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# MSM6778

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## 120-DOT COMMON DRIVER (TAB)

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### GENERAL DESCRIPTION

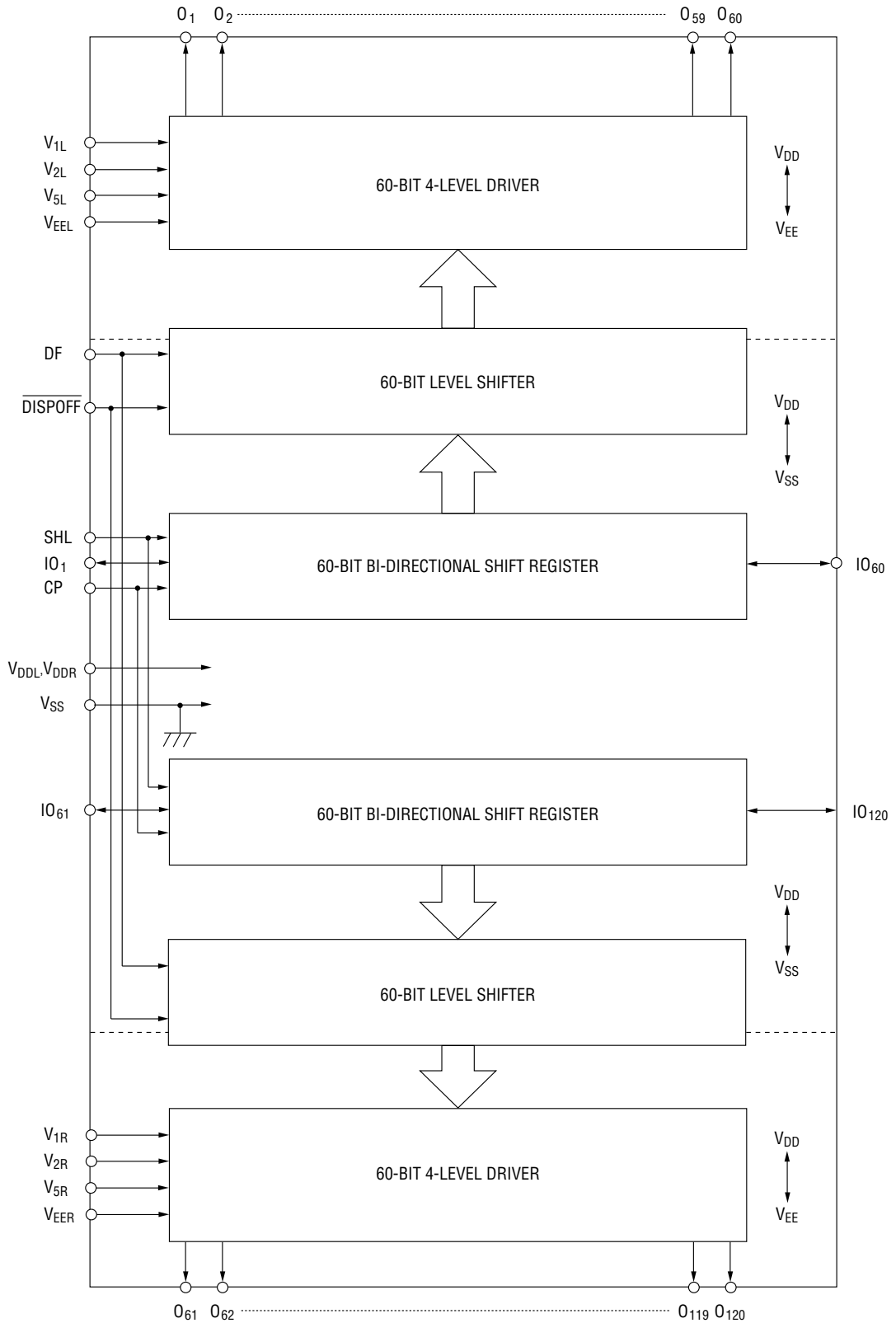
The MSM6778 is a dot-matrix LCD common driver. Fabricated in CMOS technology, the device contains two 60-bit bidirectional shift registers, two 60-bit level shifters, and two 60-bit 4-level drivers.

