Data Sheet

Alphanumeric vacuum fluorescent displays

RS stock numbers 206-9001, 206-9017, 206-9023, 206-9039, 206-9045, 206-9067, 206-9073

Introduction

Intelligent, alphanumeric, dot matrix vacuum fluorescent displays with integral display controller, drives and dc/dc converter. The modules utilise an emissive technology to provide a wide viewing angle and bright image. Light is emitted from a wide band blue-green phosphor having a peak wavelength of 550mm. The modules utilise a 5 × 7 dot matrix format and operate from a 5V power supply.

The display controller has a character generator with up to 220 characters. Data communication with a host system is via a serial or parallel interface.

Figures 1 and 2 show the typical construction of a vacuum fluorescent display (VFD), an aluminium wiring pattern, a carbon insulation layer and an anode pattern are printed on a glass base plate. a grid mesh, etched from nickel alloy, is positioned above the anodes. Grid and anodes are connected to the terminal pins via the wiring pattern on the base plate. Filament wires (cathodes) are stretched above the grid and anodes and anchored at each end of the base plate. The complete structure is then sealed in a glass package at 500°C and evacuated to 10^{-7} torr, to ensure free electron movement.

Applications

- Word processing equipment
- Electronic typewriters
- Mechanical instruments
- Point of sale terminals
- Test instruments
- Data terminals.

Features

- Either parallel or serial input can be selected
- 5V power supply
- Brightness controllable levels by using dimming function
- Bright blue-green display
- Modules can be connected to system due directly
- Compact construction.

ATTENTION

OBSERVE PRECAUTIONS FOR HANDLING

ELECTROSTATIC SENSITIVE DEVICES

Figure 1

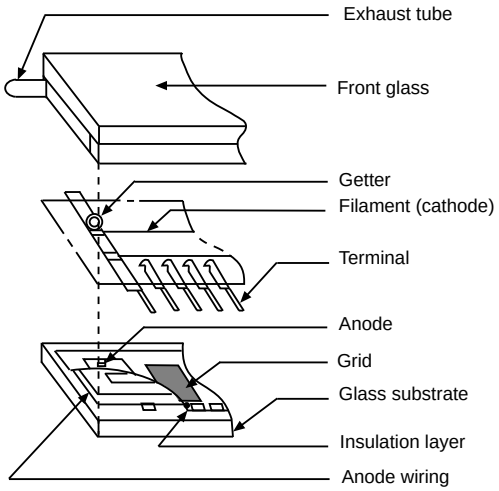
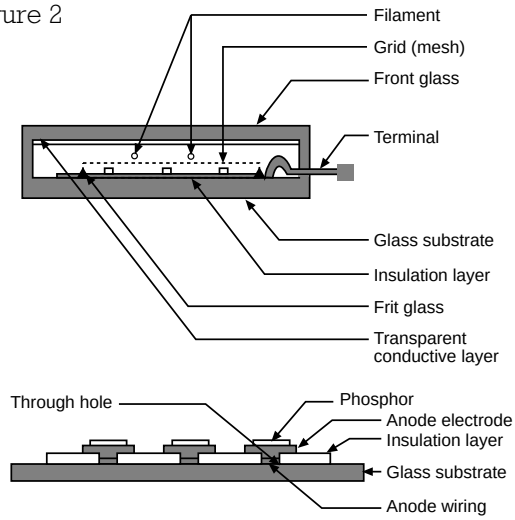


Figure 2



Absolute maximum ratings

Parameter	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	-	6.5	V
Input signal voltage	V_{IS}	-0.3	5.5	V
Operating temperature	T_{op}*	-20	+70	°C
Storage temperature	T_{stg}	-20	+70	°C
Relative humidity (Operating)	H_{op}	20	85	%
Relative humidity (Storage)	H_{stg}	20	90	%

*except 20 × 4, 11.3mm high characters module which is -10°C to +60°C

Electrical characteristics (20 × 1, 5mm high characters,, 40 × 2, 5mm high characters)

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	-	4.5	5.0	5.5	V
Supply current (20 × 1)	I_{CC}	V_{CC} = 5V	-	150	250	mA
Supply current (40 × 2)	I_{CC}	V_{CC} = 5V	-	750	1000	mA
High level input voltage	V_{IH}	V_{CC} = 5V	2.0	-	-	V
High level input current	I_{IH}	V_{CC}= 5.5V	-	-	20	μA
Low level input voltage	V_{IL}	V_{CC}= 5V	-	-	0.8	V
Low level input current	I_{IL}	V_{CC}= 5.5V	-	-	-0.36	mA
High level output voltage	V_{OH}	V_{CC}= 4.5V I_{OH} = 2.6mA	2.4	-	-	V
Low level output voltage	V_{OL}	V_{CC} = 4.5V I_{OL} = 12mA	0.25	-	0.4	V
Luminance	L	V_{CC} = 5V	340	690	-	cd/m^2

20 × 2, 4.16mm high characters, 20 × 2, 4.65mm high characters, 20 × 2, 5.5mm high characters

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	-	4.5	5.0	5.5	V
Supply current (4.16 character)	I_{CC}	V_{CC} = 5V	-	250	350	mA
Supply current (4.65 character)	I_{CC}	V_{CC} = 5	-	350	400	mA
Supply current (5.5 character)	I_{CC}	V_{CC} = 5	-	1000	1500	mA
High level input voltage	V_{IH}	V_{CC} = 5	3.5	-	-	V
High level input current	I_{IH}	V_{CC} = 5.5V	-	-	1	μA
Low level input voltage	V_{IL}	V_{CC} = 5V	-	-	1.5	V
Low level input current	I_{IL}	V_{CC} = 5.5V	-0.22	-0.11	0.05	mA
High level output voltage	V_{OH}	V_{CC} = 4.5V I_{OH} = 0.5mA	3.6	-	-	V
Low level output voltage	V_{OL}	V_{CC} = 4.5V I_{OL} = 0.5mA	-	-	0.9	V
Luminance (4.16 character)	L	V_{CC} = 5V	340	690	-	cd/m^2
Luminance (4.65 & 5.5 character)	L	V_{CC} = 5V	350	700	-	cd/m^2

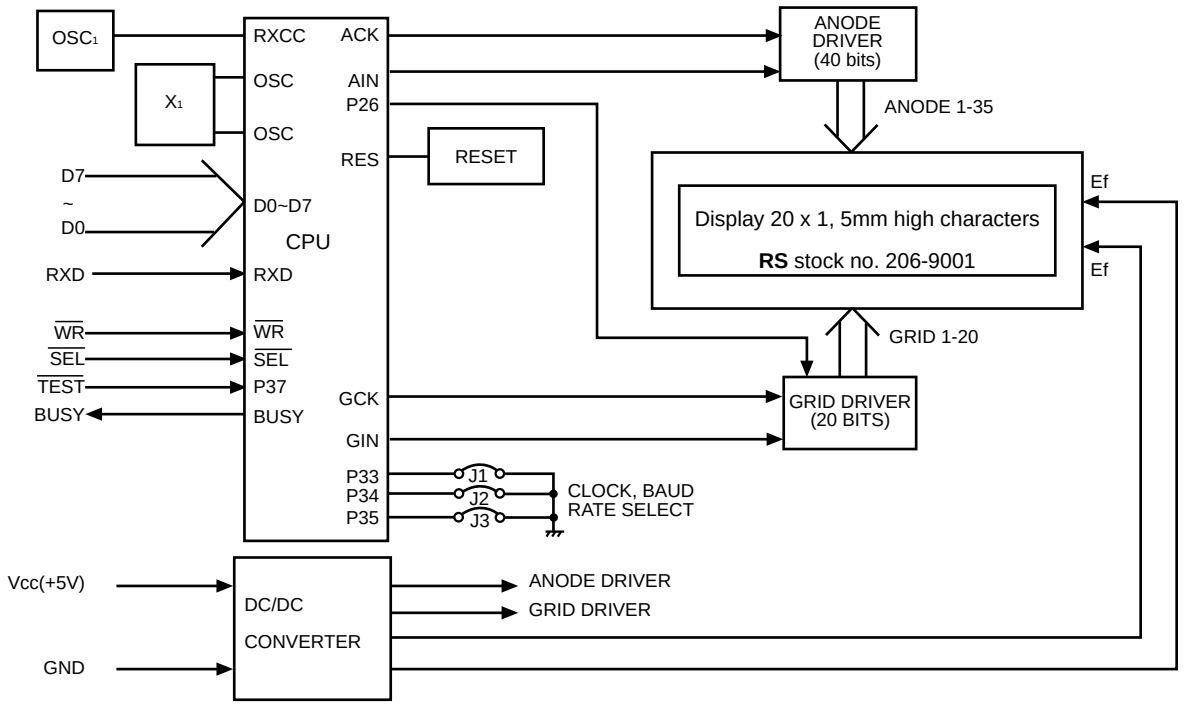
20 × 4, 5mm high characters

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	-	4.5	5.0	5.5	V
Supply current	I_{CC}	V_{CC} = 5V	-	750	1000	mA
High level input voltage	V_{IH}	V_{CC} = 5V	2.0	-	-	V
High level input current	I_{IH}	V_{IH} = 2.0V	-	-	20	μA
Low level input voltage	V_{IL}	V_{CC} = 5V	-	-	0.8	V
Low level input current	I_{IL}	V_{IL} = 0.8V	-	-	-0.4	mA
High level output voltage	V_{OH}	V_{CC} = 5V I_{OH} = 1mA	4.0	-	-	V
Low level output voltage	V_{OL}	V_{CC} = 5V I_{OL} = 4mA	-	-	0.45	V
Luminance	L	V_{CC}= 5V	340	690	-	cd/m^2

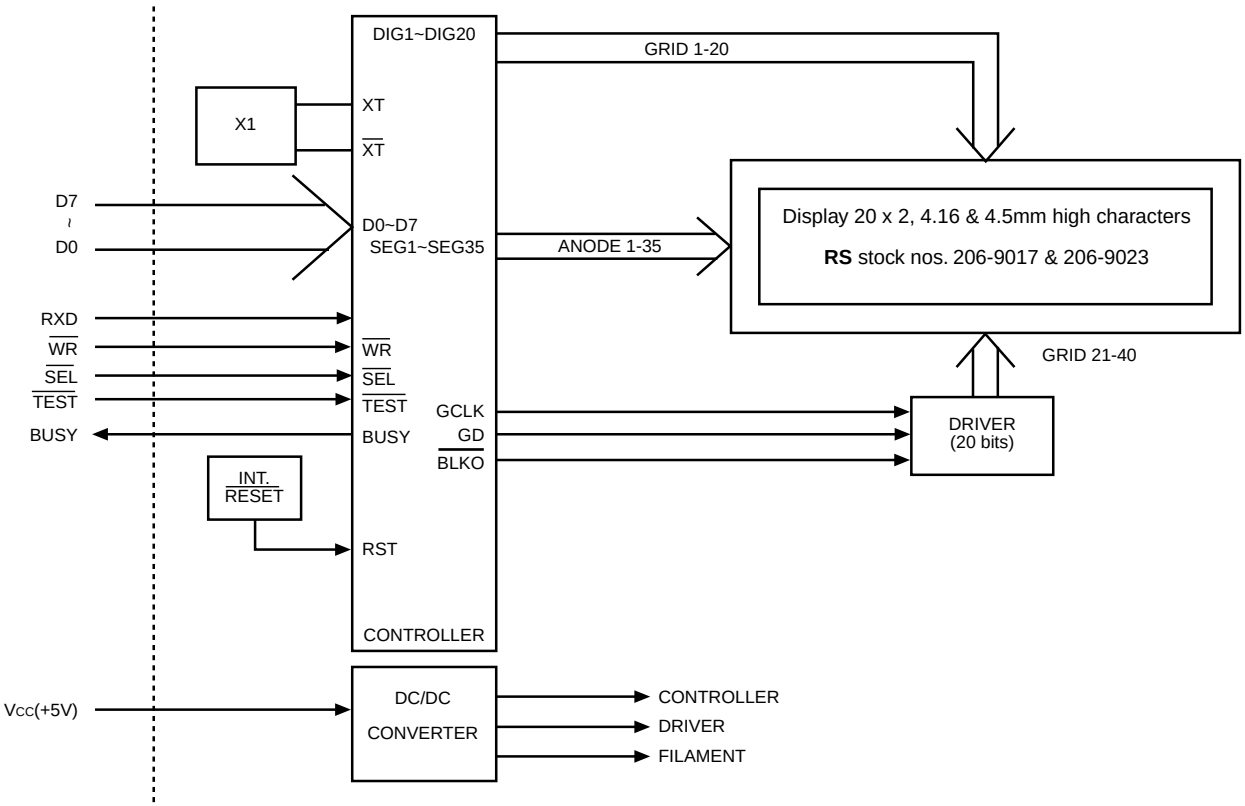
20 × 4, 11.3mm high characters

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	-	4.5	5.0	5.5	V
Supply current	I_{CC}	V_{CC} = 5V	-	2200	2700	mA
High level input voltage	V_{IH}	V_{CC}= 5V	2.6	-	-	V
High level input current	I_{IH}	V_{CC} = 5V	-	-	20	μA
Low level input voltage	V_{IL}	V_{CC}= 5V	-	-	0.5	V
Low level input current	I_{IL}	V_{CC} = 5V	-0.6	-	-	mA
High level output voltage	V_{OH}	V_{CC} = 5V I_{OH} = 2mA	3.5	-	-	V
Low level output voltage	V_{OL}	V_{CC} = 5V I_{OL} = 6mA	-	-	0.5	V
Luminance	L	V_{CC} = 5V	300	600	-	cd/m^2

