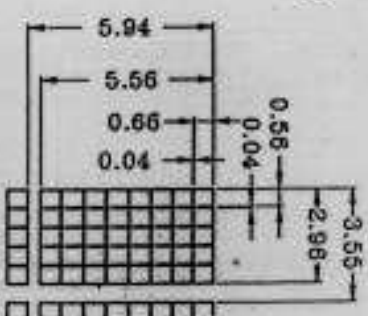
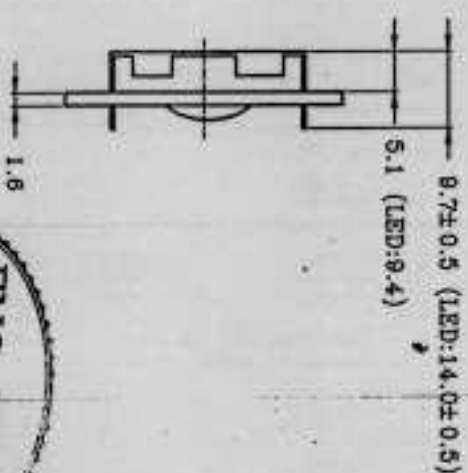
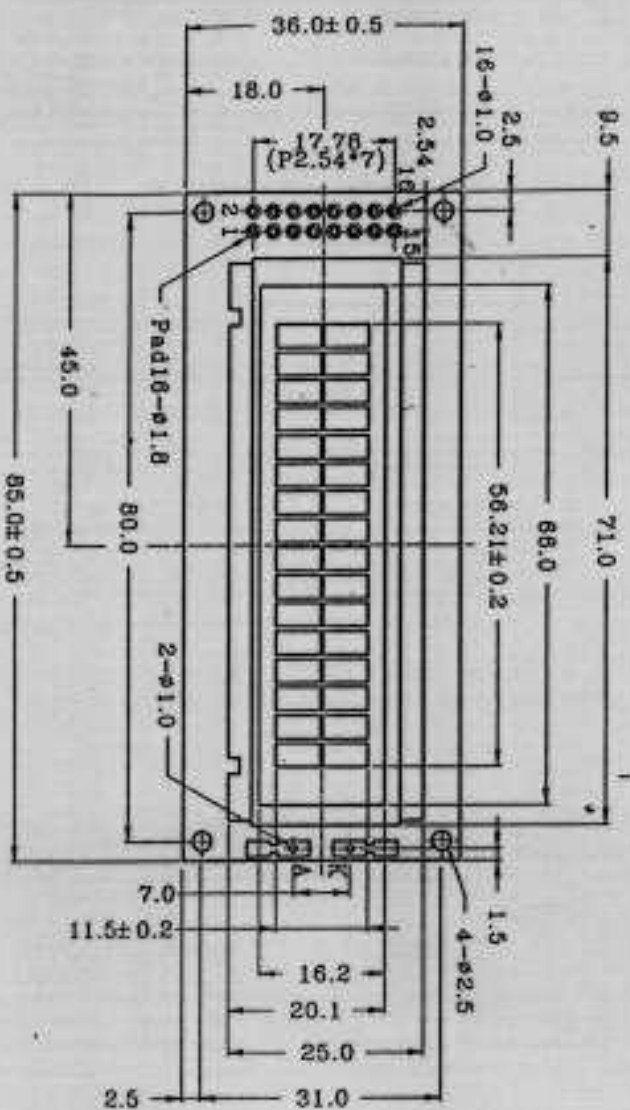
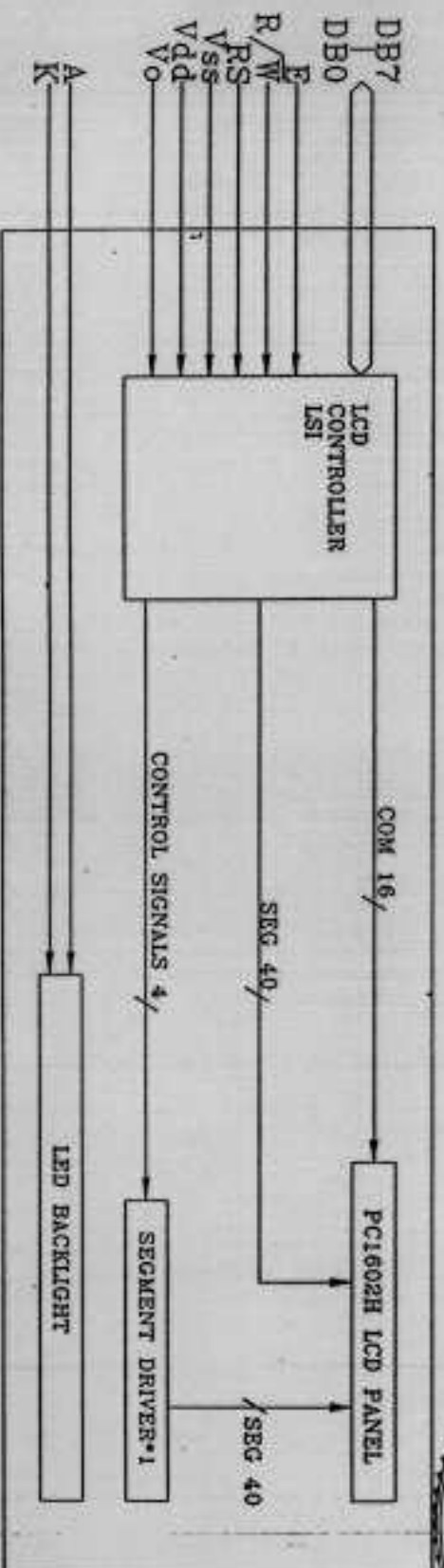