The MSM6778 has 120 LCD outputs. The number of LCD outputs can be increased by cascading MSM6778 devices, using cascade-connected I/O pins. The bias voltage which specifies a drive level can optionally be supplied externally. The MSM6778 is suitable for various types of LCD panel.

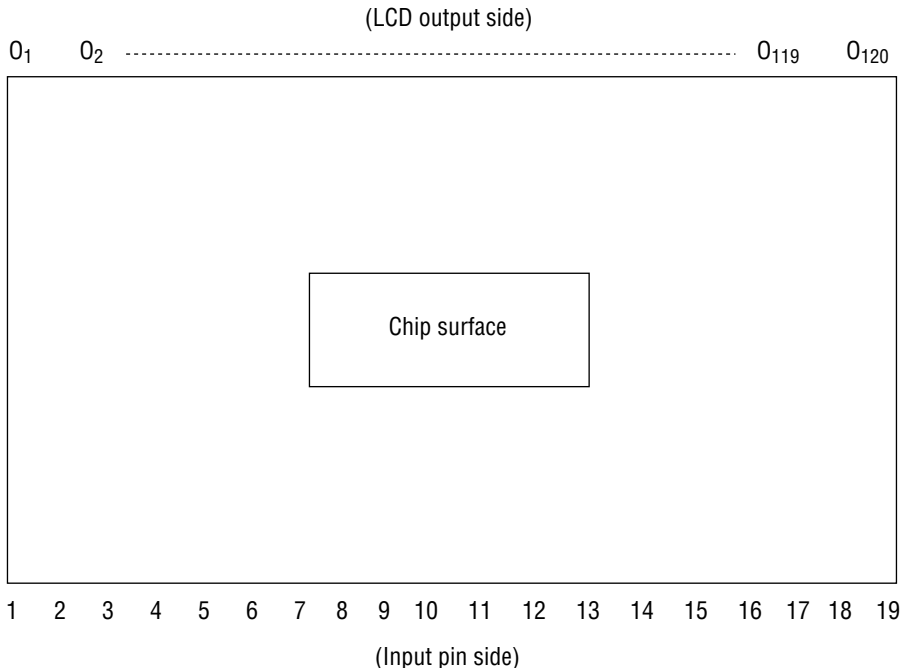
### FEATURES

- Logic supply voltage : 2.7 V to 5.5 V
- LCD drive voltage : A wide range from 18 V to 28 V
- Applicable LCD duty : 1/100 to 1/256
- The bias voltage can be externally supplied.
- Structure:
  - 35mm-wide Tape Automated Bonding (TAB) film (Product name: MSM6778AV-Z-01)
  - Tin-plating

**BLOCK DIAGRAM**



**PIN CONFIGURATION (TOP VIEW)**



**Input Pin Name**

Pin	Symbol	Pin	Symbol
1	V <sub>1L</sub>	11	IO <sub>61</sub>
2	V <sub>2L</sub>	12	IO <sub>120</sub>
3	V <sub>5L</sub>	13	DF
4	V <sub>EEL</sub>	14	CP
5	V <sub>DDL</sub>	15	V <sub>DDR</sub>
6	SHL	16	V <sub>EER</sub>
7	V <sub>SS</sub>	17	V <sub>5R</sub>
8	$\overline{\text{DISPOFF}}$	18	V <sub>2R</sub>
9	IO <sub>1</sub>	19	V <sub>1R</sub>
10	IO <sub>60</sub>		

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage (1)	V <sub>DD</sub>	T <sub>a</sub> =25°C	-0.3 to +6.5	V
Power Supply Voltage (2)	V <sub>DD</sub> -V <sub>EE</sub> *	T <sub>a</sub> =25°C	0 to 30	V
Input Voltage	V <sub>I</sub>	T <sub>a</sub> =25°C	-0.3 to V <sub>DD</sub> +0.3	V
Storage Temperature	T <sub>STG</sub>	—	-30 to +85	°C

