knockout or solid.
- 6) 12×18 dot matrix, with no space between characters.
- 7) Character blinking ratio can be selected as 1:1, 3:1, or 1:3.
- 8) 8-bit serial microcontroller interface.
- 9) 5V power supply.
- 10) CMOS for low power consumption.

●Block diagram



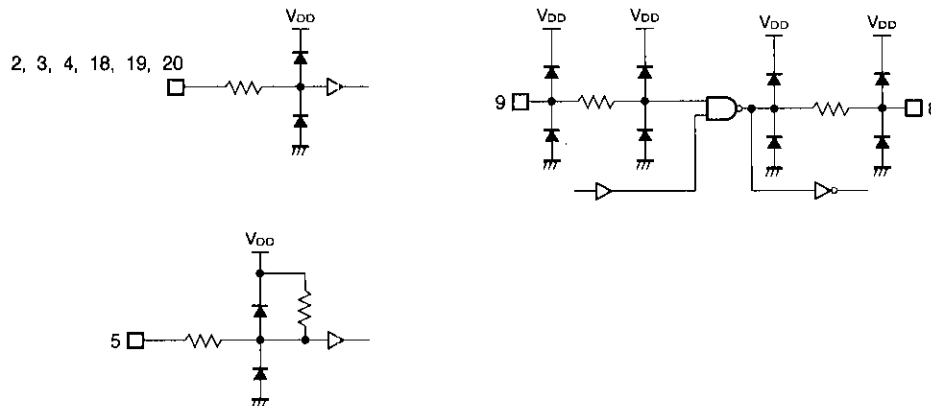
On-screen displays

Multimedia video

● Pin descriptions

Pin No.	Input/output	Symbol	Function
1	Output	BUSY	Informs the microcontroller when strobe input is possible after serial data input. Strobe input can be input when this is low.
2	Input	CLK	Clock input for reading in data. Data on the DATA pin is read in on the rising edge of the clock.
3	Input	STB	Input pin for the strobe signal after serial-data input. The eight bits of data are read in on the rising edge of the pulse applied to the STB pin. When the bit-data is character data, the data address is incremented on the falling edge of the pulse.
4	Input	DATA	Control data input pin. Data on this pin is read synchronously with the rising edge of the clock signal.
5	Input	$\overline{\text{RESET}}$	Resets all internal registers. Clears the internal RAM in the case of the BU2870FS. (Pullup resistor connected)
6	—	V_{DD}	Power supply (+5V)
7	Output	$\overline{\text{CKOUT}}$	OSC OUT inverting output. Use to check the oscillator frequency.
8	Input	$\overline{\text{OSCOUT}}$	For connection to oscillator capacitor and coil.
9	Output	OSCIN	
10	—	V_{SS}	Connect to system GND.
11	Output	VMON	High level is output when one of the VR, VG, or VB character signal outputs is high.
12	Output	VR	Character data output pin. Three-system output can be selected on a character basis. Active high output.
13		VG	
14		VB	
15	Output	V_{BLKR}	Blanking signal output for cutting the video signal. Active high output.
16		V_{BLKG}	
17		V_{BLKB}	
18	Input	$\overline{\text{VSYNC}}$	Vertical sync input. Active low input.
19	Input	$\overline{\text{HSYNC}}$	Horizontal sync input. Active low input.
20	Input	$\overline{\text{HOLD}}$	Low level input stops the oscillator. At this time, VR, VG, VB, and V_{BLK} outputs all go low. (This input is normally high.)

● Input/output circuits

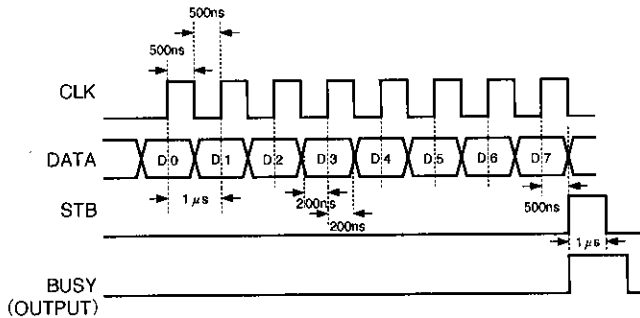


●Serial data timing

The control commands are in 8-bit serial input format. After the eight bits of command data have been input, a STB pulse is input to execute the command.