SCALE: 4/1



The tolerance unless classified $\pm 0.3\text{mm}$

UNIT:MM

PIN NO.	SIGNAL
1	Vss
2	Vdd
3	Vo
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

ELECTRICAL CHARACTERISTICS

Dc Characteristics (Vdd=+5V±10%, Vss=0V, Ta=25℃)

Parameter	Symbol	Condition	Applicable PIN	Min.	Typ	Max.	Unit
H level input voltage(1)	Vih1	—	DB0 ~ DB7	2.2	—	Vdd	V
L level input voltage(1)	Vil1	—	RS,R/W,E	-0.3	—	0.6	V
H level input voltage(2)	Vih2	—	OSC1	Vdd-1.0	—	Vdd	V
L level input voltage(2)	Vil2	—		-0.2	—	1.0	V
H level output voltage(1)	Voh1	Ioh=-0.205mA	DB0 ~ DB7	2.4	—	—	V
L level output voltage(1)	Vol1	Iol=1.2mA		—	—	0.4	V
H level output voltage(2)	Voh2	Ioh=-40uA	XSC LP D0	0.9Vdd	—	—	V
L level output voltage(2)	Vol2	Iol=40uA		—	—	0.1Vdd	V
I/o leakage current	Iil	Vin=0 to Vdd		-1	—	1	uA
Pull-UP Mos Current	-Ip	Vdd=5V		50	125	250	uA
Supply current	Iop	Rf oscillation from external clock Vdd=5v fosc=270kHz	Vdd	—	0.35	0.6	mA

Internal clock operation (Rf oscillation)

Oscillation frequency	fosc	Rf=91kΩ±2%	OSC1 OSC2	190	270	350	kHz
Oscillation frequency	fosc	Ceramic filter	OSC1 OSC2	245	250	255	kHz
LCD driving voltage	Vlcd	Vdd~V5	V1~V5	3.0	—	11.0	V

■ Absolute Maximum Rating

I T E M	S y m b o l	V a l u e	U n i t
Power Supply Voltage	Vdd -Vss	-0.3~+7.0	V
Driver Supply Voltage	Vlcd	Vdd-13.5~Vdd+0.3	
Input Voltage	Vin	-0.3~Vdd+0.3	
Operating temperature range	Top	0~+50	℃
Storage temperature range	Tst	-20~+60	

■ Description of Terminals

Symbol	Input/ Output	External Connection	Function				
R S	Input	M P U	Register selection input				
			<table><tr><td>High</td><td>Data register (for read and write)</td></tr><tr><td>Low</td><td>Instruction register (for write) Busy flag, address counter (for read)</td></tr></table>	High	Data register (for read and write)	Low	Instruction register (for write) Busy flag, address counter (for read)
High	Data register (for read and write)						
Low	Instruction register (for write) Busy flag, address counter (for read)						
R / W	Input	M P U	R/W signal input is used to select the read/write mode				
			<table><tr><td>High</td><td>Read mode</td></tr><tr><td>Low</td><td>Write mode</td></tr></table>	High	Read mode	Low	Write mode
High	Read mode						
Low	Write mode						
	Input	M P U	Start enable signal to read or write the data				
DB 4 DB 7	Input/ Output	M P U	Four high order bidirectional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.				
DB 0 DB 3	Input/ Output	M P U	Four low order bidirectional three-state data bus lines. Used for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.				
V d d V s s		Power Supply	V d d : + 5 V V s s : G N D				
V o		Power Supply	Contrast adjustment voltage				