\* V<sub>1</sub>>V<sub>2</sub>>V<sub>5</sub>>V<sub>EE</sub>, V<sub>DD</sub>≥V<sub>1</sub>>V<sub>2</sub>≥V<sub>DD</sub>-10V, V<sub>EE</sub>+10V≥V<sub>5</sub>>V<sub>EE</sub>  
 V<sub>DD</sub>=V<sub>DDL</sub>=V<sub>DDR</sub>, V<sub>1</sub>=V<sub>1L</sub>=V<sub>1R</sub>, V<sub>2</sub>=V<sub>2L</sub>=V<sub>2R</sub>, V<sub>5</sub>=V<sub>5L</sub>=V<sub>5R</sub>, V<sub>EE</sub>=V<sub>EEL</sub>=V<sub>EER</sub>

**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	Condition	Range	Unit
Power Supply Voltage (1)	V <sub>DD</sub>	—	2.7 to 5.5	V
Power Supply Voltage (2)	V <sub>DD</sub> -V <sub>EE</sub> *	No load	14 to 28	V
		During liquid crystal driving	18 to 28	V
Operating temperature	T <sub>op</sub>	—	-20 to +75	°C

\* V<sub>1</sub>>V<sub>2</sub>>V<sub>5</sub>>V<sub>EE</sub>, V<sub>DD</sub>≥V<sub>1</sub>>V<sub>2</sub>≥V<sub>DD</sub>-7V, V<sub>EE</sub>+7V≥V<sub>5</sub>>V<sub>EE</sub>  
 V<sub>DD</sub>=V<sub>DDL</sub>=V<sub>DDR</sub>, V<sub>1</sub>=V<sub>1L</sub>=V<sub>1R</sub>, V<sub>2</sub>=V<sub>2L</sub>=V<sub>2R</sub>, V<sub>5</sub>=V<sub>5L</sub>=V<sub>5R</sub>, V<sub>EE</sub>=V<sub>EEL</sub>=V<sub>EER</sub>

Note: Unlike mold packages, The Tape Carrier Package (TCP) cannot shield a light. Please shield a light to secure the electrical characteristics.

**ELECTRICAL CHARACTERISTICS**

**DC Characteristics**

(V<sub>DD</sub>=2.7 to 5.5 V, T<sub>a</sub>= -20 to +75°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" Input Voltage	V <sub>IH</sub> *1	—	0.8 V <sub>DD</sub>	—	—	V
"L" Input Voltage	V <sub>IL</sub> *1	—	—	—	0.2 V <sub>DD</sub>	V
"H" Input Current	I <sub>IH</sub> *1	V <sub>I</sub> =V <sub>DD</sub> , V <sub>DD</sub> =5.5 V	—	—	1	μA
"L" Input Current	I <sub>IL</sub> *1	V <sub>I</sub> =0 V, V <sub>DD</sub> =5.5 V	—	—	-1	μA
"H" Output Voltage	V <sub>OH</sub> *2	I <sub>O</sub> =-0.2 mA, V <sub>DD</sub> =2.7 V	V <sub>DD</sub> -0.4	—	—	V
"L" Output Voltage	V <sub>OL</sub> *2	I <sub>O</sub> =0.2 mA, V <sub>DD</sub> =2.7 V	—	—	0.4	V
ON Resistance	R <sub>ON</sub> *4	V <sub>DD</sub> -V <sub>EE</sub> =25 V, *3  V <sub>N</sub> -V <sub>O</sub>  =0.25 V	—	—	2.0	kΩ
Supply Current	I <sub>DD</sub> *5	CP=28 kHz, V <sub>DD</sub> =3.0 V	—	—	60	μA
	I <sub>EE</sub> *5	V <sub>DD</sub> -V <sub>EE</sub> =25 V, No load	—	—	400	μA
Input Capacitance	C <sub>I</sub>	f=1 MHz	—	—	—	pF