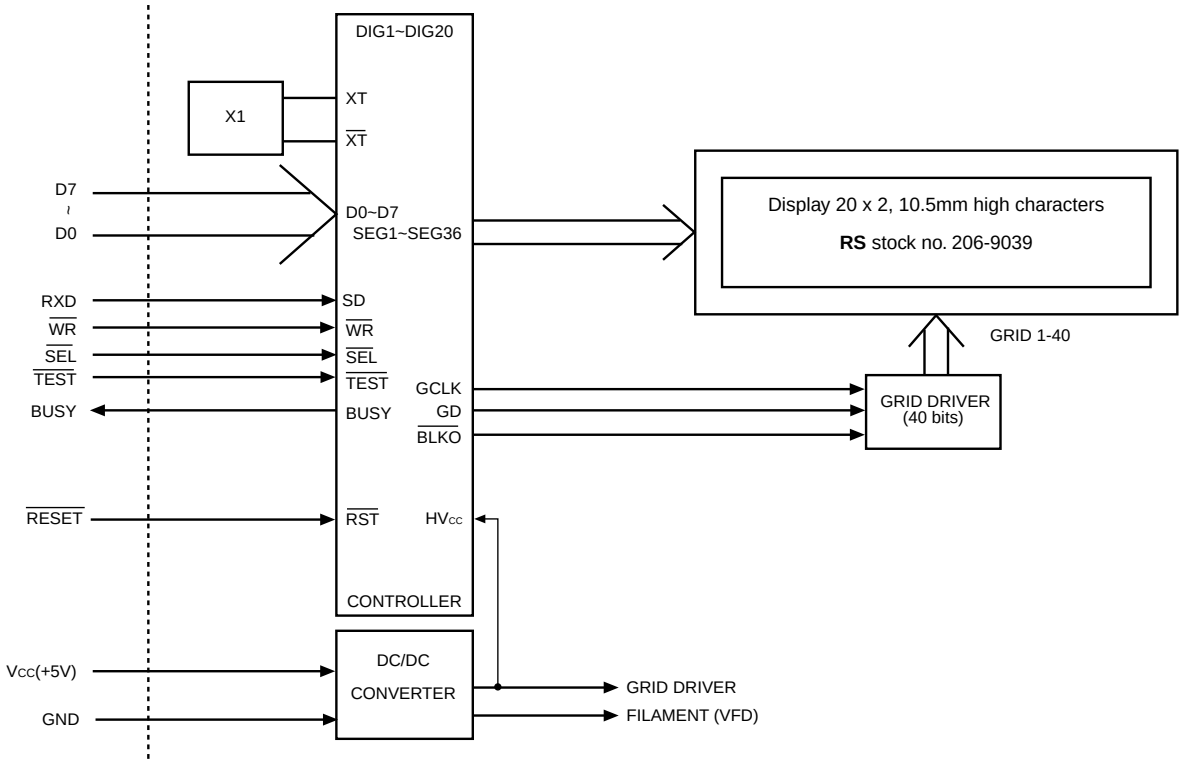
Module block diagram, 20 × 1, 5mm high characters



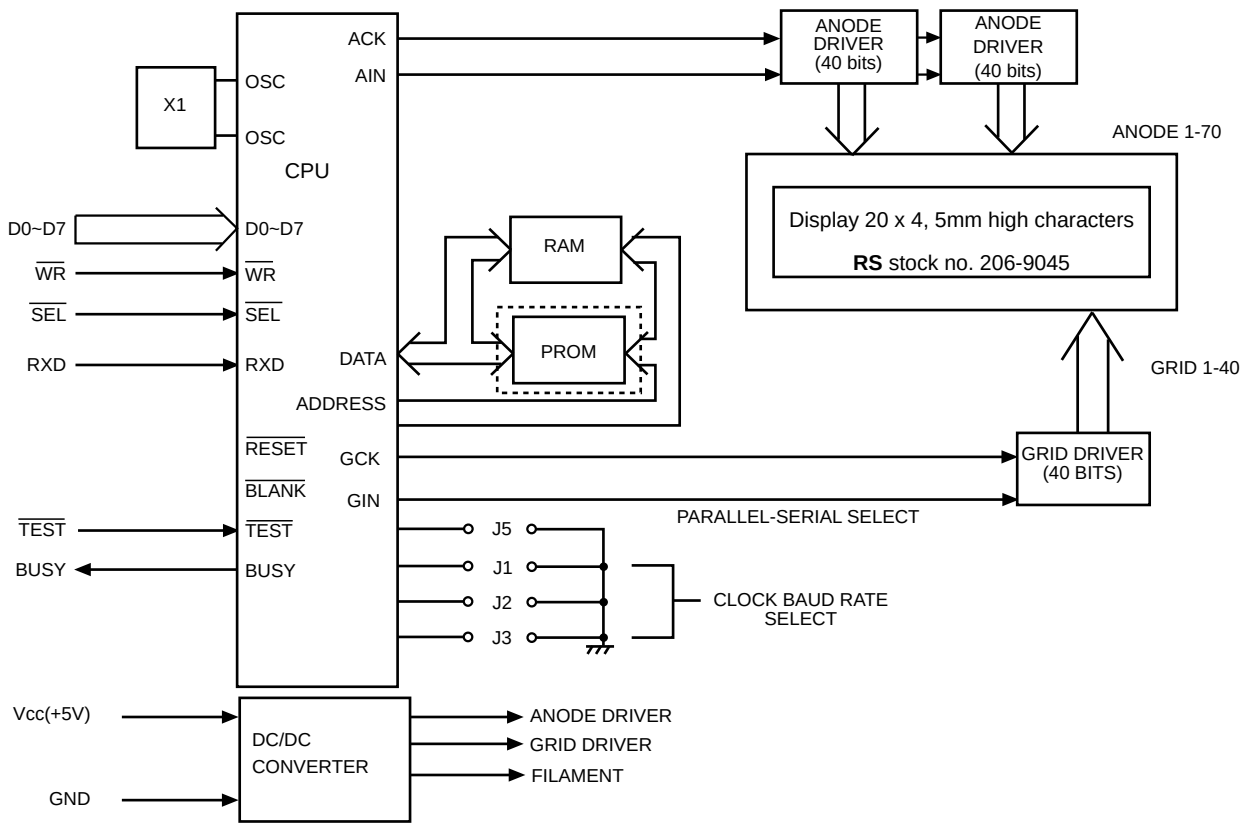
Module block diagram, 20 × 2, 4.16 & 4.65mm high characters



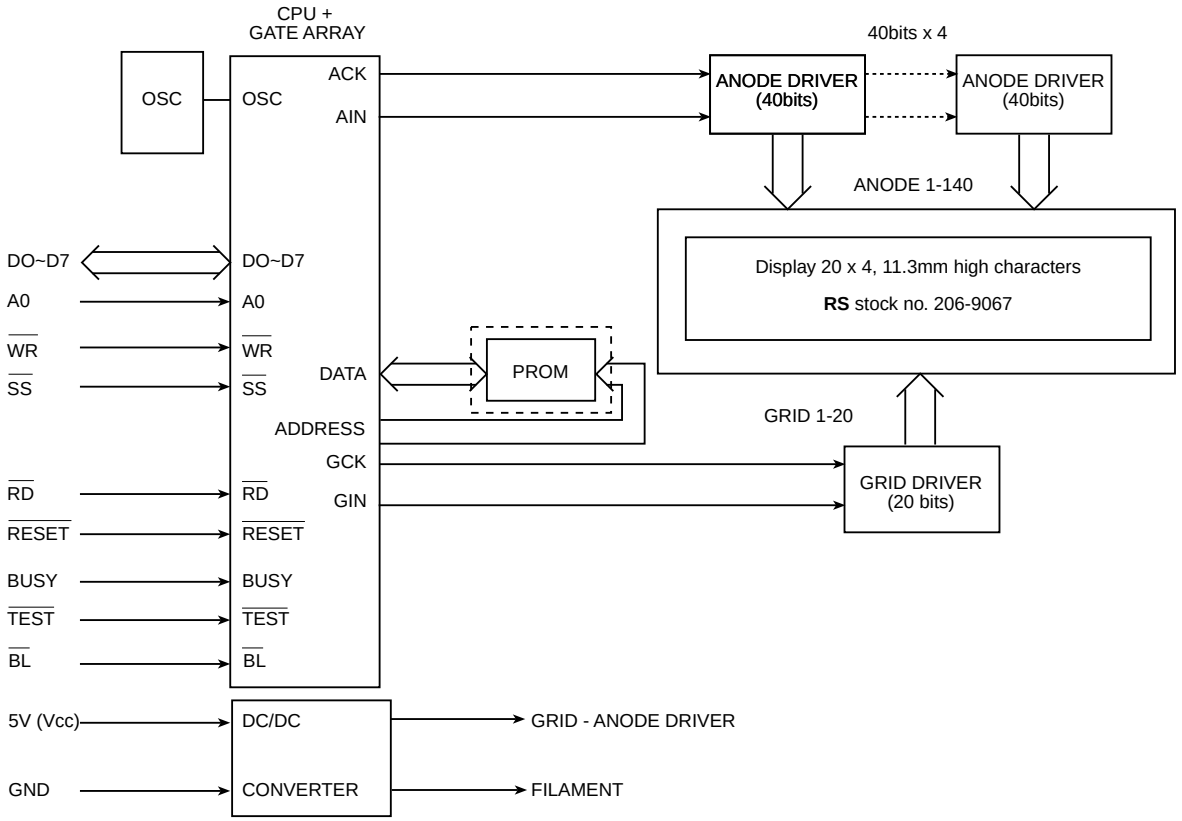
Module block diagram, 20 × 2, 10.5mm high characters