The data is read into a shift register on the rising edge of the CLK signal, and copied to the other registers on the

rising edge of the STB signal. In the case of formatted data, the BUSY signal falls after the internal state has stabilized completely. When the data is written to VRAM, the BUSY signal falls when the data write operation is complete.



●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{DD}	-0.3~7.0	V
Power dissipation	P _D	750*	mW
Operating temperature	T _{stg}	-50~150	°C
Storage temperature	T _{opr}	-20~75	°C
Pin voltages	—	-30~V _{DD} 0.3	V

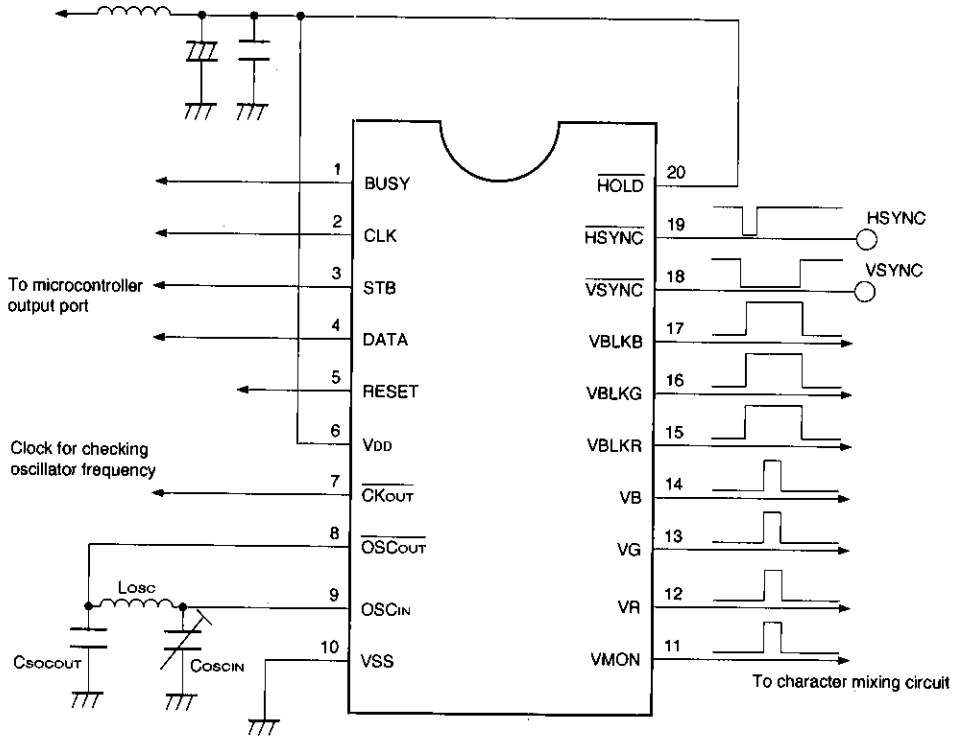
* Reduced by 6.0mW for each increase in Ta of 1°C over 25°C.

●Electrical characteristics (Unless otherwise specified: Ta=25°C and V_{DD}=5V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Operating voltage	V _{DD}	—	5	—	V	
"L" input voltage	V _{IL2}	0	—	0.3V _{DD}	V	For CMOS input
"H" input voltage	V _{IH2}	0.7V _{DD}	—	V _{DD}	V	For CMOS input
"L" output voltage	V _{OL1}	—	—	0.4	V	For OSC
"H" output voltage	V _{OH1}	4.6	—	—	V	For OSC
"L" output voltage	V _{OL2}	0	—	0.4	V	I _{OL} ≤ 2mA
"H" output voltage	V _{OH2}	4.6	—	—	V	I _{OH} ≤ 1mA
Input leakage current	I _{LI}	—	—	1	µA	
Output leakage current	I _{LO}	—	—	10	µA	
Input pullup resistance	I _{IR}	—	28	70	kΩ	Pullup input
Operating current	I _{DD}	—	—	10	mA	

©Not designed for radiation resistance.