AC Characteristics (V_{dd}=5V±10%, V_{ss}=0V, T_a=25°C)
Read Cycle

Parameter	Symbol	Min	Typ	Max	Unit	TEST PIN
Enable cycle time	t _c	500	—	—	ns	E
Enable "H" level pulse width	t _w	220	—	—	ns	E
Enable rise/fall time	t _r ,t _f	—	—	25	ns	E
RS,R/W setup time	t _{su}	40	—	—	ns	R/W,RS
RS,R/W address hold time	t _h	10	—	—	ns	R/W,RS
Read data output delay	t _d	60	—	120	ns	DB0~DB7
Read data hold time	t _{dh}	20	—	—	ns	DB0~DB7

Write Cycle

Parameter	Symbol	Min	Typ	Max	Unit	TEST PIN
Enable Cycle time	t _c	500	—	—	ns	E
Enable H level pulse width	t _w	220	—	—	ns	E
Enable rise/fall time	t _r ,t _f	—	—	25	ns	E
RS,R/W setup time	t _{su1}	40	—	—	ns	R/W,RS
RS,R/W address hold time	t _{h1}	10	—	—	ns	R/W,RS
Data setup time	t _{su2}	60	—	—	ns	DB0~DB7
Write data hold time	t _{h2}	10	—	—	ns	DB0~DB7

Optical Characteristics

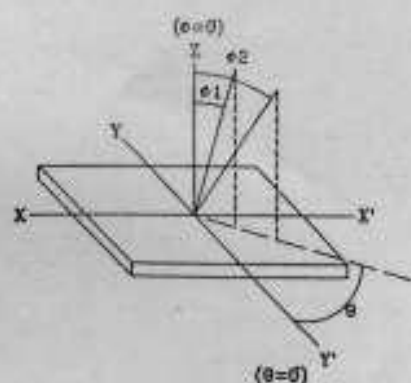
1. STN TYPE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	$\phi 2 - \phi 1$	$K=1.4$	40	—	—	deg.	#1, #2
Contrast Ratio	K	$\phi = 10^\circ$ $\theta = 0^\circ$	—	3	—	—	#3
Response Time(Rise)	tr	$\phi = 10^\circ$ $\theta = 0^\circ$	—	150	250	ms	#4
Response Time(Fall)	tf	$\phi = 10^\circ$ $\theta = 0^\circ$	—	200	300	ms	#4

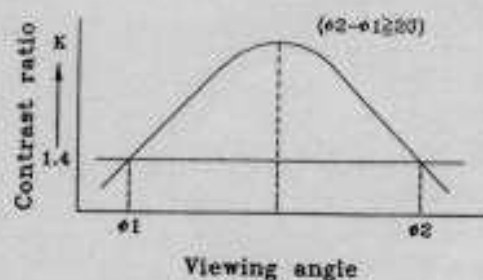
2. TN TYPE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	$\phi 2 - \phi 1$	$K=1.4$	60	—	—	deg.	#1, #2
Contrast Ratio	K	$\phi = 25^\circ$ $\theta = 0^\circ$	—	3	—	—	#3
Response Time(Rise)	tr	$\phi = 25^\circ$ $\theta = 0^\circ$	—	80	120	ms	#4
Response Time(Fall)	tf	$\phi = 25^\circ$ $\theta = 0^\circ$	—	60	90	ms	#4

