

ALL ELECTRONICS CORP.

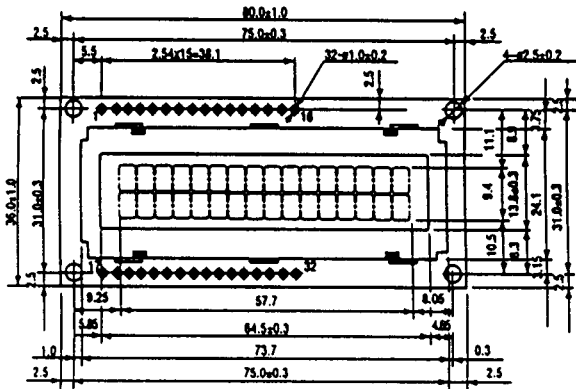
LCD-52

GENERIC SPEC AND HOOK-UP SHEET FOR 16 X 2 LCDS

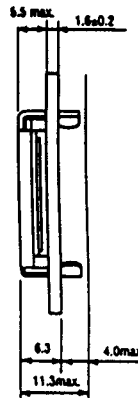
LCD-53

Since we do not have the "official" literature for this LCD, and since most LCDs are similar in structure and connectivity, we have put together this spec/hook-up sheet from the literature of three different manufacturers. We hope it contains the necessary information.

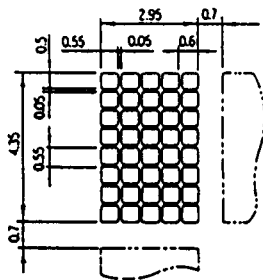
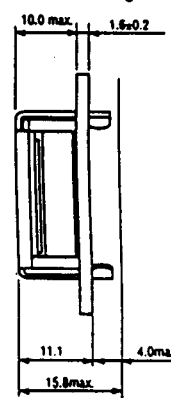
Most 16 character x 2 line LCDs have 14 connections for the display either on the top or bottom of the display. For orientation, look for a numeral 1 next to connection 1. If the LCD has a backlight, it will be powered by pins 15 and 16 or by two connections to the side of the display.



Reflective/EL Backlight



LED Backlight

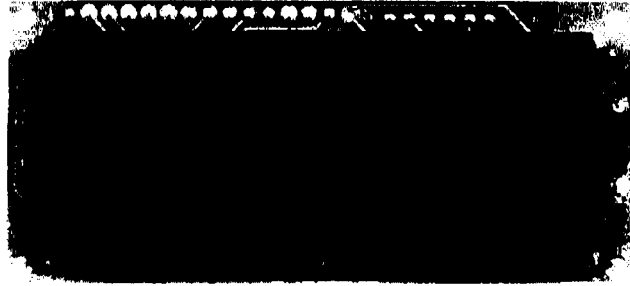


*LED Powered
through pins 15 & 16
or 31 & 32

PIN FUNCTIONS

No.	No.	Name	Function
1	17	V _{cc}	GND
2	18	V _{cc}	Power supply voltage + 5 V
3	19	V _{cc}	Liquid crystal driving voltage
4	20	RS	L: Instruction code input. H: Data input
5	21	R/W	L: Data write from MPU to LCM. H: Data read from LCM to
6	22	E	Enable
7	23	DB0	Data bus line
8	24	DB1	Data bus line
9	25	DB2	Data bus line
10	26	DB3	Data bus line
11	27	DB4	Data bus line
12	28	DB5	Data bus line
13	29	DB6	Data bus line
14	30	DB7	Data bus line
15	31	V _e '	Anode
16	32	V _e "	Cathode

HDM-16216L-5



FEATURE

Display format	16 Characters x 2 lines
Display type	TN
Display mode	Positive
Viewing direction	6 O'clock
Driving method	1/16 Duty

PHYSICAL DATA

Module size	80.0W x 36.0H x 13.0T mm
Min. view area	65.6W x 13.8H mm
Character construction	5 x 7 dots
Character size	2.95W x 3.8H mm
Character pitch	3.65 mm
Dot size	0.55W x 0.5H mm
Weight	about 30 g

ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Test Condition	Standard Value		Unit
			min.	max.	
Power supply for logic	V _{DD} -V _{SS}	T _a = 25°C	0	7.0	V
Power supply for LCD	V _{DD} -V _L	T _a = 25°C	0	13.5	V
Input voltage	V _{IN}	T _a = 25°C	V _{SS}	V _{DD}	V
LED forward current	I _F	-	-	120	mA
LED reverse voltage	V _R	-	-	8	V
LED power consumption	P _D	-	-	0.54	W
Operation temperature	T _{OP}	-	0	50	°C
Storage temperature	T _{STG}	-	-20	60	°C