●Application example



● Command format

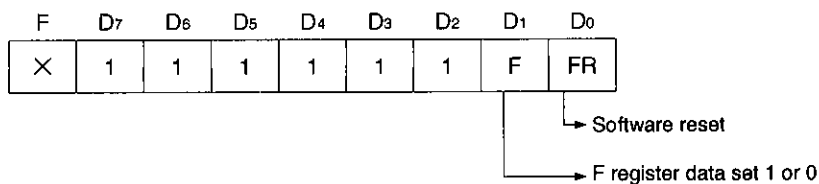
The control command format is 8-bit serial data.

After the eight bits of data for the command have been input, a STB pulse is input to execute the command.

Content	F	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀
Display character data	0	0	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀
Character unit, blink data	0	1	0	0	0	Blink	R	G	B
Character display line address	0	1	0	0	1	AR ₃	AR ₂	AR ₁	AR ₀
Character display column address	0	1	0	1	AC ₄	AC ₃	AC ₂	AC ₁	AC ₀
Background specification	0	1	1	0	BS ₄	BS ₃	RB	GB	BB
Blinking, dot oscillation control and display ON/OFF	0	1	1	1	0	D ₀	BL ₂	BL ₁	OSC
Character code, bank switch *1	0	1	1	1	1	0	1	0	A
Frame control	0	1	1	1	1	0	0	E _{g1}	0
Format specification	X	1	1	1	1	1	1	F	FR
Display position vertical address	1	0	1	0	V ₄	V ₃	V ₂	V ₁	V ₀
Display position horizontal address	1	1	1	0	H ₄	H ₃	H ₂	H ₁	H ₀
Character size specification	1	1	0	M	S ₄	AR ₃	AR ₂	AR ₁	AR ₀
Test mode setting	1	1	1	1	0	T ₃	T ₂	T ₁	T ₀

*1 Only used for the BU2870FS.

• Format set



Software reset (BU2848FS and BU2873FS)

Reset when a "1" is input. The software reset data is not latched. After this command is executed, the following registers are reset.

- Character size register
- test mode set register
- format specification F→0

Data in the other registers is preserved. In the case of the BU2870FS, zeros are written to the RAM.

·Character display column address

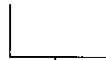
F	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀
0	1	0	1	AC ₄	AC ₃	AC ₂	AC ₁	AC ₀



Specifies the digit address when writing display data.
Do not specify an address outside the range 0H to 17H.
AC₄ to AC₀
MSB LSB

