
ML9060

1/2 DUTY, 160-OUTPUT STATIC LCD DRIVER

GENERAL DESCRIPTION

The ML9060 consists of a 320-bit shift register, a 320-bit data latch, 160 sets of LCD drivers, and a common signal generator circuit.

The LCD display data is input serially to the shift register from the DATA IN pin in synchronization with the CLOCK IN signal, and is stored in the data latch by the LOAD IN signal.

The LCD display data stored in the data latch is output via the LCD drivers.

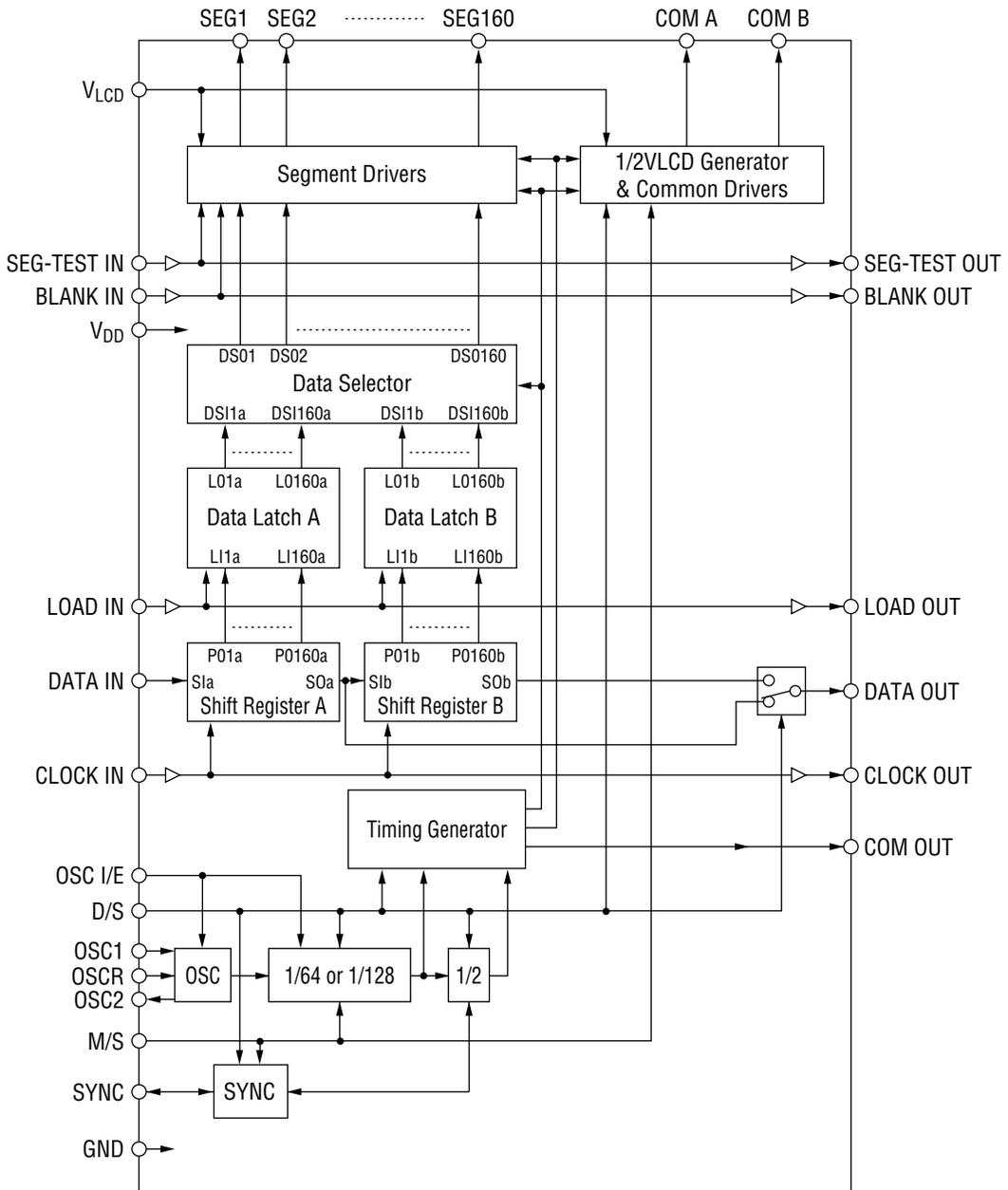
A maximum of 160 segments of LCD can be driven in static display mode and a maximum of 320 segments can be driven directly in the 1/2 duty display mode.

It is possible to select the mode of using the internal oscillator circuit or the mode of using an external clock for the common signal generator circuit. The ML9060 also outputs the sync signal during the 1/2 duty display mode.