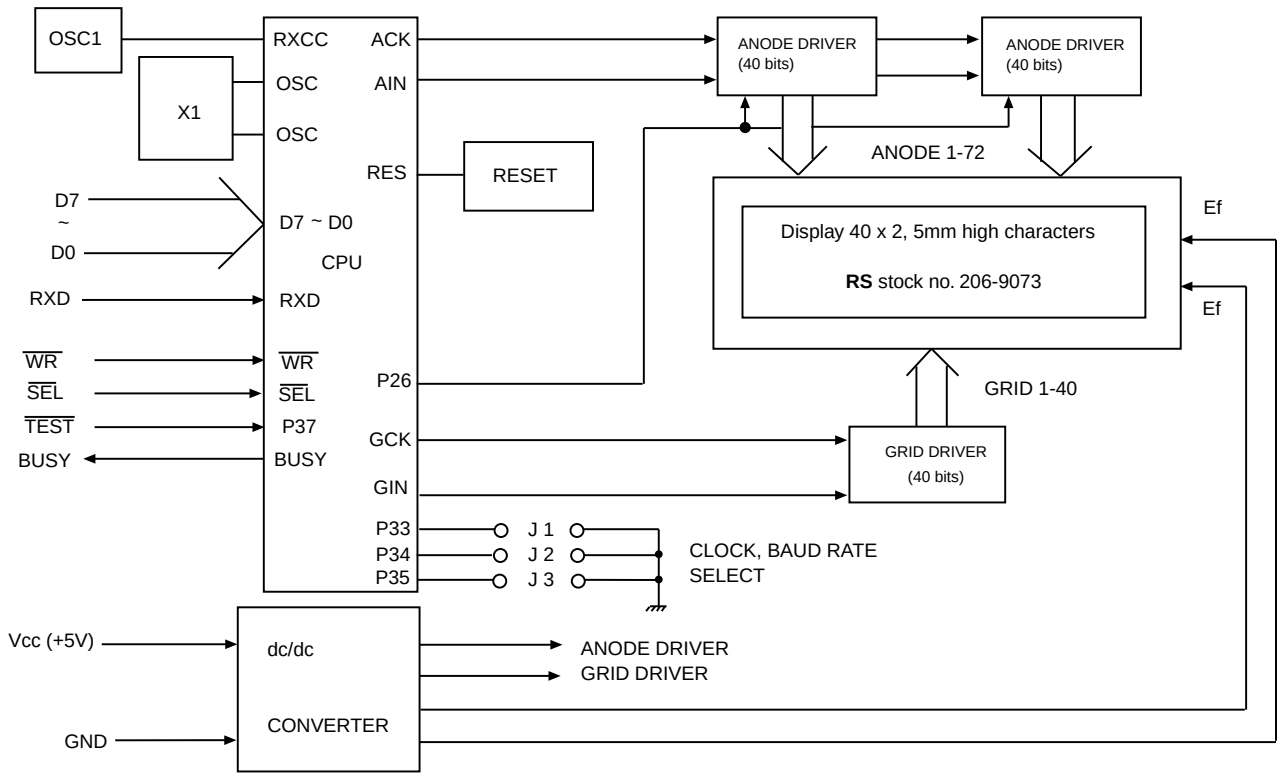
Module block diagram, 20 × 4, 5mm high characters



Module block diagram, 20 × 4, 11.3mm high characters

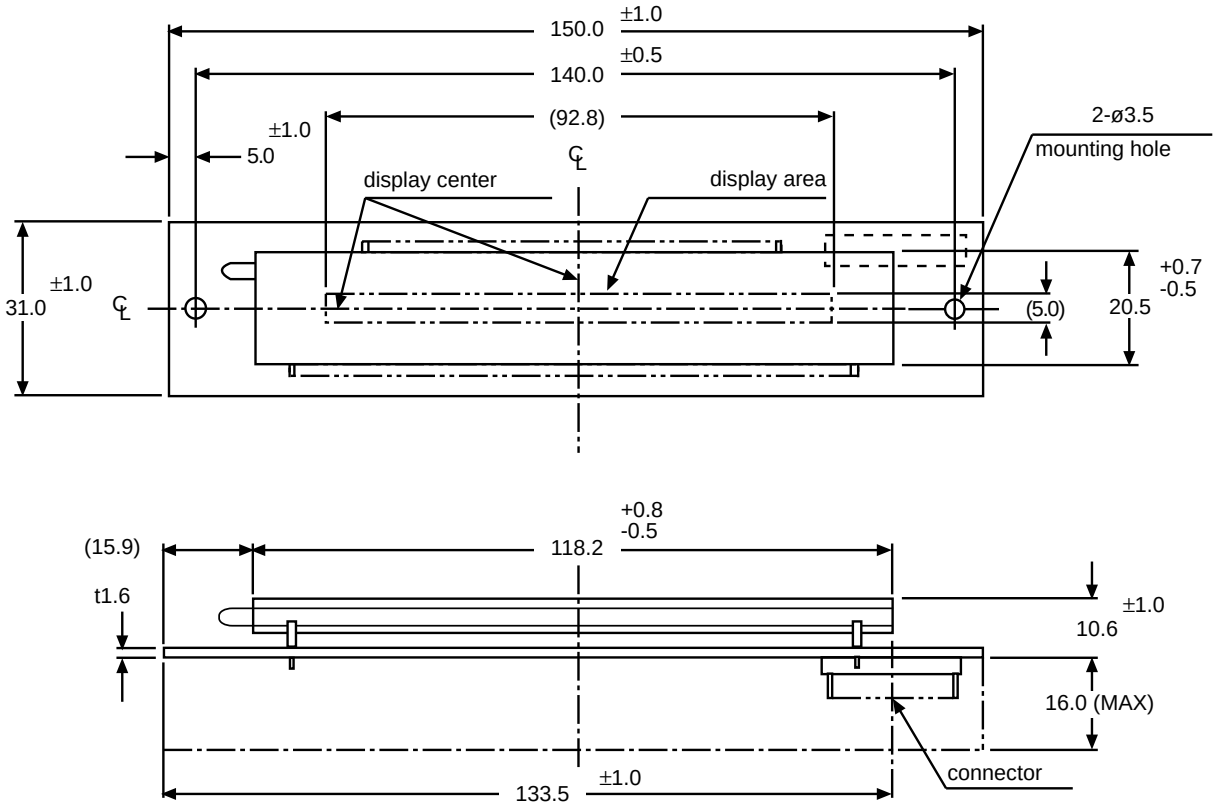


Module block diagram, 40 × 2, 5mm high characters



Mechanical dimensions

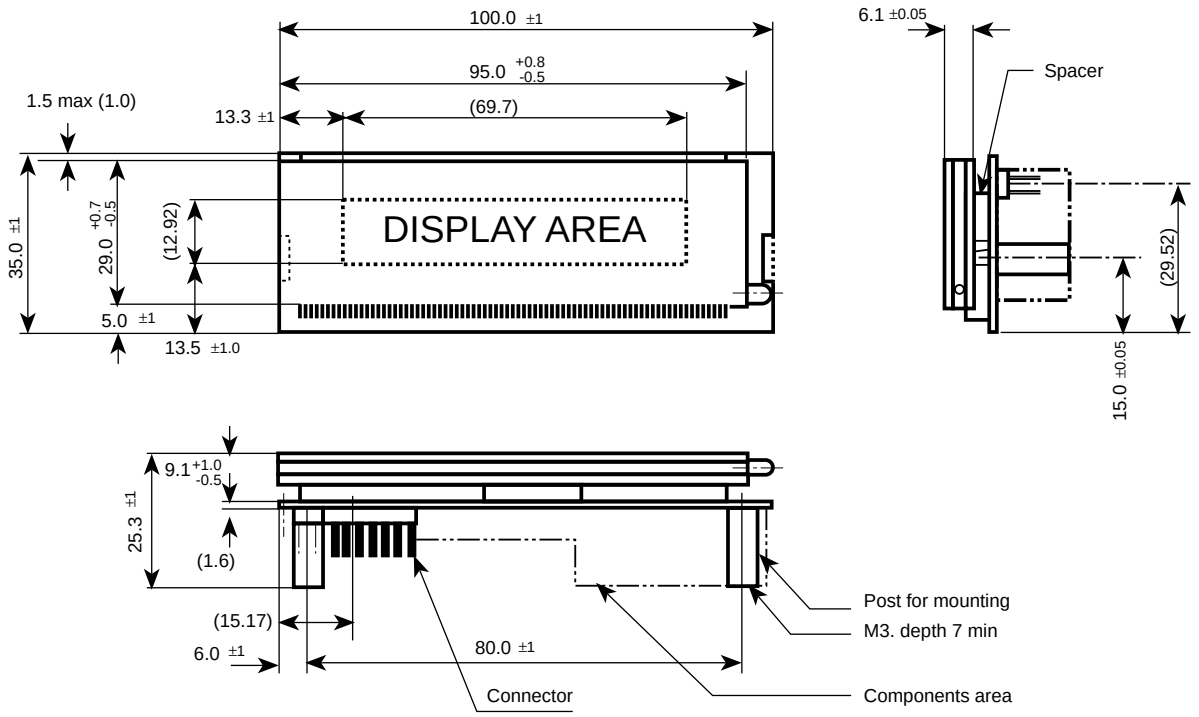
20 × 1, 5mm high characters (**RS** stock no. 206-9001)



Pin no.	Signal	Serial in	Parallel in	Pin no.	Signal	Serial in	Parallel in
1	D7	NC	O	2	+5V	O	O
3	D6	NC	O	4	+5V	O	O
5	D5	NC	O	6	+5V	O	O
7	D4	NC	O	8	GND	O	O
9	D3	NC	O	10	GND	O	O
11	D2	NC	O	12	GND	O	O
13	D1	NC	O	14	GND	O	O
15	D0	NC	O	16	$\overline{\text{TEST}}$	O	O
17	$\overline{\text{WR}}$	NC	O	18	$\overline{\text{SEL}}$	NC	O
19	RXD	O	NC	20	BUSY	O	O

NC : NO-CONNECTION
O : CONNECTION

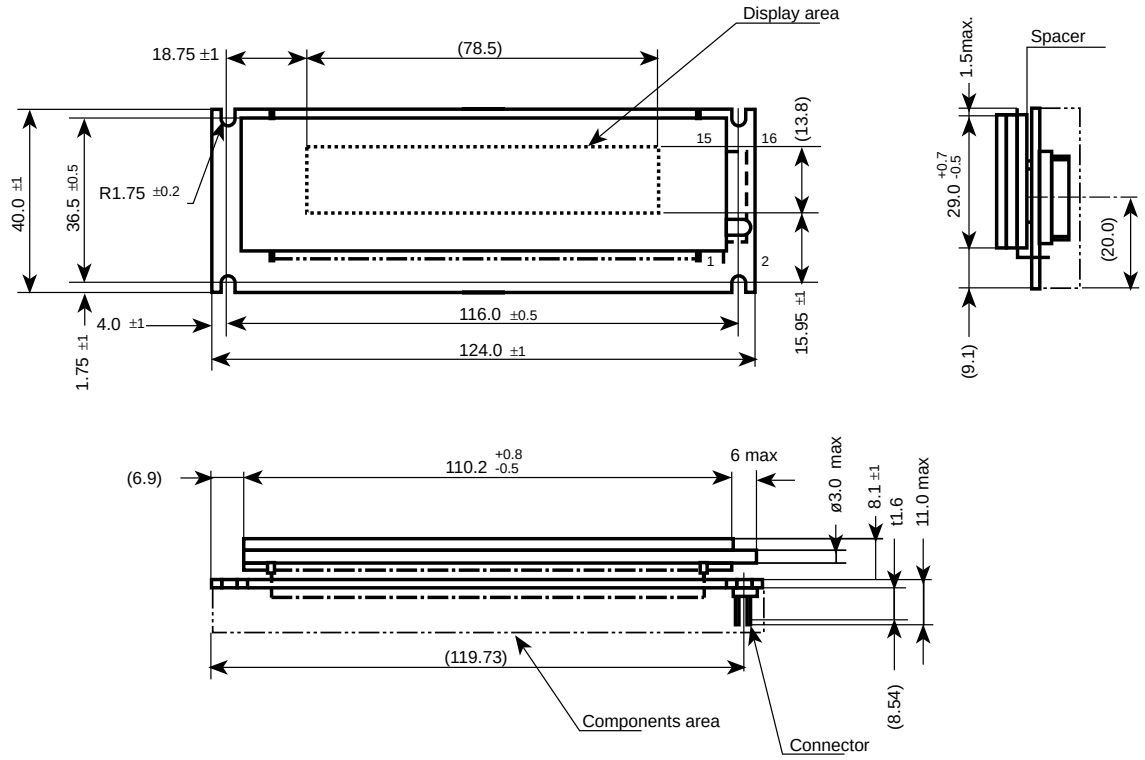
20 × 2, 4.16mm high characters (**RS** stock no. 206-9017)