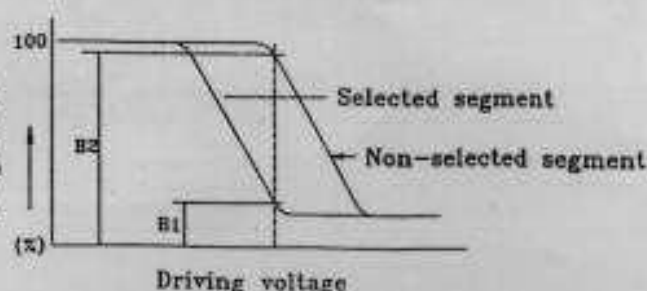
*1. Definition of ϕ AND θ



*2. Contrast vs viewing angle

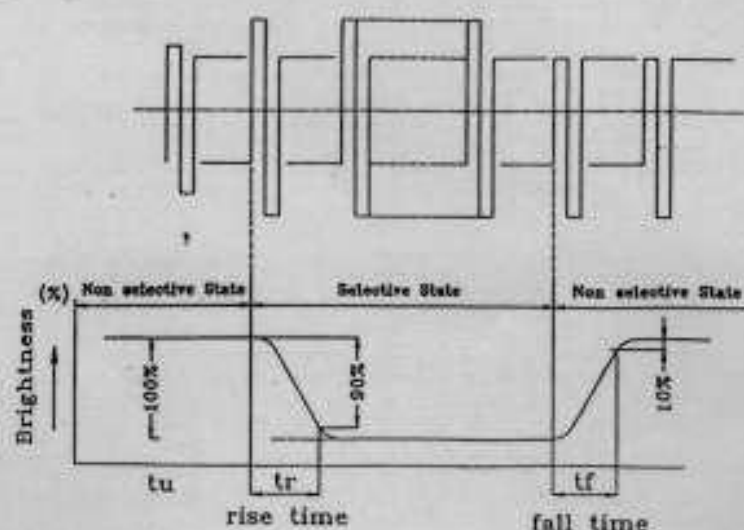


*3. definition of contrast ratio



$$K = \frac{\text{Brightness of non-selected segment}(B2)}{\text{Brightness of selected segment}(B1)}$$

*4. Definition of optical response



■ LED BACKLIGHT

Long life, low power consumption and simple power supply. Three different color of red, green and orange are available, or color can be changed alternatively. 2 back light methods are available, beneath illumination and side illumination.

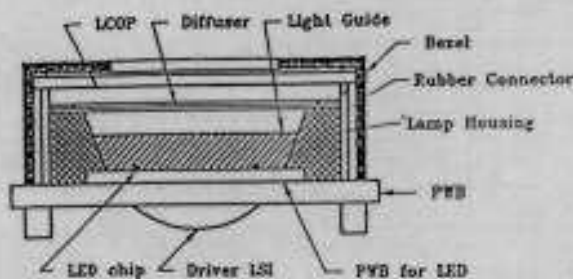
Features

- Low voltage deiving(DC) is available.
- Low life time 100,000 hours (average).
- No noise occurrence.

- Various color of red, green and orange etc.
(multi-color by alternative switch is also available)
- Operating characteristics
EX:PC 2002-A series is $I_F=210\text{mA}$,
 $I_V=250\text{ cd/m}^2$.

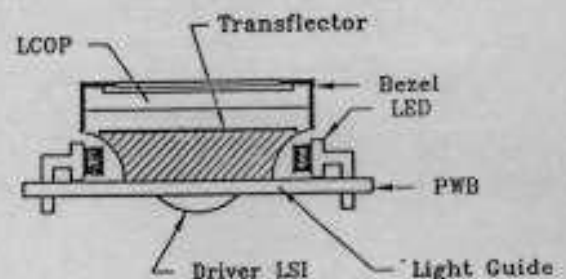
■ Beneath Illumination

Less quantity of chip even illumination.



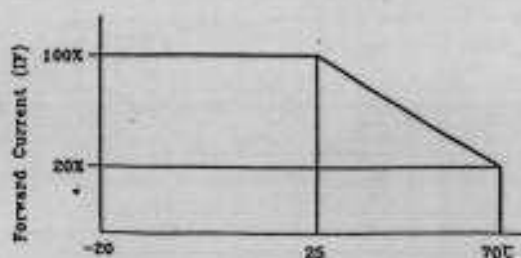
■ Side Illumination

Combination LED with light guide offers thin structure type of illumination.

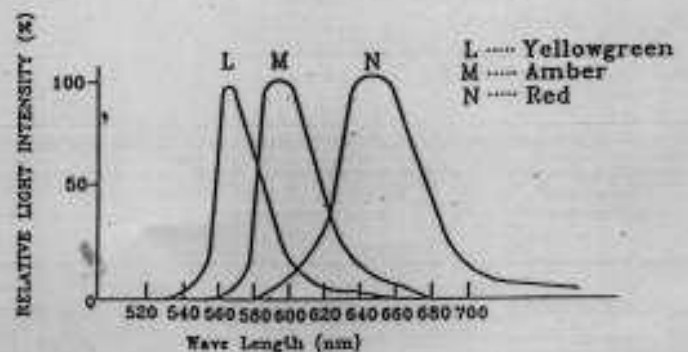


Electrical Characteristics (Reference Date)