ELECTRICAL CHARACTERISTICS

Item	Symbol	Test Condition	Standard Value			Unit
			min.	typ.	max.	
Input high voltage	V _{IH}	-	2.2	-	-	V
Input low voltage	V _{IL}	-	-	-	0.6	V
Output high voltage	V _{OH}	I _{OH} = 0.205mA	2.4	-	-	V
Output low voltage	V _{OL}	I _{OL} = 1.2mA	-	-	0.4	V
Power supply current	I _{DD}	V _{DD} = 5.0V T _a = 0°C	-	0.8	1.8	mA
Power supply for LCD (note-1)	V _{DD} -V _L	T _a = 25°C	-	4.4	-	V
		T _a = 50°C	-	3.6	-	V
		T _a = 0°C	-	3.9	4.1	4.5	V
Brightness (note-2)	L	I _F = 75 mA	30	50	-	NIT

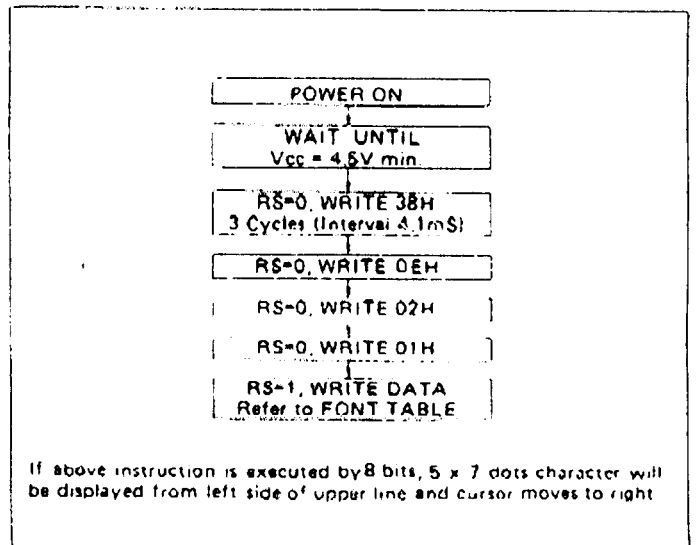
NOTE 1. Power supply for LCD is variable with RL in accordance with contrast.
2. Measured on the bare LED backlight unit

PIN CONNECTIONS

Pin No.	Symbol	Level	Function
1	V _{SS}	-	Power supply
2	V _{DD}	-	
3	V _L	-	
4	RS	H/L	H: Data input L: Instruction data input
5	R/W	H/L	H: Data read L: Data write
6	E	H,H*L	Enable signal
7	D0	H/L	Data bus line*
8	D1	H/L	
9	D2	H/L	
10	D3	H/L	
11	D4	H/L	
12	D5	H/L	
13	D6	H/L	
14	D7	H/L	
15	A	-	ANODE for LED backlighting

* In case of 4 bits instruction, data is transferred by twice using only 4 buses of D4-D7, and D0-D3 are not used; first operation is higher order 4 bits and second is lower 4 bits of 8 bits, but in case of 8 bits instruction, data is transferred by data bus of D0-D7.

TEST PROCEDURE

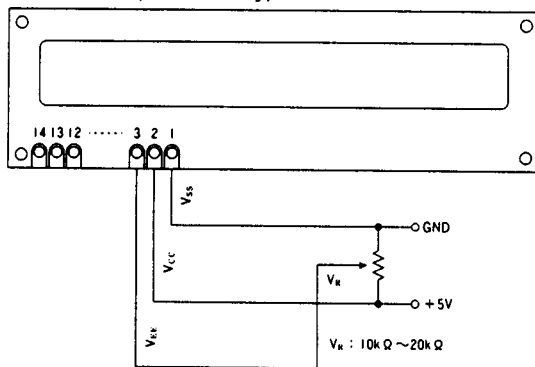


«Features»