\*1 Applicable to pins CP, IO<sub>1</sub>, IO<sub>60</sub>, IO<sub>61</sub>, IO<sub>120</sub>, SHL, DF,  $\overline{\text{DISPOFF}}$

\*2 Applicable to pins IO<sub>1</sub>, IO<sub>60</sub>, IO<sub>61</sub>, IO<sub>120</sub>

\*3 V<sub>N</sub>=V<sub>1</sub>, V<sub>2</sub>, V<sub>5</sub>, V<sub>EE</sub>, V<sub>2</sub>=1/16 (V<sub>DD</sub>-V<sub>EE</sub>), V<sub>5</sub>=15/16 (V<sub>DD</sub>-V<sub>EE</sub>)

\*4 Applicable to pins O<sub>1</sub> to O<sub>120</sub>

\*5 I<sub>DD</sub> shows the supply current between V<sub>DD</sub> and V<sub>SS</sub>. I<sub>EE</sub> shows the supply current between V<sub>DD</sub> and V<sub>EE</sub>.

Note: The above values are guaranteed when TCP is protected from light.

Switching Characteristics

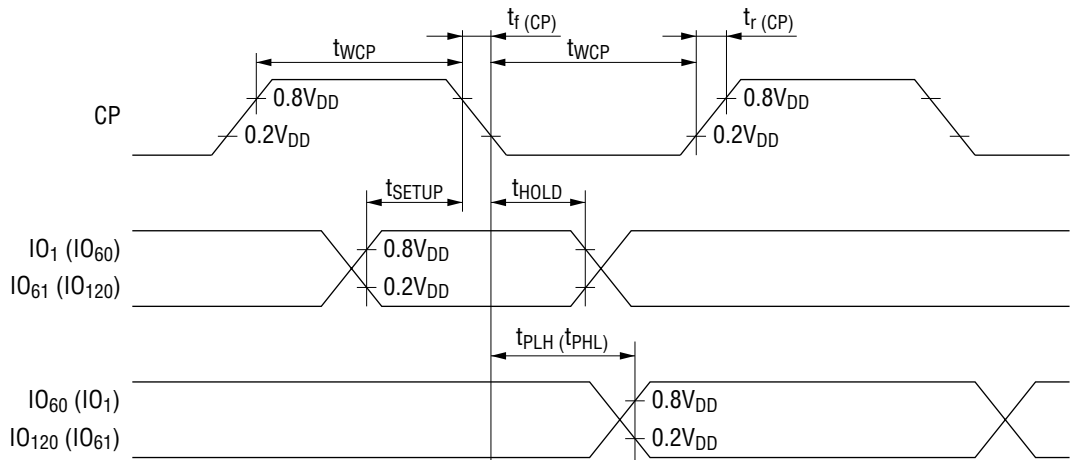
( $V_{DD}=2.7$  to  $5.5$  V,  $T_a=-20$  to  $+75^\circ\text{C}$ ,  $C_L=15$  pF)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
$IO_1, IO_{61}$ ( $IO_{60}, IO_{120}$ ) "H", "L" Propagation Delay Time	$t_{PLH}$ $t_{PHL}$	—	*1	—	3	$\mu\text{s}$
Clock Frequency	$f_{CP}$	—	—	—	1	MHz
CP Pulse Width	$t_{WCP}$	—	63	—	—	ns
Data Setup Time $IO_1, IO_{61} \rightarrow CP$ ( $IO_{60}, IO_{120} \rightarrow CP$ )	$t_{SETUP}$	—	100	—	—	ns
Data Hold Time $CP \rightarrow IO_1, IO_{61}$ ( $CP \rightarrow IO_{60}, IO_{120}$ )	$t_{HOLD}$	—	100	—	—	ns
CP Rise, Fall Time	$t_r$ (CP) $t_f$ (CP)	—	—	—	20	ns

\*1 The relationship between  $t_{PLH}$  ( $t_{PLH}$ ) Min. and  $t_{HOLD}$  Min. satisfies the operation in a cascade connection state.