·Background specification

F	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀
0	1	1	0	BS ₄	BS ₃	F	G	B



Background specification

BS ₄	BS ₃	Background
0	0	No background
1	0	Blank background
1	1	Solid background

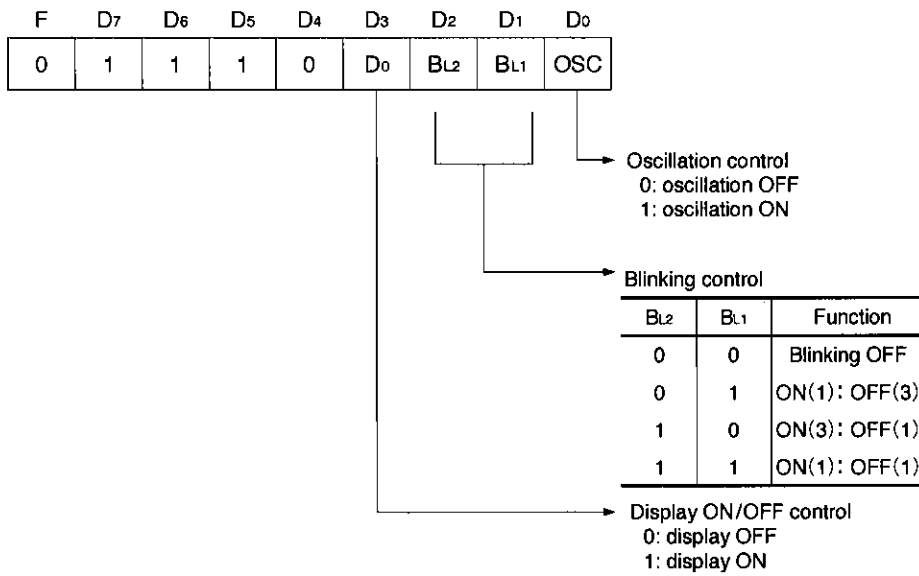
·Frame

F	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀
0	1	1	1	1	0	0	E _{g1}	X

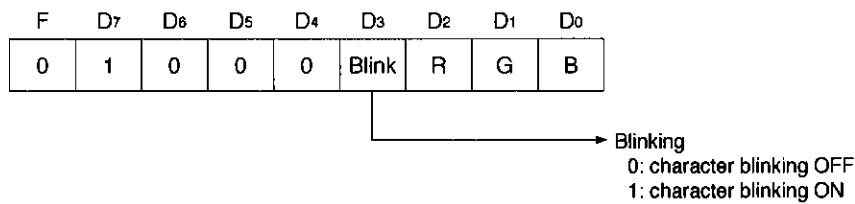
Frame control
0: no border
1: border

●Command format

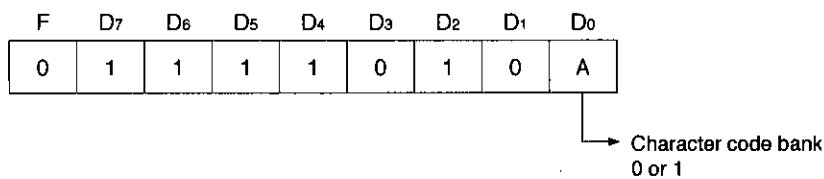
·Blinking, dot oscillation control, and display ON/OFF



·Color and blinking data for each character

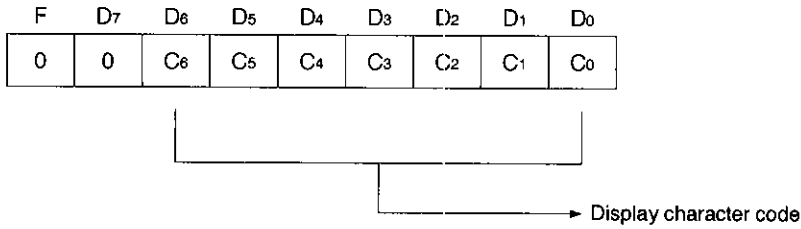


·Character code bank switching

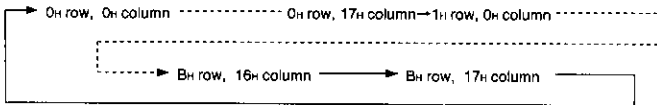
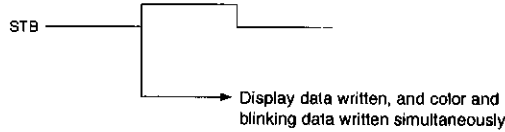


With the BU2870FS, use 0 and 1 to select between the two banks of 128 characters. This command does not apply to the BU2848FS and BU2873FS.

·Writing display data



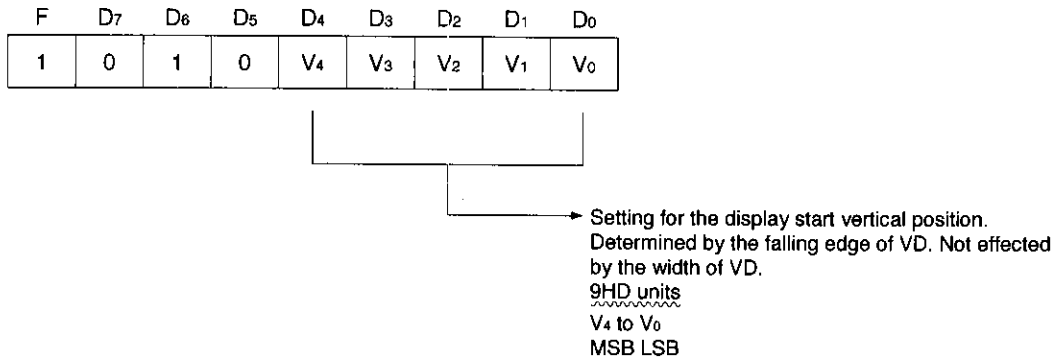
The address counter is incremented after the display data writing is complete.



- * 1) The address counter is incremented after the RAM data is written. It is not effected by the STB pulse width.
- * 2) The BUSY flag is high while the data is being written, but all other commands can be processed simultaneously.

It is possible to change the display position horizontal address and display position vertical address as described below.