Pin no.	Signal	Serial in	Parallel in	Pin no.	Signal	Serial in	Parallel in
1	D7	NC	O	2	5V	O	O
3	D6	NC	O	4	5V	O	O
5	D5	NC	O	6	5V	O	O
7	D4	NC	O	8	GND	O	O
9	D3	NC	O	10	GND	O	O
11	D2	NC	O	12	GND	O	O
13	D1	NC	O	14	GND	O	O
15	D0	NC	O	16	$\overline{\text{TEST}}$	O	O
17	$\overline{\text{WR}}$	NC	O	18	$\overline{\text{SEL}}$	NC	O
19	RXD	O	NC	20	BUSY	O	O

NC : NO-CONNECTION
O : CONNECTION

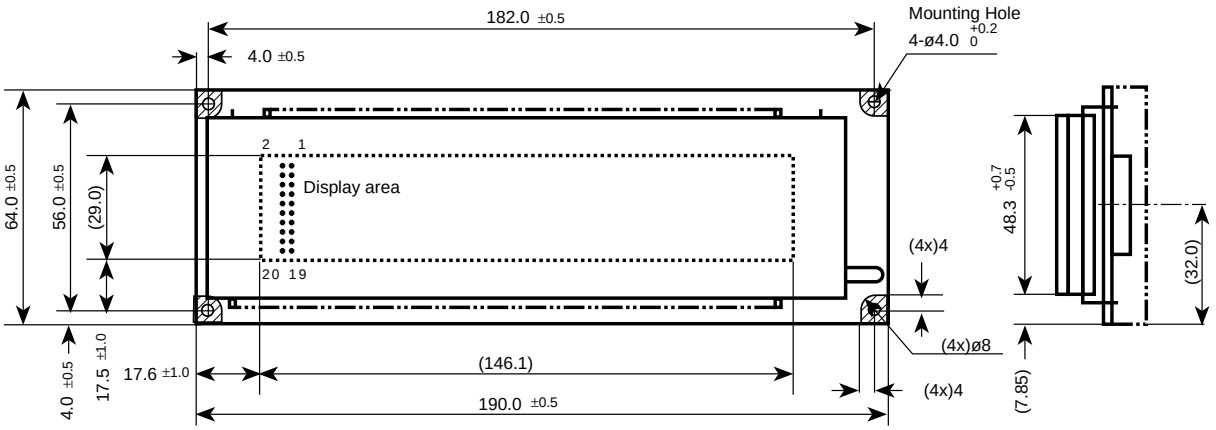
20 × 2, 4.65mm high characters (**RS** stock no. 206-9023)

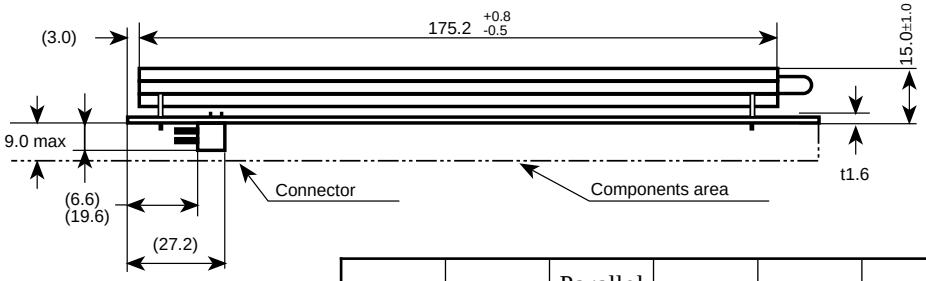


Pin no.	Signal	Serial in	Parallel in	Pin no.	Signal	Serial in	Parallel in
1	D7	NC	O	2	D6	NC	O
3	D5	NC	O	4	D4	NC	O
5	D3	NC	O	6	D2	NC	O
7	D1	NC	O	8	D0	NC	O
9	$\overline{WR}$	NC	O	10	$\overline{SEL}$	NC	O
11	RXD	O	NC	12	BUSY	O	O
13	GND	O	O	14	GND	O	O
15	Vcc	O	O	16	$\overline{TEST}$	O	O

NC : NO-CONNECTION
O : CONNECTION

20 × 2, 10.5mm high characters (**RS** stock no. 206-9039)

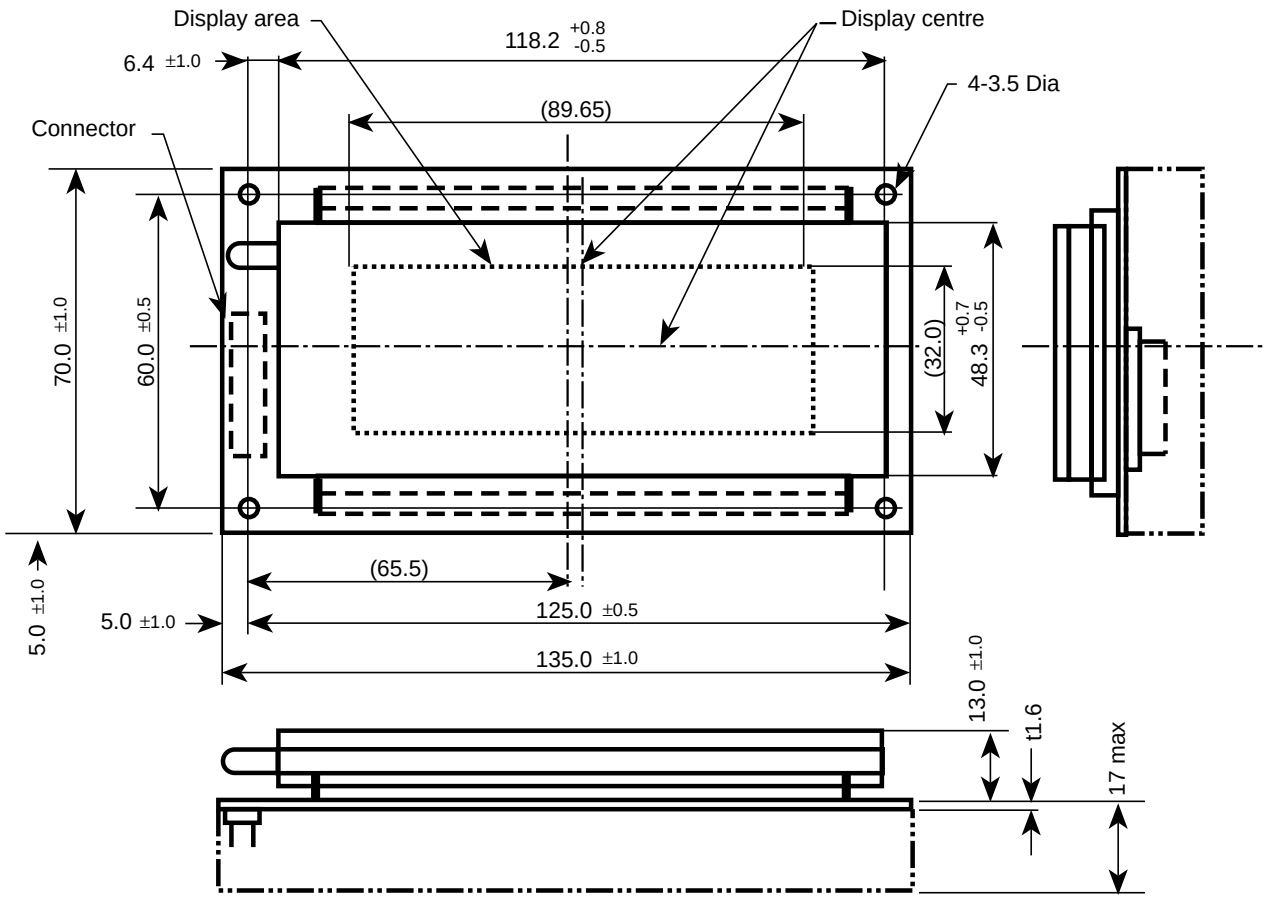




Pin no.	Signal	Parallel in	Serial in	Pin no.	Signal	Parallel in	Serial in
1	D7	O	NC	2	Vcc	O	O
3	D6	O	NC	4	Vcc	O	O
5	D5	O	NC	6	Vcc	O	O
7	D4	O	NC	8	$\overline{\text{RESET}}$	O	O
9	D3	O	NC	10	GND	O	O
11	D2	O	NC	12	GND	O	O
13	D1	O	NC	14	GND	O	O
15	D0	O	NC	16	$\overline{\text{TEST}}$	O	O
17	$\overline{\text{WR}}$	O	NC	18	$\overline{\text{SEL}}$	O	NC
19	RXD	NC	O	20	BUSY	O	O

NC : NO-CONNECTION
O : CONNECTION

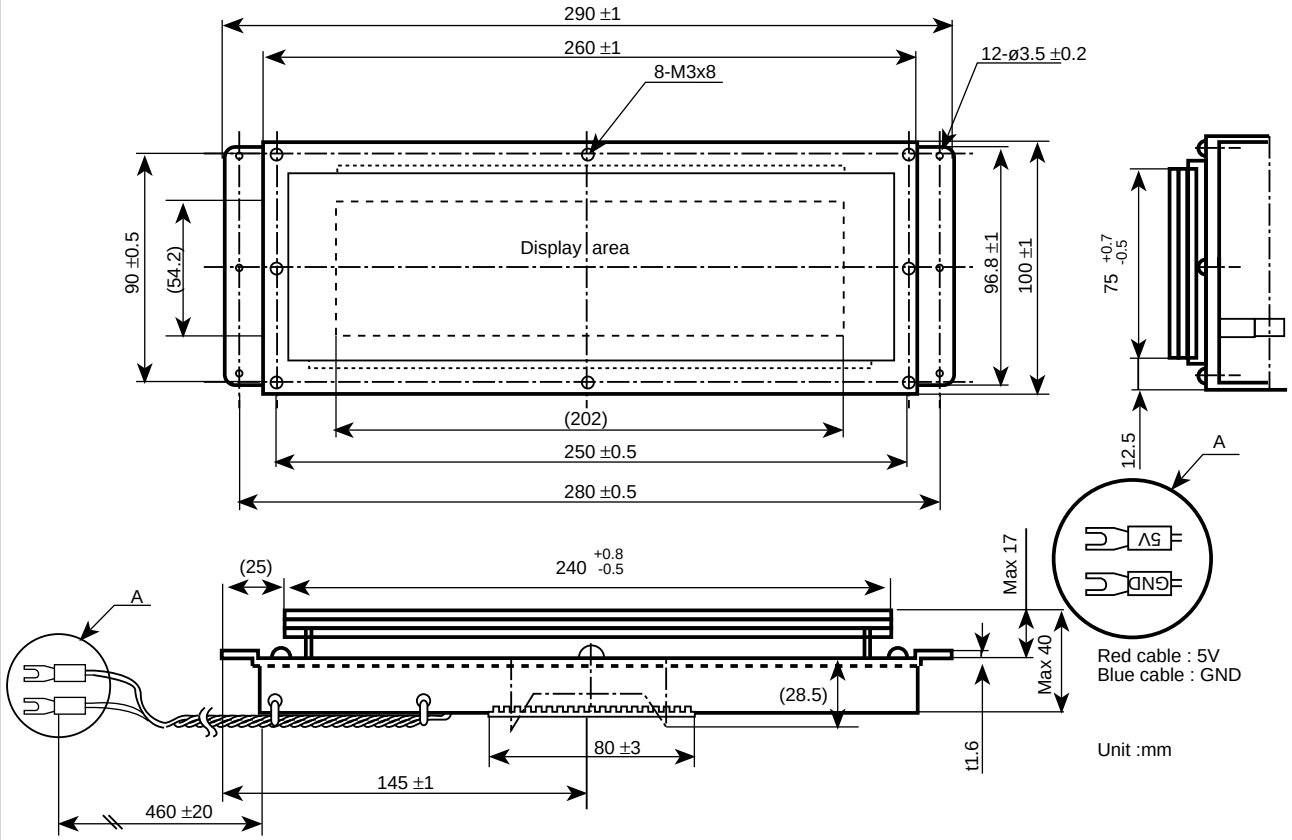
20 × 4, 5mm high characters (**RS** stock no. 206-9045)