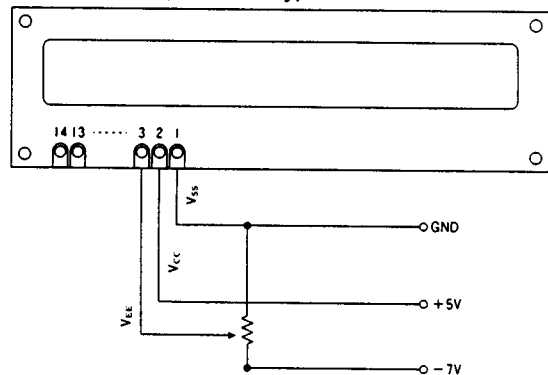
- (1) Interface with 8-bit or 4-bit MPU is available.
- (2) 192 kind of alphabets, numerals, symbols and special characters can be displayed by built-in character generator (ROM)
- (3) Other preferred characters can be displayed by character generator (RAM)
- (4) Various functions of instruction are available by programming:
 - Clear display ● Cursor at home ● On/off cursor ● Blink character
 - Shift display ● Shift cursor ● Resd/write display data, Etc.
- (5) Compact and light weight design which can be easily assembled in devices.
- (6) Single power supply +5V drive (except for extended temp. type)
- (7) Low power consumption.

EXAMPLE OF POWER SUPPLY (Except for DMC40401 series)

Normal Temperature Type

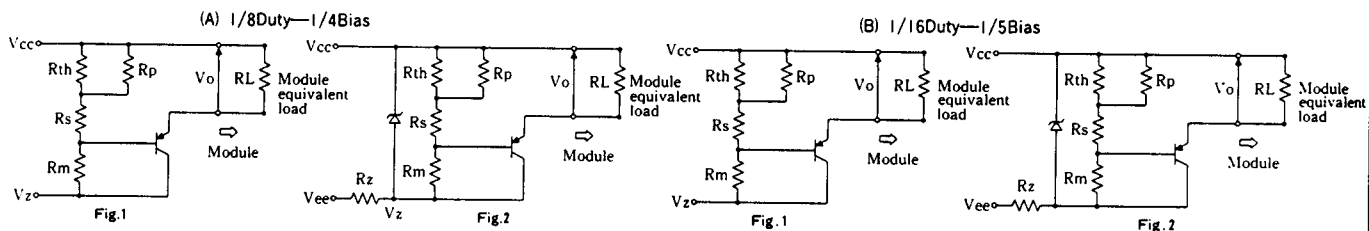


Extended Temperature Type



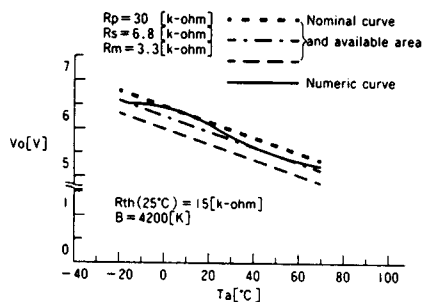
*NOTE: If V_{EE} vary from recommended value, you cannot get proper contrast or viewing angle.

Examples of Temperature Compensation Circuits for Extended Temp Typ. (Only for reference)

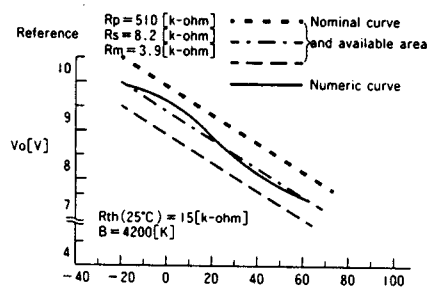


Thermistor: $R_{th}(25^{\circ}\text{C}) = 15[\text{k}\text{-ohm}]$, $B = 4200[\text{K}]$
 Resistors: $R_p = 30[\text{k}\text{-ohm}]$, $R_s = 6.8[\text{k}\text{-ohm}]$, $R_m = 3.3[\text{k}\text{-ohm}]$
 Transistor: PNP Type
 $V_{cc} = +5\text{V}$, $V_{ss} = 0\text{V}$ (Logic Supply)
 $V_z = -8[\text{V}]$ (-7.8 to -8.2[V])
 $V_{ee} < V_z[\text{V}]$, $R_z = (V_z - V_{ee})/5[\text{k}\text{-ohm}]$