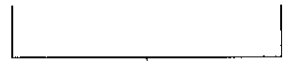
·Display position vertical address



●Command format

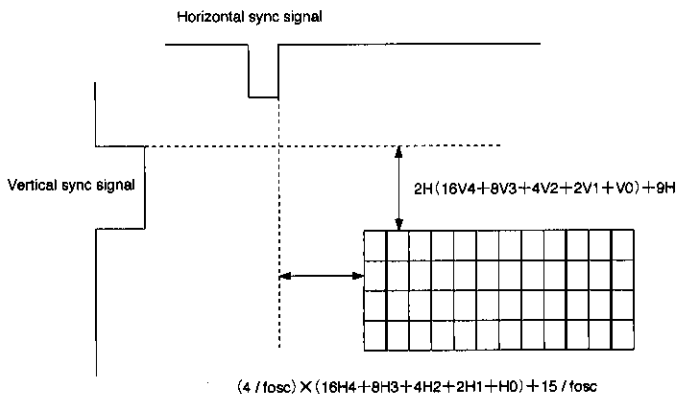
·Display position horizontal address

F	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀
1	1	1	0	H ₄	H ₃	H ₂	H ₁	H ₀



→ Setting for the display start horizontal position.
 Sets the time from the falling edge of HD.
 12 dot units
 H₄ to H₀
 MSB LSB

·The character display address specified by the display position vertical address and display position horizontal address commands is determined as shown in the diagram below.



* When specifying a double-square character, do not specify (H₀, H₁, H₂, H₃, H₄)=(0, 0, 0, 0, 0).

Character display

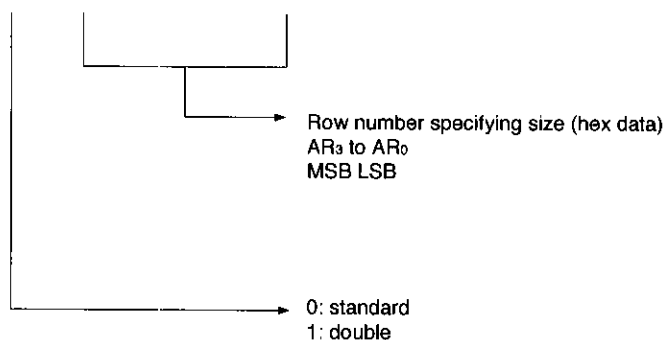
The number of characters that can be displayed is 288 (12 lines×24 characters).

AC0~AC4	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	
AR3 ~AR0	00																								
	01																								
	02																								
	03																								
	04																								
	05																								
	06																								
	07																								
	08																								
	09																								
	0A																								
0B																									

Display RAM address for TV screen

Character size specification

F	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	0	S ₄	AR ₃	AR ₂	AR ₁	AR ₀