Pin no.	Signal	Serial in	Parallel in	Pin no.	Signal	Serial in	Parallel in
1	D7	NC	O	2	+5V	O	O
3	D6	NC	O	4	+5V	O	O
5	D5	NC	O	6	+5V	O	O
7	D4	NC	O	8	GND	O	O
9	D3	NC	O	10	GND	O	O
11	D2	NC	O	12	GND	O	O
13	D1	NC	O	14	GND	O	O
15	D0	NC	O	16	$\overline{\text{TEST}}$	O	O
17	$\overline{\text{WR}}$	NC	O	18	$\overline{\text{SEL}}$	NC	O
19	RXD	O	NC	20	BUSY	O	O

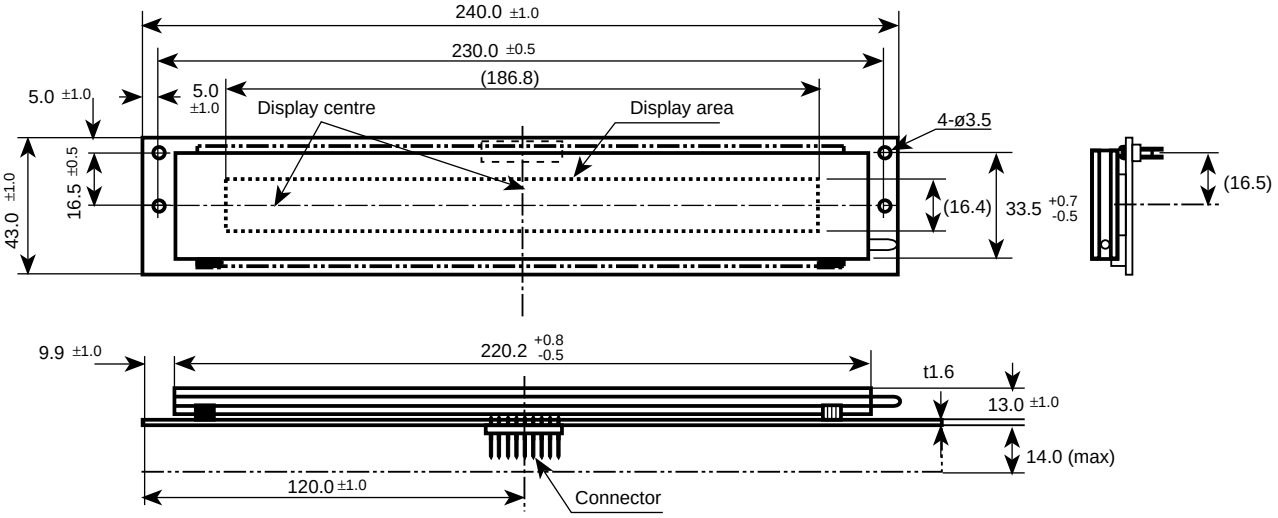
NC : NO-CONNECTION
O : CONNECTION

20 × 4, 11.3mm high characters (**RS** stock no. 206-9067)



Pin no.	Signal	Pin no.	Signal
1	D7	2	GND
3	D6	4	GND
5	D5	6	GND
7	D4	8	GND
9	D3	10	GND
11	D2	12	GND
13	D1	14	GND
15	D0	16	GND
17	$\overline{WR}$	18	GND
19	A0	20	GND
21	$\overline{RD}$	22	GND
23	$\overline{SS}$	24	GND
25	$\overline{TEST}$	26	GND
27	BUSY	28	GND
29	$\overline{BL}$	30	GND
31	$\overline{RESET}$	32	GND
33	NC	34	GND

40 x 2, 5mm high characters (**RS** stock no. 206-9073)



Pin no.	Signal	Serial in	Parallel in	Pin no.	Signal	Serial in	Parallel in
1	D7	NC	O	2	+5V	O	O
3	D6	NC	O	4	+5V	O	O
5	D5	NC	O	6	+5V	O	O
7	D4	NC	O	8	GND	O	O
9	D3	NC	O	10	GND	O	O
11	D2	NC	O	12	GND	O	O
13	D1	NC	O	14	GND	O	O
15	D0	NC	O	16	$\overline{\text{TEST}}$	O	O
17	$\overline{\text{WR}}$	NC	O	18	$\overline{\text{SEL}}$	NC	O
19	RXD	O	NC	20	BUSY	O	O

NC : NO-CONNECTION
O : CONNECTION

Functions

The modules have data and control code write, self test and power on reset functions.

Data and control code write-in

20 × 1, 5mm character height (RS stock no. 206-9001)
40 × 2, 5mm character height (RS stock no. 206-9073)

$\overline{TEST}$	$\overline{WR}$	$\overline{SEL}$	FUNCTION
1 or open	0 → 1	0	Data and control code write
0	-	-	Self test mode

20 × 2, 4.16mm character height (RS stock no. 206-9017)

	$\overline{TEST}$	$\overline{SEL}$	$\overline{WR}$	$\overline{RXD}$	Function
Parallel and Serial interface	L	H or L	H or L	H or L	Self test
Parallel interface	H or NC	L	↑	NC	Data and control code write in
Serial interface	H or NC	NC	NC	*	Data and control code write in

L : Low level (0V)
H : High level (5V)
NC : non connection
↑ : low to high transition
* : RXD (Serial input)

20 × 2, 4.65mm character height (RS stock no. 206-9023)
20 × 2, 10.5mm character height (RS stock no. 206-9039)

	$\overline{TEST}$	$\overline{SEL}$	$\overline{WR}$	$\overline{RXD}$	Function
Parallel and Serial interface	L	H or L	H or L	H or L	Self test
Parallel interface	H or NC	L	↑	NC	Data and control code write in
Serial interface	H or NC	NC	NC	*	Data and control code write in

20 × 4, 5mm character height (RS stock no. 206-9045)

	$\overline{TEST}$	$\overline{SEL}$	$\overline{WR}$	Function
Parallel and Serial interface	0	-	-	Self test mode
Parallel interface	1	0	0	Data and control code write
Serial interface	1	NC	NC	Data and control code write

NC : No connection
0 : Low level (0V)
1 : High level (5V)

20 × 4, 11.3mm character height (**RS** stock no. 206-9067)

$\overline{SS}$	$\overline{WR}$	$\overline{RD}$	A_0	$\overline{BL}$	$\overline{RESET}$	$\overline{TEST}$	BUSY	FUNCTION	Data Bus Direction	
									HOST	MODULE
0	0-1	1	0	-	1	-	0	Data write-in		→
0	0-1	1	1	-	1	-	0	Command write-in		→
0	1	0	-	-	1	-	0	Data read-out	←	
-	-	-	-	0	1	-	0	Blanking		
-	-	-	-	-	0	-	-	Reset		
-	-	-	-	-	-	0	0	Test mode		

When the data is being written in, the Busy signal is active which indicates that the module is processing the data.
(When the module is processing, the BUSY signal is high '1'.)
The data or control command is to be written in at the rising edge of WR (0 → 1), when SEL or A0 = low '0'.
After a character is written in, the write-in position will be shifted to the right one digit automatically.
The above action can be executed only when the BUSY signal is low '0'.

Character fonts

20 × 1, 5mm character height (**RS** stock no. 206-9001)
40 × 2, 5mm character height (**RS** stock no. 206-9073)

D3 D2 D1 D0 \ D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
0 0 0 0	0		DP	SP	0	@	P	‘	p	Ç	È	á	α	§	À	Й	≦
0 0 0 1	1		DC1	!	1	A	Q	a	q	ü	æ	í	β	IE	É	Л	≧
0 0 1 0	2		DC2	"	2	B	R	b	r	é	Æ	ó	γ	IR	Ù	П	≠
0 0 1 1	3		DC3	#	3	C	S	c	s	â	ô	ú	Δ	∫	Ë	У	⊥
0 1 0 0	4	DIM	DC4	$	4	D	T	d	t	ä	ö	ñ	ϵ	x̄	Ï	Ф	∞
0 1 0 1	5			%	5	E	U	e	u	à	ò	Ñ	η	-1	Â	Ц	~
0 1 1 0	6			&	6	F	V	f	v	å	Û	a	θ	2	Ê	Ч	≡
0 1 1 1	7			’	7	G	W	g	w	ç	ù	o	λ	3	Î	Ш	⊕
1 0 0 0	8	BS		(	8	H	X	h	x	ê	y	¿	μ	x	Ô	Щ	⊖
1 0 0 1	9	HT		)	9	I	Y	i	y	ë	Ö	⌐	π	√	Û	Ъ	←
1 0 1 0	A	LF		*	:	J	Z	j	z	è	Ü	¬	ρ	±	Ь	Ы	→
1 0 1 1	B			+	;	K	[	k	{	ï	∉	½	δ		Г	Э	|←
1 1 0 0	C			,	<	L	\	l	¦	î	£	¼	τ		Д	Ю	→|
1 1 0 1	D	CR		-	=	M	]	m	}	ì	¥	¡	ϕ		Ж	Я	‖
1 1 1 0	E			.	>	N	^	n	~	Ä	Pt	⋘	Ω		З		
1 1 1 1	F		RST	/	?	O	_	o	FD	Å	f	⋙	Σ		И	°	

Note: DC4 applies to 40 × 2, 5mm character height (**RS** stock no. 206-9073) only
SP: SPACE
FD: FULL DOT

20 × 2, 4.16mm character height (**RS** stock no. 206-9017)

D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
D3 D2 D1 D0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0		DP	SP													
0 0 0 1																
0 0 1 0																
0 0 1 1																
0 1 0 0	DIM															
0 1 0 1																
0 1 1 0																
0 1 1 1		DC														
1 0 0 0	BS															
1 0 0 1	HT															
1 0 1 0																
1 0 1 1																
1 1 0 0																
1 1 0 1	CLR															
1 1 1 0																
1 1 1 1	ALD	RST														SP

SP = SPACE

20 × 2, 4.65mm character height (**RS** stock no. 206-9023)

D3 D2 D1 D0	D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
0 0 0 0	0		DP	SP	0	@	P	`	p								
0 0 0 1	1			!	1	A	Q	a	q								
0 0 1 0	2			"	2	B	R	b	r								
0 0 1 1	3			#	3	C	S	c	s								
0 1 0 0	4	DIM		$	4	D	T	d	t								
0 1 0 1	5			%	5	E	U	e	u								
0 1 1 0	6			&	6	F	V	f	v								
0 1 1 1	7		DC	'	7	G	W	g	w								
1 0 0 0	8	BS		(	8	H	X	h	x								
1 0 0 1	9	HT		)	9	I	Y	i	y								
1 0 1 0	A			*	:	J	Z	j	z								
1 0 1 1	B			+	;	K	[	k	{					SP			
1 1 0 0	C			,	<	L	\	l	|					SP			
1 1 0 1	D	CLR		-	=	M	]	m	}					SP			
1 1 1 0	E			.	>	N	^	n	~					SP		SP	SP
1 1 1 1	F	ALD	RST	/	?	O	_	o						SP		SP	SP

SP = SPACE

20 × 2, 10.5mm character height (**RS** stock no. 206-9039)

D7 D6 D5 D4		0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
D3 D2 D1 D0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		DP	SP													
0 0 0 1	1																
0 0 1 0	2																
0 0 1 1	3																
0 1 0 0	4	DIM															
0 1 0 1	5																
0 1 1 0	6																
0 1 1 1	7		DC														
1 0 0 0	8	BS	TON														
1 0 0 1	9	HT	TOF														
1 0 1 0	A		TFF														
1 0 1 1	B																
1 1 0 0	C																
1 1 0 1	D	CLR															
1 1 1 0	E																
1 1 1 1	F	ALD	RST														SP