- Forward current
Derating Curve

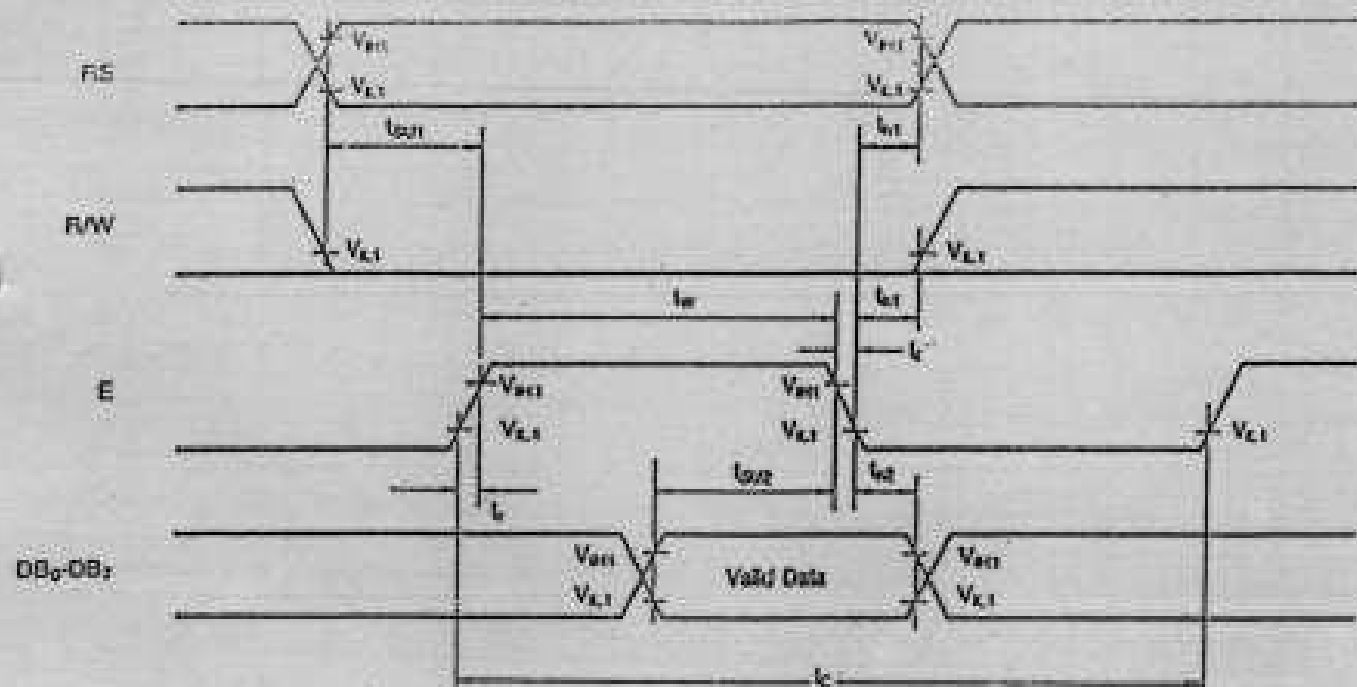


- Wave Length vs Relative Light Intensity

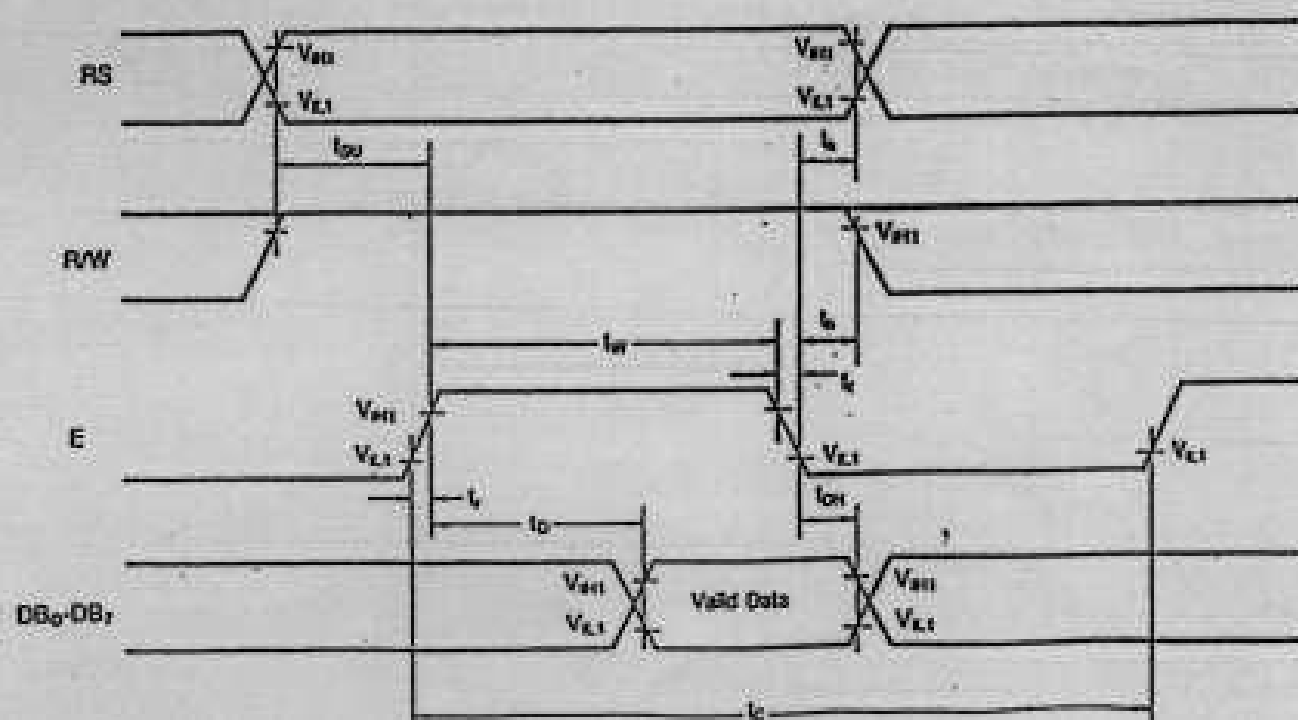


■ Timing Characteristics

(1) Write mode



(2) Read mode



HIGH-LEVEL		1758	1759	1760	1761	1762	1763	1764	1765	1766	1767	1768	1769	1770	1771
LOW-LEVEL		1772	1773	1774	1775	1776	1777	1778	1779	1780	1781	1782	1783	1784	1785
1786	1787	1788	1789	1790	1791	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801
1802	1803	1804	1805	1806	1807	1808	1809	1810	1811	1812	1813	1814	1815	1816	1817
1818	1819	1820	1821	1822	1823	1824	1825	1826	1827	1828	1829	1830	1831	1832	1833
1834	1835	1836	1837	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849
1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865
1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881
1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897
1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913
1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945
1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057
2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073
2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089
2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105
2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121