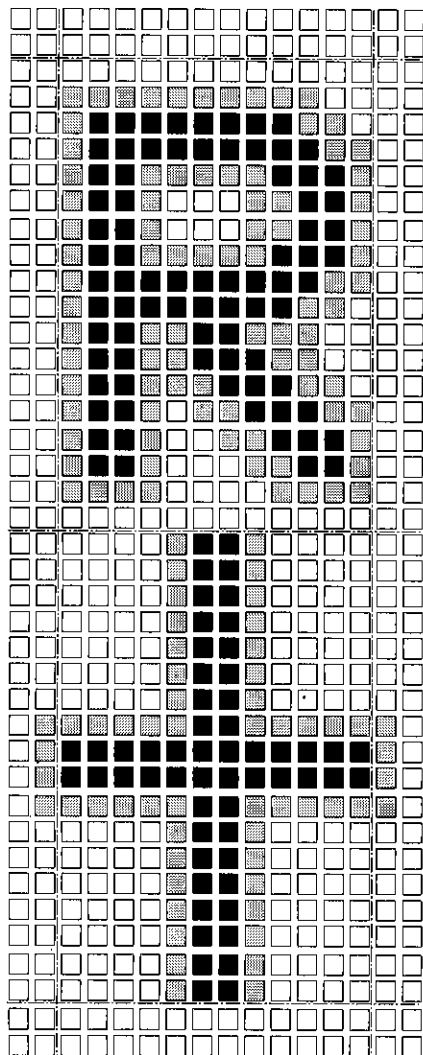
● EPROM address and character data

EPROM Address	[ROM1]							Character data (HEX)	[ROM2]							Character data (HEX)		
	Character data (BIN)								Character data (BIN)									
	A0	A1	A2	A3	A4	A5	A6	A7		A0	A1	A2	A3	A4	A5	A6	A7	
0000	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	00
0001	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	00
0002	0	0	0	0	0	1	1	0	60	0	0	0	0	0	0	0	0	00
0003	0	0	0	0	1	1	1	1	F0	0	0	0	0	0	0	0	0	00
0004	0	0	0	1	1	1	1	1	F8	0	0	0	0	1	0	0	0	01
0005	0	0	1	1	1	0	0	0	80	0	0	0	0	1	1	0	0	03
0006	0	1	1	1	0	0	0	0	0E	0	0	0	0	1	1	0	0	07
0007	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
0008	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
0009	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
000A	0	1	1	1	1	1	1	1	FE	0	0	0	0	1	1	0	0	07
000B	0	1	1	1	1	1	1	1	FE	0	0	0	0	1	1	0	0	07
000C	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
000D	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
000E	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
000F	0	1	1	0	0	0	0	0	06	0	0	0	0	1	1	0	0	06
0010	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	00
0011	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	00
0012	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	00
.				.									.					
.				.									.					
001F	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	00

On-screen displays

Multimedia video

● Frame data

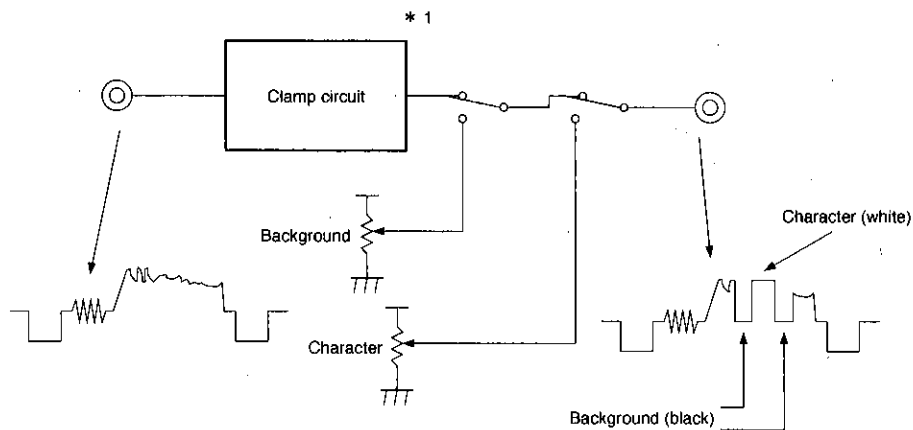


- White
- Character data
- ▨ Border
- - - Character size

The conditions for display of border data are no character data above the cell, and character data in one of the cells above, below, left, right, or diagonally removed from the cell. However, border data is not displayed above character data in the first row, below character data in the 18th row, or when there is character data in the first column. When there is character data in the 12th column, border data is displayed on the right, but when the next character is in the off state, the border is not displayed. In the case of the 24th character, the border data for character data in the 12th column is not displayed. Character blinking is set individually for each character. When there is a border to the left or right in another character's area, blinking does not occur.

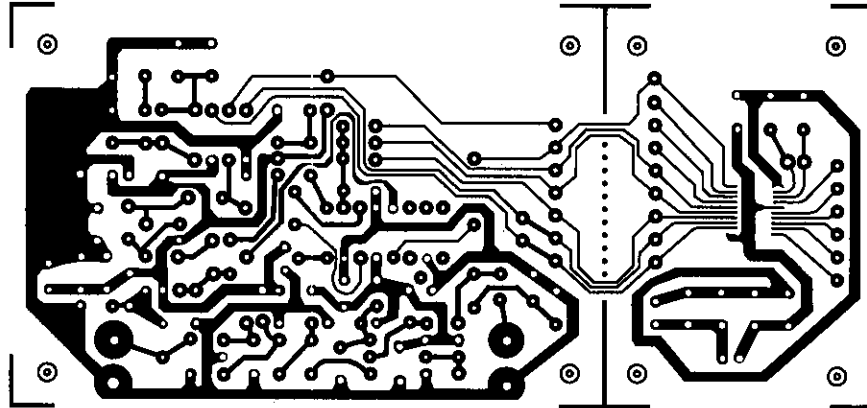
● Character superimposition (black and white)

To superimpose characters on a VCR, either a composite or color difference (component) signal is used. In the case of a composite signal, sync and color signals are included, so caution is required to ensure that the timing does not overlap.