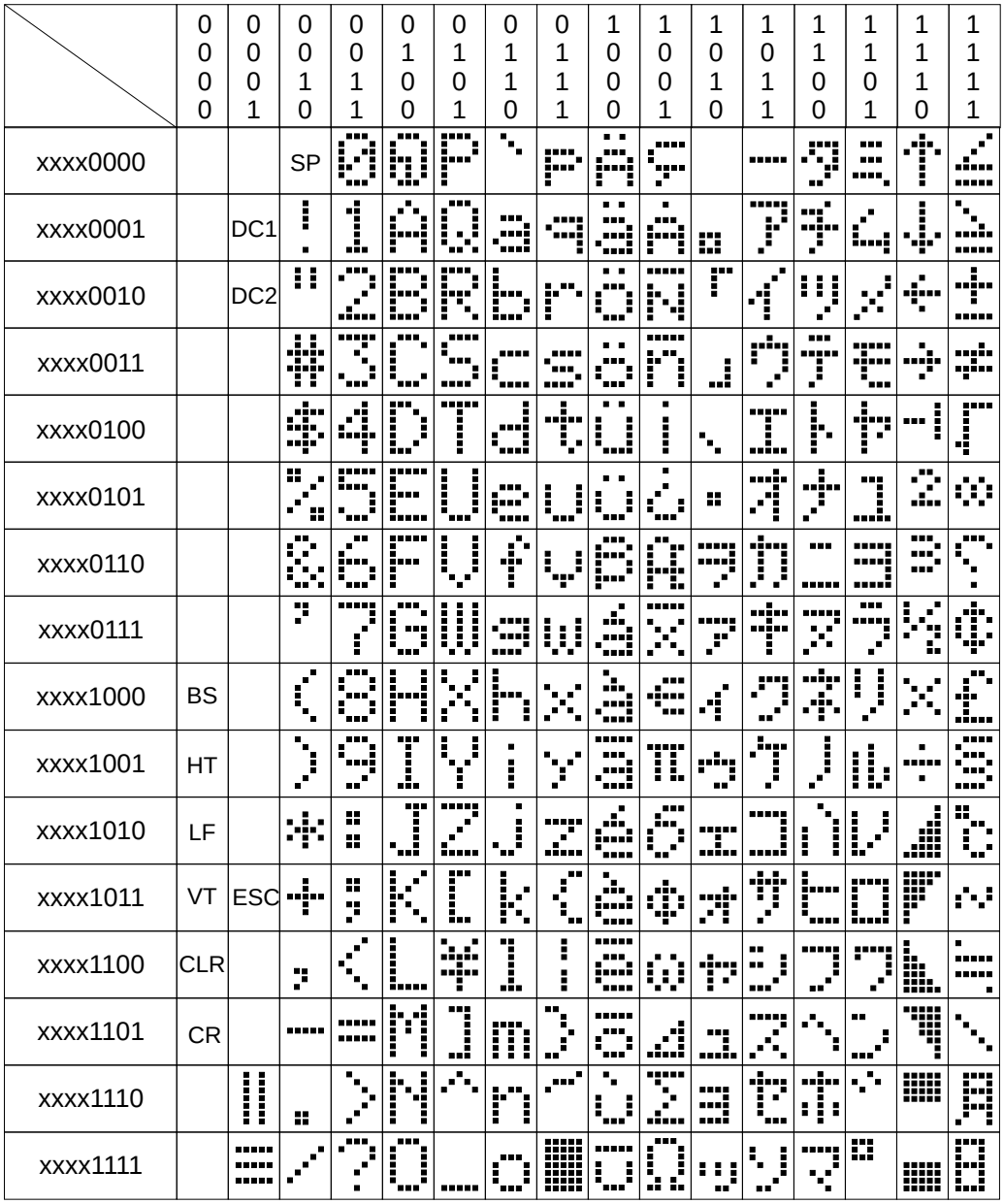
SP = SPACE

20 × 4, 5mm character height (**RS** stock no. 206-9045)

D3 D2 D1 D0	D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		DP														
0 0 0 1	1		DC1														
0 0 1 0	2		DC2														
0 0 1 1	3	DEF															
0 1 0 0	4	DIM															
0 1 0 1	5																
0 1 1 0	6																
0 1 1 1	7																
1 0 0 0	8	BS															
1 0 0 1	9	HT															
1 0 1 0	A	LF															
1 0 1 1	B																
1 1 0 0	C																
1 1 0 1	D	CR												UF0			
1 1 1 0	E													UF1			
1 1 1 1	F		RST											UF2			

SP = SPACE

20 × 4, 11.3mm character height (**RS** stock no. 206-9067)



SP = SPACE

Control code

The control codes are available as follows:

1. DIM: Dimming (04 HEX)
2. BS: Back Space (08 HEX)
3. HT: Horizontal Tab (09 HEX)
4. LF: Line Feed (0A HEX)
5. CR: Carriage Return (0D HEX)

5a. Clear (0D HEX) applies to 20 × 2, 4.16mm character, 20 × 2, 4.65mm character, 20 × 2, 10.5mm character only

6. DP: Display Position (10 HEX)
7. DC1: Normal Display Mode (11 HEX)

7a. DC1: Auto Carriage Return Mode (11 HEX) 20 × 1 (**RS** stock no. 206-9001 only)

8. DC2: Vertical Scroll Mode (12 HEX)

8a. DC2: Over Write Mode (12 HEX) applies to 20 × 1 (**RS** stock no. 206-9001) only

9. DC3: Cursor On Mode (13 HEX)

9a. DC3: Horizontal Scroll Mode (13 HEX) applies to 20 × 1 (**RS** stock no. 206-9001 only)

10. DC4: Cursor Off Mode (14 HEX)
11. RST: Reset (1F HEX)
12. DC: Cursor Mode (17 HEX)
13. ALD: All Display (0F HEX)
14. TON: Triangle Mark On
15. TOF: Triangle Mark Off
16. Triangle Mark All Off
17. Define Characters UFO~2 (03 HEX)
18. VT: Vertical Tab (OBHEX)
19. ESC: Escape (1BHEX)

1. DIM (Dimming)

Brightness can be controlled into either four or five levels dependent upon module by using this function. After writing 04H, another HEX byte is written to change the brightness output, see below.

1byte	+	1 byte
(DIM command code), 04H		Dimming level data

20 × 1 (**RS** stock no. 206-9001)

20 × 4, 5mm character height (**RS** stock no. 206-9045)

40 × 2 (**RS** stock no. 206-9073)

Dimming level	Data
100%	FFH
60%	60H
40%	40H
20%	20H

20 × 2, 4.16mm character height (**RS** stock no. 206-9017)

20 × 2, 4.65mm character height (**RS** stock no. 206-9023)

20 × 2, 10.5mm character height (**RS** stock no. 206-9039)

Dimming level	Data
100%	FFH
80%	80H
60%	60H
40%	40H
20%	20H
0%	00H

2. BS (Back Space)

DC1 MODE: The cursor position (write-in position) is shifted to the left one digit, (beyond this point, the position of the cursor is identical with write-in position of the display, unless otherwise specified. Under DC4 MODE, the cursor will not show up).

When the cursor is on the most significant digit of the second row, the cursor moves to the least significant digit of the first row.

When the cursor is on the most significant digit of the second row, the cursor moves to the least significant digit of the first row.

DC2 MODE: The same as above

4 row displays

The write-in position is shifted to the left one digit, (beyond this point, the position of write-in position is identical with write-in position of the display, unless otherwise specified. Under DC8 MODE, the write-in position will not show up).

When the write-in position is on the most significant digit of the third row, the write-in position moves to the least significant digit of the second row.

When the write-in position is on the most significant digit of the first row, the write-in position moves to the least significant digit of the fourth row.

3. HT (Horizontal tab):

DC1 MODE: The cursor position is shifted to the right one digit. When the cursor is on the least significant digit of the first row, the cursor moves to the most significant digit of the second row.

When the cursor is on the least significant digit of the second row, the cursor moves to the most significant digit of the first row.

DC2 MODE: When the cursor is on the least significant digit of the second row, the characters displayed in the second row are shifted up to the first row and the cursor moves to the most significant digit of the second row. Subsequently, the second row is cleared.

4 row displays

DC1 MODE: The write-in position is shifted to the right one digit. When the write-in position is on the least significant digit of the first row, the write-in position moves to the most significant digit of the second row.

When the write in position is on least significant digit of the fourth row, the write in position moves to the most significant digit of the first row.

DC2 MODE: The write in position is shifted to the right one digit. When the write-in position is on the least significant digit of the fourth row, the characters displayed in the fourth row are shifted up to the third row and the write-in position moves to the most significant digit of the fourth row. Subsequently, the fourth row is cleared.

4. LF (Line Feed):

DC1 MODE: The cursor moves up or down to another row staying on the same line.

DC2 MODE: When the cursor is in the second row, the character displayed there, is shifted up to the first row, leaving the cursor at its present position, then the second row is cleared.

When the cursor is in the first row, the same as DC1 MODE operation.

4 row displays

When the write-in position is in the fourth row, the character displayed second to fourth row, is shifted up, leaving the write-in position at its present position, then the fourth row is cleared.

When the write-in position is in first to third row, the write-in position moves down to the row below staying on the same line.

5. CR (Carriage Return):

DC1 MODE: The cursor moves to the most significant digit of the same row.

DC2 MODE: The same as DC1 MODE operation.

5a. CLR (Clear):

All the characters displayed are erased, the write-in position moves to the most significant digit of the first row. But the Dimming level and Cursor Mode are kept.

6. DP (Display Position):

Instead of writing the character from the first digit, the write-in starting position can be pointed by using this function.

After writing 10HEX to prepare the module for this command, another HEX byte is written to specify the position desired.

A third byte representing data is then sent.

Format Char. × Line	Character Height	Row	The most significant digit	The least significant digit
20 × 1	5	-	00HEX	13HEX
20 × 2 20 × 2 20 × 2	4.16 4.65 10.5	1st 2nd	00HEX 14HEX	13HEX 27HEX
20 × 4 20 × 4	5 11.3	1st 2nd 3rd 4th	00HEX 14HEX 28HEX 3CHEX	13HEX 27HEX 3BHEX 4FHEX
40 × 2	5	1st 2nd	00HEX 28HEX	27HEX 4FHEX

7. DC1 (Normal Display Mode)

After writing a character, the cursor is shifted to the right one digit automatically.

When the cursor is on the least significant digit of the first row, the cursor moves to the most significant digit of the second row. When the cursor is on the least significant digit of the second row, the cursor moves to the most significant digit of the first row.

4 row displays

After writing a character, the write-in position is shifted to the right one digit automatically.

When the write-in position is on the least significant digit of the first to third row, the write-in position moves to the most significant digit of the row below.

When the character is displayed on the least significant digit of the fourth row, the write-in position is on the same digit.

And the character code is written in the module next, first, all digits are cleared, second, the character is displayed on the most significant digit of the first row and the write-in position moves to the next digit.

When the power is turned on, this DC1 MODE is selected, and will be held until another mode is selected.

7a. DC1 (Auto Carriage Return)

All the characters displayed are erased, then write-in position is set on the most significant digit.

When a character is written to the least significant digit, the write-in position stays on this digit.

When the next data is written-in, all the characters displayed are erased, and this character is written to the most significant digit.

Then the write-in position is set on the second digit.

8. DC2 (Vertical Scroll Mode)

After writing the characters up to the least significant digit of the second row, all the characters displayed in the second row are shifted to the upper row (first row), clearing the second row:

When the power is turned on, this DC2 MODE is selected, and will be held until another mode is selected.

4 row displays

After writing the characters up to the least significant digit of the fourth row, all the characters displayed in the second to fourth row are shifted to the upper row, clearing the fourth row.

8a. DC2 (Over Write)

The write position is fixed on the least significant digit.

9. DC3 (Cursor On Mode)

The cursor is displayed. When the power is turned on, this DC3 MODE is selected and will be held until another mode (DC4) is selected.

9a. DC3 (Horizontal Scroll)

All the characters displayed are shifted to the left one digit, and a character is written on the least significant digit.

The write-in position is fixed on this digit.

10. DC4 (Cursor OFF Mode)

The cursor will not be displayed.

11. RST (Reset)

Resetting the module.

All the characters displayed are erased, then the write-in position (cursor position) is set on the most significant digit of the first row.

The displaying status is the same as the Power on Reset.

The display mode is set for DC2. The cursor mode is set for DC3,

12. DC (Cursor Mode)

After writing 17 HEX, another HEX byte is written to change the cursor mode.