2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137
2138	2139	2140	2141	2142	2143	2144	2145	214							

M DISPLAY COMMAND

Parameter	RS	R/V	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	DESCRIPTION
CLEAR DISPLAY	0	0	0	0	0	0	0	0	0	1	
CURSOR HOME	0	0	0	0	0	0	0	0	1	=	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	SH	DB1=1: Increment DB1=0: Decrement DB0=1: The display is shifted DB0=0: The display is not shifted
DISPLAY ON/OFF	0	0	0	0	0	0	1	0	C	B	DB2=1: Display on DB2=0: Display off DB1=1: Cursor on DB1=0: Cursor off DB0=1: Blinking on DB0=0: Blinking off
CURSOR/ DISPLAY SHIFT	0	0	0	0	0	1	S/C	R/L	=	=	DB3=1: Shifts display one character DB2=1: Right shift DB2=0: Left shift
FUNCTION SET	0	0	0	0	1	DL	R	F	=	=	DB4=1: 8 bits DB4=0: 4 bits DB3=1: 2 lines display (1/16 duty) DB3=0: 1 line display (DB2=1: 5×10 dots, 1/11 duty DB2=0: 5×7 dots, 1/8 duty)
SET CGRAM ADDRESS	0	0	0	1	ACG						The address length that can be set is 84 addresses
SET DDRAH ADDRESS	0	0	1	ADD						The address length that can be set is 50 addresses	
READ BUSY FLAG/ ADDRESS COUNTER	0	1	B-F	A/C						DB7=1: Busy (instruction not accepted) DB7=0: Ready (instruction accepted)	
WRITE DATA	1	0	Write Data								
READ DATA	1	1	Read Data								

NOTE: = Don't care.