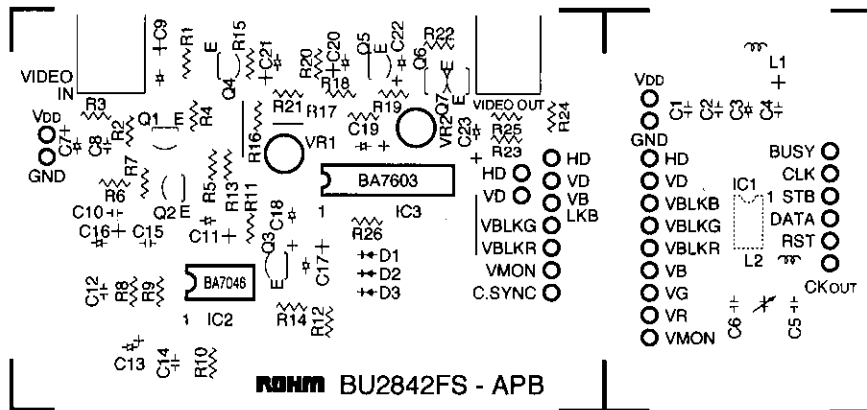


* 1) Composite signals have their level fixed at $1V_{P-P}$, and the DC level is fixed. However, in many cases, the signal used has had its frequency components removed by a capacitor. To superimpose white, gray, and black levels the DC level of the signal to be superimposed must be fixed with reference to the pedestal-level voltage. This is done using a clamp circuit.

●PCB for application example circuit (solder side)

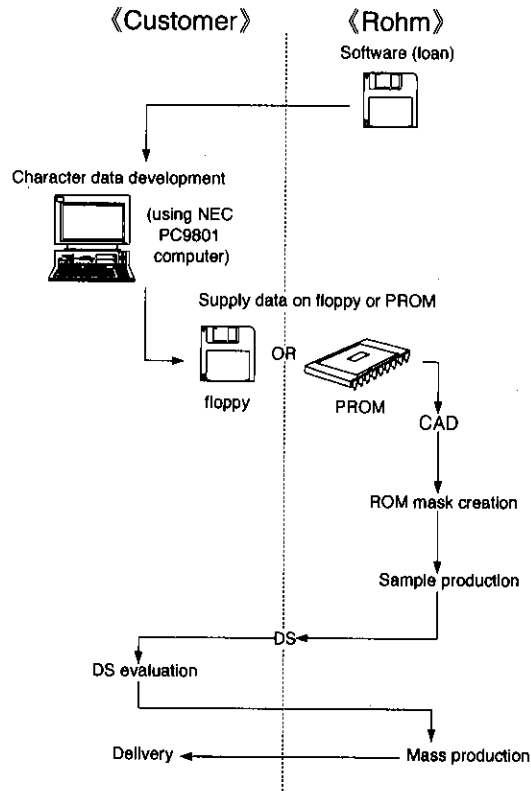


●PCB for application example circuit (component side)

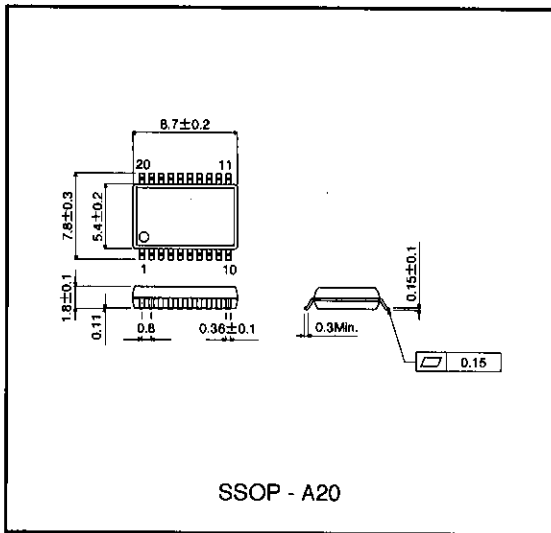


●Development flowchart

★Character data development flowchart



●External dimensions (Units: mm)



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