1 byte	÷	1 byte
(DC5 command Code)		(Select Mode Data)

TABLE 9

Select Mode	Data
Lighting	FFH
Blinking	88H
No Lighting	00H

The cursor is always displayed at the write-in position.

The cursor is formed by the 5 dots located at the bottom of the 5 × 7 dot matrix character font.

The cursor will be displayed as an over writing mode and the behaviour of the cursor under the lighting mode and blinking mode are explained below.

1. Lighting Mode

When the non displayed position is assigned as a write-in position, the cursor will be displayed there.

If a position that already has a character located is assigned, the character will be eliminated and the cursor displayed.

2. Blinking Mode

The cursor will be repeated ON and OFF every 0.3 seconds when the non-displayed position is selected for the write-in position.

If a position that already has a character located is selected (as a write-in position), the character and the cursor will be displayed alternately.

3. No Lighting Mode

The no lighting mode means that the cursor will not be displayed.

When the power is turned on, no lighting mode will be selected automatically.

Therefore, if the cursor is required, DC command shall be sent to select the cursor lighting or blinking mode.

13. ALD (All Display)

The full dots in all digits are displayed.

The dimming level is set for 100%.

To release this mode, the module is turned off or the RST command shall be written.

14. TON (Triangle Mark On)

This command is Triangle Mark control code.

After writing 18 HEX, the successive another HEX byte of data will be accepted as the turn on position.

The most significant digit	The least significant digit
14 HEX	27 HEX

15. TOF (Triangle Mark Off)

This command is Triangle Mark control code.

After writing 19 HEX, the successive another HEX byte of data will be accepted as the turn off position.

The most significant digit	The least significant digit
14 HEX	27 HEX

16. TFF (Triangle Mark All Off)

All the Triangle Mark displayed are erased.

17. DEF (Define UFO~2)

The DEF command defines user definable characters, UFO~2. (up to 3 fonts)

These fonts are stored in the module as follows:

1 byte	1 byte	5 byte
DEF command code (03 H)	Position code (CDH to CFH)	the font data

a) Character font

1-1	2-1	3-1	4-1	5-1
1-2	2-2	3-2	4-2	5-2
1-3	2-3	3-3	4-3	5-3
1-4	2-4	3-4	4-4	5-4
1-5	2-5	3-5	4-5	5-5
1-6	2-6	3-6	4-6	5-6
1-7	2-7	3-7	4-7	5-7

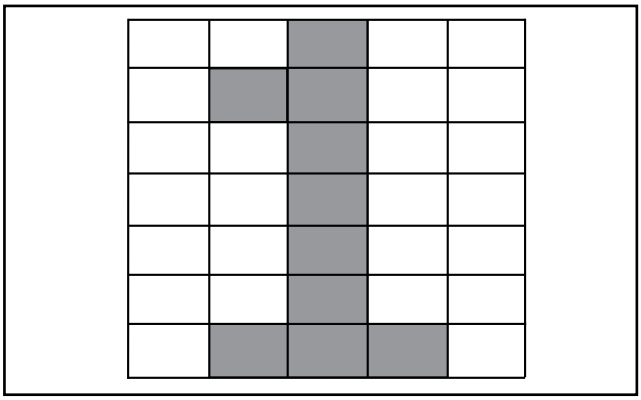
b) Font data

		bit							
		7	6	5	4	3	2	1	0
	1st	1-1	2-1	3-1	4-1	5-1	1-2	2-2	3-2
	2nd	4-2	5-2	1-3	2-3	3-3	4-3	5-3	1-4
Byte	3rd	2-4	3-4	4-4	5-4	1-5	2-5	3-5	4-5
	4th	5-5	1-6	2-6	3-6	4-6	5-6	1-7	2-7
	5th	3-7	4-7	5-7	"0"	"0"	"0"	"0"	"0"

Example of write-in character "1" in UF0.

Control and data strings 03H, FCH, 23H, 08H, 42H, 15H, C0H.

a) Character



b) Font data

		bit							
		7	6	5	4	3	2	1	0
	1st	0	0	1	0	0	0	1	1
	2nd	0	0	0	0	1	0	0	0
Byte	3rd	0	1	0	0	0	0	1	0
	4th	0	0	0	1	0	0	0	1
	5th	1	1	0	0	0	0	0	0

''1'': Turn On

''0'': Turn Off

Defining User's Font

It is recommended to store these definable characters at the initialisation of the module. All the data will remain in the RAM. There is no back-up system of this RAM, therefore, restore the data when the power is off.

18. VT: Vertical Tab

DC1 MODE: The write in position is shifted up one row. When the write in position is in the first row, it moves to the fourth row.

DC2 MODE: The same as DC1 mode operation.

19. ESC: Escape

The write in starting position can be pointed by using this function.

1 BHEX + 1Byte + 1Byte

(control code) (Vertical position) (Horizontal position)

First byte (Vertical)

0000 0000 : 00HEX (1st row)

0000 0001 : 01HEX (2nd row)

0000 0010 : 02HEX (3rd row)

0000 0011 : 03HEX (4th row)

next byte (Horizontal)

0000 0000 : 00HEX (1st digit)

0001 0011 : 13HEX (20th digit)

Self-Test

$\overline{\text{Test}}$ = Low ''0'' (connector pin #16 is connected to GND for all modules except 20 × 4, 11.3mm character height, connector pin #25 is connected to ground) starts the Self-Test. Then the display shows all characters, alphabet, numerics and symbols, in that order.

Eighty (2 × 40) characters are displayed at a time.

Using this mode, neither data write-in nor control code write-in is allowed.

To release this mode, $\overline{\text{TEST}}$ must be set to ''1''.

Power on Reset

When the module is turned on, the display and the memory are cleared and the module is initialised.

The display mode is set for DC2, and the cursor mode is set for DC3.

*For 20 × 1 module the display mode is set for set DC1,

Selection of input mode

The pin connections on the mechanical dimensions drawings show the combinations of the signal lines for the parallel or serial input. User must choose one of the combinations.

Unused signal lines are to be open (internally pulled up).

The tables below shows the combinations of the signal lines for the parallel or serial input.

Baud rate selection

20 × 1, 5mm character height (**RS** stock no. 206-9001)

40 × 2, 5mm character height (**RS** stock no. 206-9073)

In case of serial input, it is possible to choose eight kinds of baud rate by J1~J2 assham below, J3 clock select open: Outside Clock (307.2 KHz) OSC1

short: Internal Clock (4.0 MHz) X1

J1	short	open	short	open
J2	short	short	open	open
J3 short	62500(bps)	31250	15625	7812.5
J3 open	9600	4800	2400	1200

Note: J1, J2 are shorted and J3 is open when a module is supplied (9600bps is selected when serial input is used).

Baud rate selection

20 × 2, 4.16mm character height (**RS** stock no. 206-9017)

In case of serial input, it is possible to choose four kinds of baud rate by J1~J2, as shown, below.

J1	Open	Short	Open	Short
J2	Open	Open	Short	Short
baud rate	9600	4800	2400	1200

Baud rate selection

20 × 2, 4.65mm character height (**RS** stock no. 206-9023)

20 × 2, 10.5mm character height (**RS** stock no. 206-9039)

In case of serial input, it is possible to choose eight kinds of baud rate by J1~J3, as shown below.

J1		Open	Short	Open	Short
J2		Open	Open	Short	Short
J3	Short	62500	31250	15625	7812.5
	Open	9600	4800	2400	1200

Baud rate selection

20 × 4, 5mm character height (**RS** stock no.206-9045)

In case of serial input, it is possible to choose eight kinds of baud rate by J1~J3, as shown below.

When serial input is selected, J5 must be short.

J1	short	open	short	open
J2	short	short	open	open
J3 short	1200 (bps)	2400	4800	9600
J3 open	7812.5	15625	31250	62500

Note: When the module is supplied J1, J2, J3 and J5 are open.

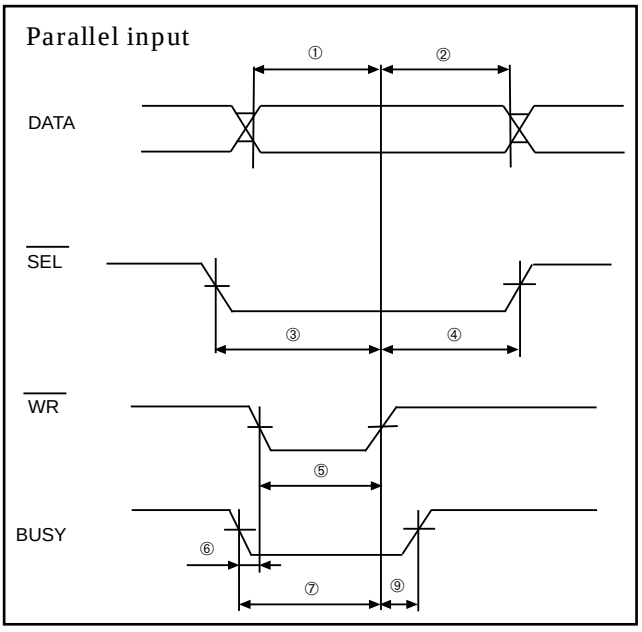
The 20 × 4, 11.3mm character height (**RS** stock no. 206-9067) module has a parallel interface only.

Write-in timing

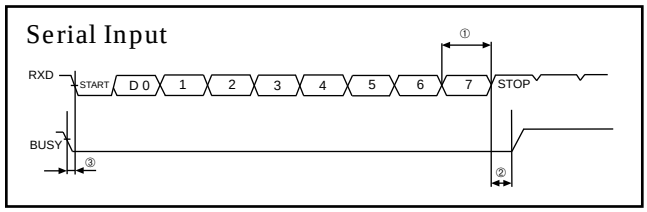
Ensure the BUSY signal is 'L', when data is to be written in.

20 × 1, 5mm character height (**RS** stock no. 206-9001)

40 × 2, 5mm character height (**RS** stock no. 206-9073)

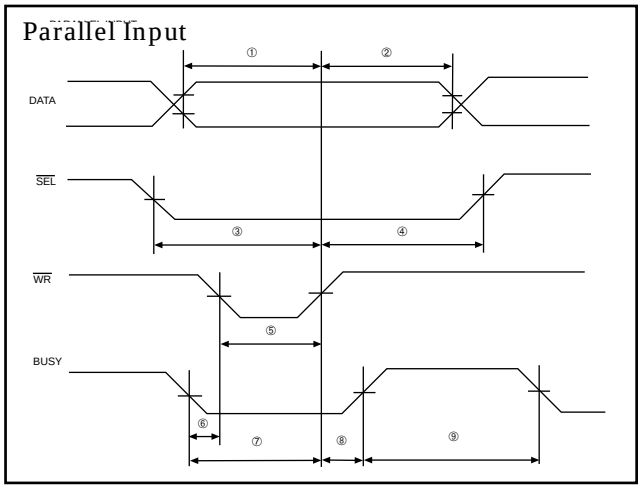


		Min.	Max.	Note
①	tsu (DATA)	50ns	-	
②	th (DATA)	50ns	-	
③	tsu ($\overline{SEL}$)	50ns	-	
④	th ($\overline{SEL}$)	50ns	-	
⑤	tpw ($\overline{WR}$)	50ns	-	
⑥	twait (1)	0ns	-	
⑦	twait (2)	250ns	-	For Min. 250ns, $\overline{WR}$ should not be active (positive H), after BUSY is '0'
⑧	tdelay	-	50ns	

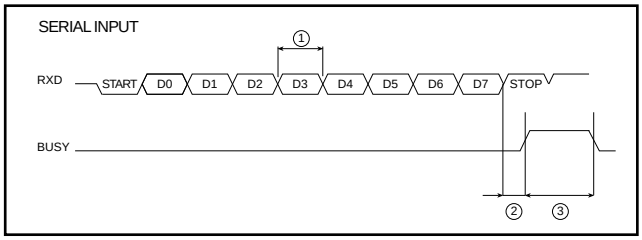


① t (DATA) = 10^6/baud rate (μs)
(This depends on the selection of the baud rate).
② t (DATA) /2 (μs)
(BUSY becomes '1' at the centre of stop bit).
③ t (WAIT) : 0 (μs)
(START should be active ('0'), after BUSY is '0').