Thermistor: $R_{th}(25^{\circ}\text{C}) = 15[\text{k}\text{-ohm}]$, $B = 4200[\text{K}]$
 Resistors: $R_p = 510[\text{k}\text{-ohm}]$, $R_s = 8.2[\text{k}\text{-ohm}]$, $R_m = 3.9[\text{k}\text{-ohm}]$
 Transistor: PNP Type
 $V_{cc} = +5\text{V}$, $V_{ss} = 0\text{V}$ (Logic Supply)
 $V_z = -11[\text{V}]$ (-10.725 to -11.275[V])
 $V_{ee} < V_z[\text{V}]$, $R_z = (V_z - V_{ee})/5[\text{k}\text{-ohm}]$



Ta (°C)	Vo (V)
-20	6.56
-10	6.50
0	6.40
10	6.26
20	6.09
30	5.88
40	5.67
50	5.47
60	5.29
70	5.15

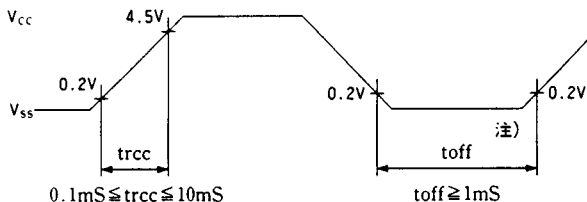


Ta (°C)	Vo (V)
-20	10.01
-10	9.84
0	9.60
10	9.28
20	8.89
30	8.49
40	8.11
50	7.79
60	7.53
70	7.33

*Specifications are subject to change without notice.

The internal reset circuit will be operated properly when the following power supply conditions are satisfied.
If it is not operated properly, please perform initial setting along with the instruction.

Item	Symbol	Measuring Condition	Standard Value			Unit
			min.	typ.	max.	
Power Supply Rise Time	trcc	—	0.1	—	10	mS
Power Supply OFF Time	toff	—	1	—	—	mS



Note: toff defines period that power supply is off when power supply shut down momentarily or repeats on /off state.

RESET FUNCTION

● Initialization made by Internal Reset Circuit

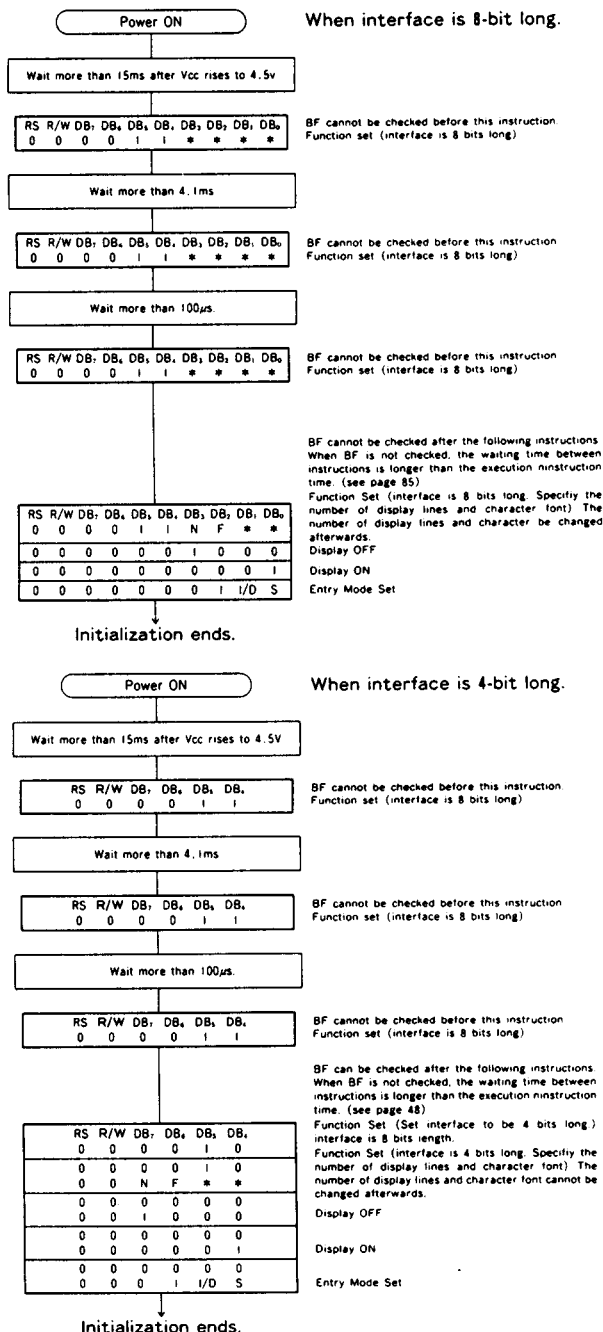
HD44780 automatically initializes (resets) when power is supplied (built-in internal reset circuit). The following instructions are executed in initialization. The busy flag (BF) is kept in busy state until initialization ends. (BF = 1) The busy state is 10ms after Vcc reach to 4.5V.