Note 1: When display is controlled by  $\overline{\text{DISPOFF}}$  pin, CP rise and fall time must be  $\leq 1 \mu\text{s}$ .

Note 2: The above values are guaranteed when TCP is protected from light.



## FUNCTIONAL DESCRIPTION

### Pin Functional Description

- **IO<sub>1</sub>, IO<sub>60</sub>, IO<sub>61</sub>, IO<sub>120</sub>**

These are I/O pins of the two 60-bit bidirectional shift registers.

- **SHL**

This pin selects the shift direction of the two 60-bit bidirectional shift registers.

Set this pin to "H" or "L" level during power-on.

SHL	Shift Direction	I/O pins		Function
L	O <sub>1</sub> → O <sub>60</sub>	IO <sub>1</sub> , IO <sub>61</sub>	Input	IO <sub>1</sub> and IO <sub>61</sub> are data input pins for the shift register. The entered data is read in at the falling edge of a clock pulse. The data is output from IO <sub>60</sub> and IO <sub>120</sub> behind the number of bits (60) of the shift register.
	O <sub>61</sub> → O <sub>120</sub>	IO <sub>60</sub> , IO <sub>120</sub>	Output	
H	O <sub>60</sub> → O <sub>1</sub>	IO <sub>60</sub> , IO <sub>120</sub>	Input	IO <sub>60</sub> and IO <sub>120</sub> are data input pins for the shift register. The entered data is read in at the falling edge of a clock pulse. The data is output from IO <sub>1</sub> and IO <sub>61</sub> behind the number of bits (60) of the shift register.
	O <sub>120</sub> → O <sub>61</sub>	IO <sub>1</sub> , IO <sub>61</sub>	Output	

- **CP**

This is a clock pulse input for the two 60-bit bidirectional shift registers. Scan data is shifted at the falling edge of a clock pulse.

- **DF**

This is a synchronous signal input for alternate signal for LCD driving.

- **DISPOFF**

This is an input used to control the output levels of O<sub>1</sub> to O<sub>120</sub>. During low level input, the V<sub>1</sub> level is output from the output pins O<sub>1</sub> to O<sub>120</sub> independently of the data of the shift register. See the truth table.

- **O<sub>1</sub> to O<sub>120</sub>**

These are outputs for the 4-level drivers, which correspond directly to each bit of the shift register. One of the four levels V<sub>1</sub>, V<sub>2</sub>, V<sub>5</sub>, and V<sub>EE</sub> is selected and output depending on the combination of the shift register data and a DF signal. See the Truth Table.

- **V<sub>1L</sub>, V<sub>2L</sub>, V<sub>5L</sub>, V<sub>EE</sub>L, V<sub>1R</sub>, V<sub>2R</sub>, V<sub>5R</sub>, V<sub>EE</sub>R**

These are LCD drive bias voltage inputs.

- **V<sub>DDL</sub>, V<sub>DDR</sub>, V<sub>SS</sub>**

These are power supply pins for the device. V<sub>DD</sub> is usually from 2.7 V to 5.5 V and V<sub>SS</sub> is 0 V.

**Truth Table**

DF	SHIFT REGISTER DATA	DISPOFF	DRIVER OUTPUT (O <sub>1</sub> to O <sub>120</sub> )
L	L	H	V <sub>2</sub>
L	H	H	V <sub>EE</sub>
H	L	H	V <sub>5</sub>
H	H	H	V <sub>1</sub>
X	X	L	V <sub>1</sub>

X : Don't care

**NOTES ON USE (when turning the power ON or OFF)**

The LCD drivers of this IC require a high voltage. For this reason, if a high voltage is applied to the LCD drivers with the logic power supply floating, excess current flows. This may damage the IC.

Be sure to follow the sequence below when turning the power ON or OFF.

Power ON : Logic circuits ON → LCD drivers ON, or both ON at a time

Power OFF : LCD drivers OFF → logic circuits OFF, or both OFF at a time