20 × 2, 4.16mm character height (**RS** stock no. 206-9017)



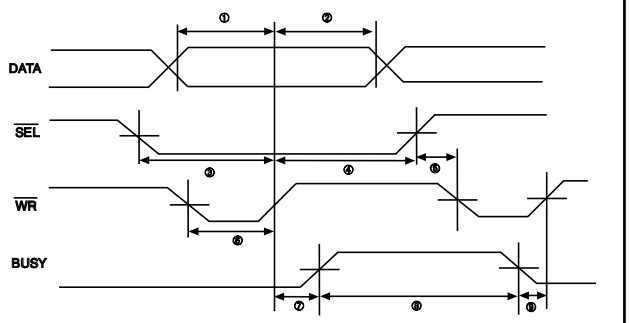
		Min.	Max.	Note
①	tsu (DATA)	50ns	-	
②	th (DATA)	100ns	-	
③	tsu ($\overline{SEL}$)	50ns	-	
④	th ($\overline{SEL}$)	50ns	-	
⑤	tpw ($\overline{WR}$)	50ns	-	
⑥	twait (1)	0ns	-	
⑦	twait (2)	1μs	-	
⑧	tdelay	-	150ns	
⑨	twait (3)	-	45μs	



① t (DATA) = 10^6/baud rate (μs)
(This depends on the selection of the baud rate).
② t (DATA) /2 (μs)
(BUSY becomes 'H' at the centre of stop bit).
③ t (WAIT) : 2~45(μs)

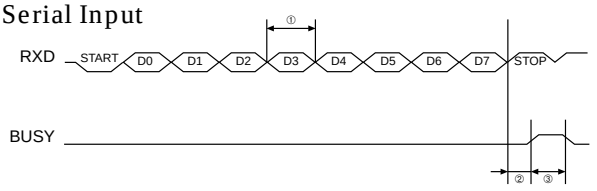
20 × 2, 4.65mm character height (RS stock no. 206-9023)
20 × 2, 10.5mm character height (RS stock no. 206-9039)

Parallel Input



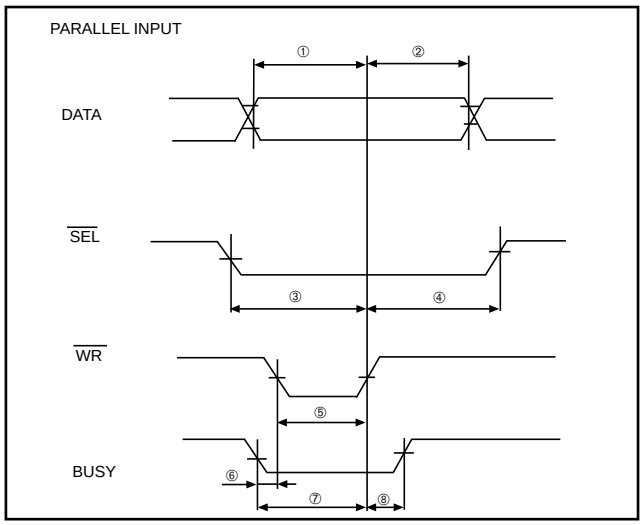
		Min.	Max.	Note
①	tsu (DATA)	50ns	-	
②	th (DATA)	100ns	-	
③	tsu ($\overline{SEL}$)	50ns	-	
④	th ($\overline{SEL}$)	50ns	-	
⑤	twait ($\overline{WR1}$)	50ns	-	
⑥	tpw (WR)	50ns	-	
⑦	tdelay	-	150ns	
⑧	tpw (BUSY)	-	45µs	
⑨	twait (WR2)	1µs	-	

Serial Input

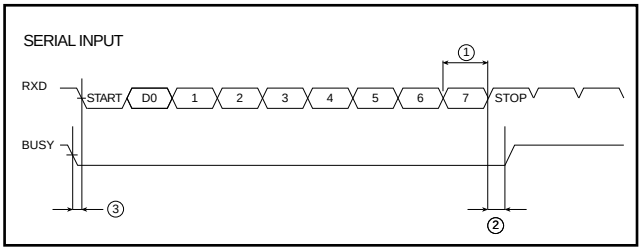


① t (DATA) = 10^6/baud rate (µs)
(This depends on the selection of the baud rate).
② t (DATA) /2 (µs)
(BUSY becomes 'H' at the centre of stop bit).
③ t (WAIT) : 2~45(µs)

20 × 4, 5mm character height (RS stock no. 206-9045)



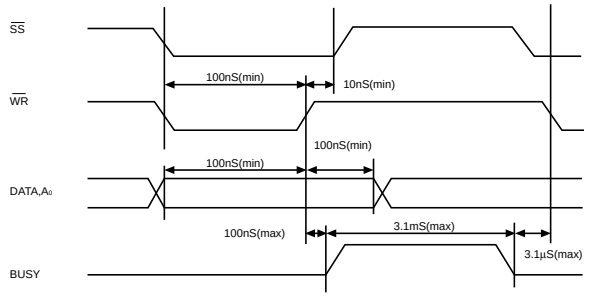
		Min.	Max.	Note
①	tsu (DATA)	65ns	-	
②	th (DATA)	55ns	-	
③	tsu ($\overline{SEL}$)	75ns	-	
④	th ($\overline{SEL}$)	0ns	-	
⑤	tpw ($\overline{WR}$)	75ns	-	
⑥	twait (1)	0ns	-	
⑦	twait (2)	200ns	-	For Min. 200ns, $\overline{WR}$ should not be active (positive H), after BUSY is '0'
⑧	tdelay	-	50ns	



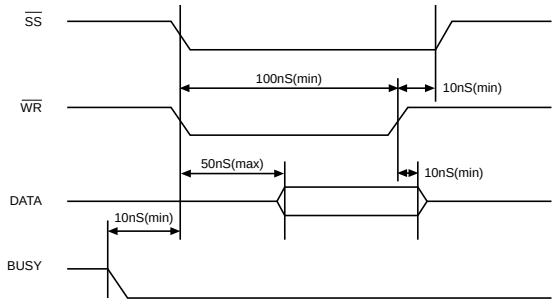
① t (DATA) = 10^6/baud rate (µs)
(This depends on the selection of the baud rate).
② t (DATA) /2 (µs)
(BUSY becomes '1' at the centre of stop bit).
③ t (WAIT) : 0(µs)
(START should be active ('0'), after BUSY is '0').

20 × 4, 11.3mm character height (RS stock no. 206-9067)

Write-in timing



Read timing



Interface to CPUS

Since the modules are designed to be directly connected to the bus line, the interface can be simplified.

Figures 3 and 4 show examples for interfacing to typical CPUS.

Figure 5, figure 6 and figure 7 show examples for interfacing to typical I/O devices.

Figure 3 Connection to Z-80

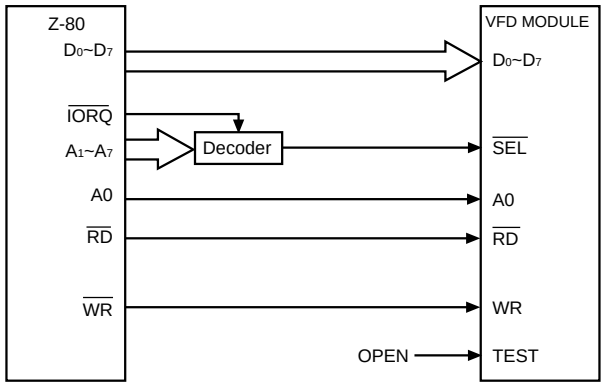
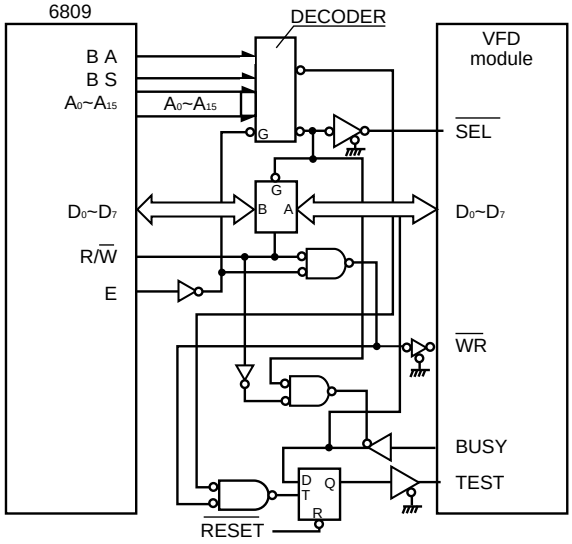


Figure 4 Connection to 6809



Connection to I/O devices

Figure 5 Connection to Z80A-S10

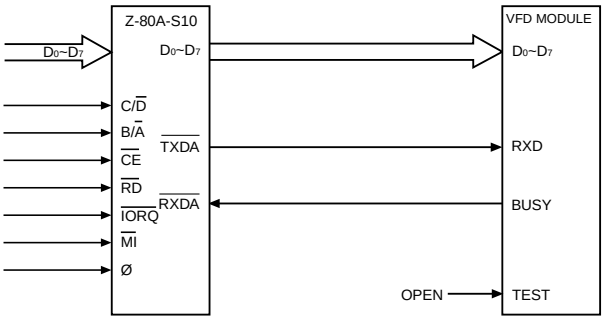


Figure 6 Connection to Z80-P10

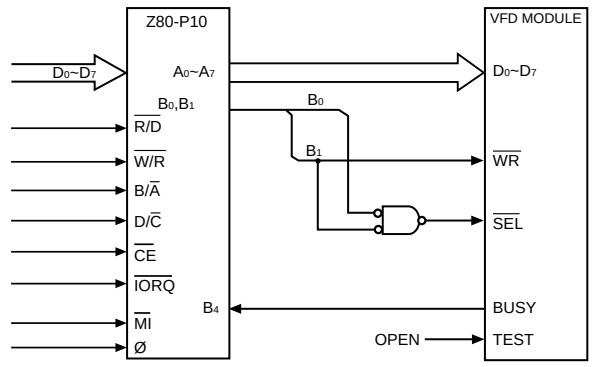
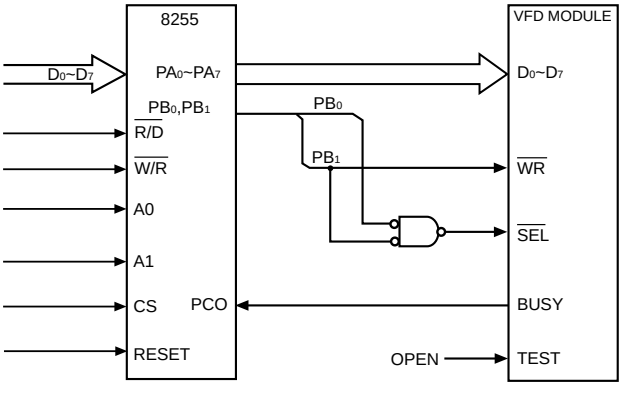


Figure 7 Connection to 8255



Operating recommendations

1. Avoid applying excessive shock or vibration beyond the specification for this module.
2. Since VFDs are made of glass material, careful handling is important.
3. Applying lower voltage than specified may cause non activation for the selected pixels.

   Conversely, a higher voltage may cause non-selected pixels to become activated. If the above phenomenon is observed, check the voltage level of the power supply.
4. Avoid plugging or unplugging the interface connection with the power on.
5. If the start up time of the supply voltage is slow, the CPU may not be reset. The supply voltage must have risen up to a specified voltage level, within 30msec.
6. When the power supply is turned on, such as 5A, 1msec. of rush current may flow, because of the dc/dc converter equipped on the module.
7. Avoid using the module where excessive interference of noise is expected. Noise affects the interface signal and causes improper operation. Keep the length of the interface cable less than 50cm.
8. When the power supply is turned off, the capacitor is not discharged immediately. The high voltage applied to the VFD must not contact the controller IC. Shorting of the mounted components, (within 30sec. after the power is off) may cause damage.