- (1) Display clear
- (2) Function set
 - DL = 1: 8bit long interface data
 - DL = 0: 4bit F = 0: 5 × 7dot character font
 - N = 1: 2lines
 - N = 0: 1line
- (3) Display ON/OFF control
 - D = 0: Display OFF C = 0: Cursor OFF B = 0: Blink OFF
- (4) Entry mode set
 - I/D = 1: + (increment) S = 0: No shift

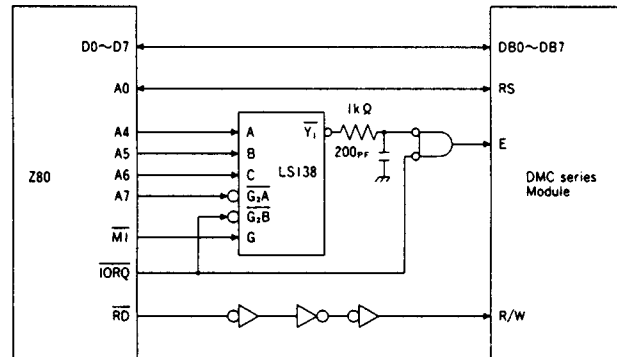
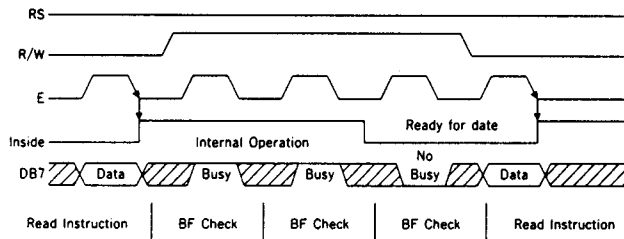
Note: When conditions stated in "Power Supply Conditions Using Reset Circuit" are not satisfied, the internal reset circuit will not operate properly and initialization will not be performed. Please make initialization using MPU along with "Initialization along with Instruction"

● Initialization along with Instruction

If power supply conditions are not satisfied, which for proper operation of internal reset circuit, it is required to make initialization along with instruction. Please make following procedures:

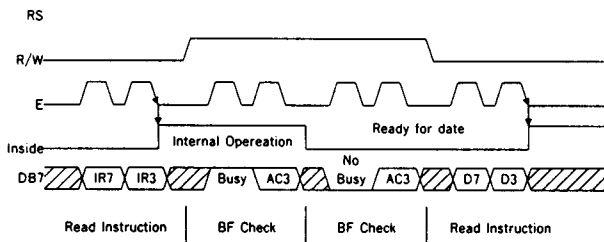


Example of Interface with 8-bit MPU (Z80)

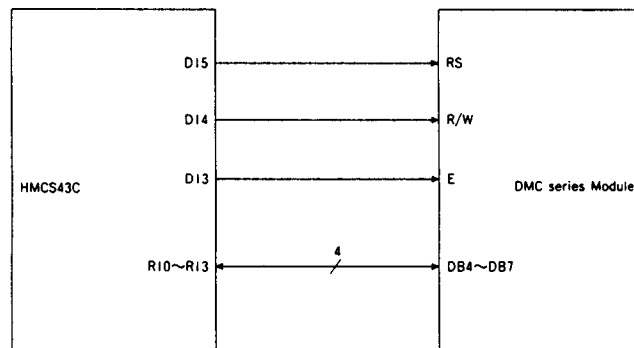


Example of Interface with 4-bit MPU(HMCS43C)

Interface with 4-bit MPU can be made through I/O port of 4-bit MPU. If there are enough I/O ports, data can be transferred by 8-bit, however, if there isn't data transfer can be done by 4-bit in twice (select interface is 4-bit long), and timing sequence will be complicated in this case. Please take into account that 2 cycles of BF check is necessary, while 2 cycles of data transfer are also necessary.



Note: IR7, IR3: 7th bit, 3rd bit of instuction
AC3 : 3th bit of Address Counter



INSTRUCTIONS (Except for DMC40401 series)

Instruction											Executed Time (max.) fosc=250kHz		
	RS	R/V/D/F	D	C	B	I/D	S	R/L	I/D	S			
Clear Display	0	0	0	0	0	0	0	0	0	0	I	Clears all display and returns the cursor to the home position (Address 0).	1.64mS
Cursor At Home	0	0	0	0	0	0	0	0	0	I	*	Returns the cursor to the home position (Address 0). Also returns the display being shifted to the original position DDAM contents remain unchanged.	1.64mS
Entry Mode Set	0	0	0	0	0	0	0	I	I/D	S	Sets the cursor move direction and specifies or not to shift the display. These operations are performed during data write and read.	40μS	
Display On/Off Control	0	0	0	0	0	0	I	D	C	B	Sets ON/OFF of all display (D) cursor ON/OFF (C), and blink of cursor position character (B).	40μS	
Cursor/Display Shift	0	0	0	0	0	I	S/C	R/L	*	*	Moves the cursor and shifts the display without changing DDRAM contents.	40μS	
Function Set	0	0	0	0	I	DL	N	F	*	*	Sets interface data length (DL) number of display lines (N) and character font (F).	40μS	
CGRAM Address Set	0	0	0	I	A _{CG}					Sets the CGRAM data is sent and received after this setting.		40μS	
DDRAM Address Set	0	0	I	A _{DD}					Sets the CGRAM data is sent and received after this setting.		40μS		
Busy Flag/ Address Read	0	I	BF	AC					Reads Busy flag (FB) indicating internal operation is being performed and reads address counter contents.		0μS		
CGRAM/DDRAM Data Write	I	0	WRITE DATA					Writes data into DDRAM or CGRAM.		40μS			
CGRAM/DDRAM Data Read	I	I	READ DATA					Reads data into DDRAM or CGRAM.		40μS			

Code	Description	Executed Time (max.)
I/D=I: Increment I/D=0: Decrement S=I: With display shift S/C=I: Display shift S/C=0: Cursor movement R/L=I: Shift to the right R/L=0: Shift to the left DL=I: 8-bit DL=0: 4-bit N=I: 2lines N=0: 1lines F=I: 5×10dots F=0: 5×7dots BF=I: internal operation is being performed BF=0: instruction acceptable	DDRAM: Display Data RAM CGRAM: Character Generator RAM ACG: CGRAM Address ADD: DDRAM Address Corresponds to cursor address. AC: Address Counter, used for both DDRAM and CGRAM *: Invalid	fcp or fosc=250kHz However, when frequency changes, execution time also changes Ex if fcp or fosc is 270kHz, $40\mu S \times \frac{250}{270} = 37\mu S$

FONT TABLE (5×11Dots)

Lower 4-bit	Upper 4-bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
× × × × 0000	CG RAM (1)													
× × × × 0001	(2)	!	1	H	0	a	a	4	u	7	7	4	a	q
× × × × 0010	(3)	"	2	B	R	b	r	"	4	v	x	p	0	
× × × × 0011	(4)	#	3	C	S	c	s	!	0	f	e	s	o	
× × × × 0100	(5)	\$	4	D	T	d	t	,	I	l	t	p	o	
× × × × 0101	(6)	%	5	E	U	e	u	.	7	7	1	c	0	
× × × × 0110	(7)	&	6	F	V	f	v	7	0	2	3	p	z	
× × × × 0111	(8)	"	7	G	W	w	7	7	7	g	n			
× × × × 1000	(1)	(	8	H	X	h	x	4	0	7	0	r	x	
× × × × 1001	(2)	)	9	I	Y	y	o	7	0	7	0	y		
× × × × 1010	(3)	*	:	J	Z	j	z	z	o	h	v	j	f	
× × × × 1011	(4)	+	:	K	L	k	l	(	*	7	e	o	7	A
× × × × 1100	(5)	,	<	L	#	l	l	7	0	7	7	o	A	
× × × × 1101	(6)	-	=	M	J	m	j	u	z	o	z	t	÷	
× × × × 1110	(7)	.	>	N	^	n	7	a	t	o	7	n		

(5×8Dots)

110	111
o	p
a	q
e	o
s	o
u	o
o	z
o	n
r	x
y	
i	f
o	A
o	A
t	÷
n	

*CGRAM is Character Generator RAM which memorize characters that you can freely input by program.
 *32 characters stated under upper 4-bit of 1110 and 1111 are 5×10 dots, and part of which is cut when you use in display which display fonts is 5×7 dots.
 Please note.

5×11 dots type product:

DMC16106A, DMC16101A, DMC24138, DMC32132, DMC40131