FEATURES

- Logic power supply : 2.7 to 5.5V
- LCD Driving voltage : 4.5 to 16V
- Maximum number of segments that can be driven:
 - Static display mode : 160 segments
 - 1/2 Duty display mode : 320 segments
- Serial transfer clock : 1 MHz max.
- The microcontroller interface consists of the three signals DATA IN, CLOCK IN, and LOAD IN.
- An RC oscillator circuit is built in which can use either an external resistor or the internal resistor.
- Cascade connection of several ICs is possible. (Max. 3 chips)
- Built-in common signal generator circuit.
- Built-in common output mid-level voltage generator circuit.
- Input for turning all segments ON is available (SEG-TEST IN).
- Input for turning all segments OFF is available (BLANK IN).
- Gold bump chip Product name: ML9060DVWA

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Condition | Rating | Unit |
|----------------------------|-----------|--------------------------|-------------------------|------------------|
| Logic power supply voltage | V_{DD} | $T_a = 25^\circ\text{C}$ | -0.3 to +6.5 | V |
| LCD Driving voltage | V_{LCD} | $T_a = 25^\circ\text{C}$ | 0 to 18 | V |
| Input voltage | V_I | $T_a = 25^\circ\text{C}$ | GND-0.3 to $V_{DD}+0.3$ | V |
| Storage temperature | T_{STG} | — | -55 to +150 | $^\circ\text{C}$ |

RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | Condition | Range | Unit |
|--------------------------------|-------------|-----------|------------|------------------|
| Logic power supply voltage | V_{DD}^* | — | 2.7 to 5.5 | V |
| LCD Driving voltage | V_{LCD}^* | — | 4.5 to 16 | V |
| Junction operating temperature | T_{jop} | — | -40 to +85 | $^\circ\text{C}$ |

*: Use with $V_{DD} \leq V_{LCD}$

Note: Never place a short between an output pin and another output pin or between an output pin and other pins (input pins, I/O pins, or power supply pins).

: In order to prevent malfunctioning of the device, turn on the logic power supply first and then turn on the LCD driving power supply, and also turn off the LCD driving power supply and then turn off the logic power supply.

ELECTRICAL CHARACTERISTICS**DC Characteristics**(V_{DD} = 2.7 to 5.5V, V_{LCD} = 4.5 to 16V, T_j = -40 to +85°C)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Applicable pin | |
|-------------------------|---------------------|--|-------------------------|------------------------------|---------------------|------------------------------|--------------------------------|---|
| "H" Input voltage | V _{IH1} *1 | — | 0.7V _{DD} | — | V _{DD} | V | DATA IN CLOCK IN LOAD IN | |
| | V _{IH2} *2 | | 0.8V _{DD} | — | V _{DD} | | | |
| "L" Input voltage | V _{IL1} *1 | — | GND | — | 0.3V _{DD} | V | SEG-TEST IN BLANK IN | |
| | V _{IL2} *2 | | GND | — | 0.2V _{DD} | | | |
| Input leakage current 1 | I _{L1} | V _I = V _{DD} or 0V | — | — | ±1.0 | μA | M/S, D/S OSC1, OSC I/E | |
| Input leakage current 2 | I _{L2} | V _I = V _{DD} or 0V D/S = "H" M/S = "L" | — | — | ±10 | μA | SYNC | |
| "H" Output voltage | Segment | V _{OHS} | I _O = -30μA | V _{LCD} -0.2 | — | — | V | SEG1 to SEG160 |
| | Common | V _{OHC} *3 | I _O = -150μA | V _{LCD} -0.2 | — | — | V | COM A, COM B |
| | Logic | V _{OHL1} | I _O = -100μA | 0.9V _{DD} | — | — | V | DATA OUT CLOCK OUT LOAD OUT SEG-TEST OUT BLANK OUT COM OUT SYNC |
| | | V _{OHL2} | I _O = -200μA | 0.9V _{DD} | — | — | V | OSC2 |
| "M" Output voltage | Common | V _{OMC} *3 | I _O = ±150μA | 1/2V _{LCD} -0.15 | 1/2V _{LCD} | 1/2V _{LCD} +0.15 | V | COM A, COM B |
| "L" Output voltage | Segment | V _{OLS} | I _O = 30μA | — | — | 0.2 | V | SEG1 to SEG160 |
| | Common | V _{OLC} *3 | I _O = 150μA | — | — | 0.2 | V | COM A, COM B |
| | Logic | V _{OLL1} | I _O = 100μA | — | — | 0.1V _{DD} | V | DATA OUT CLOCK OUT LOAD OUT SEG-TEST OUT BLANK OUT COM OUT SYNC |
| | | V _{OLL2} | I _O = 200μA | — | — | 0.1V _{DD} | V | OSC2 |
| Output resistance | Segment | R _{SEG} | — | — | 10 | kΩ | SEG1 to SEG160 | |
| | Common | R _{COM} | — | — | 1.5 | kΩ | COM A, COM B | |

"M": Middle level

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Applicable pin |
|---------------------------|------------|--|------|------|------|---------------|----------------|
| Static supply current | I_{DD1} | D/S = "L" (Static) Fix other input levels at either "H" or "L" Oscillator stopped No load | — | — | 30 | μA | V_{DD} |
| | I_{DD2} | D/S = "H" (1/2duty) Fix other input levels at either "H" or "L" Oscillator stopped No load | — | — | 30 | μA | V_{DD} |
| | I_{LCD1} | D/S = "L" (Static) Fix other input levels at either "H" or "L" Oscillator stopped No load | — | — | 30 | μA | V_{LCD} |
| | I_{LCD2} | D/S = "H" (1/2duty) Fix other input levels at either "H" or "L" Oscillator stopped No load | — | — | 900 | μA | V_{LCD} |
| Dynamic supply current *4 | I_{DD1} | $V_{DD} = 5.5\text{V}$ D/S = "L" (Static) OSC1 is Open OSC2 is connected to OSCR Other inputs are "H" or "L" No load | — | — | 3 | mA | V_{DD} |
| | I_{DD2} | $V_{DD} = 5.5\text{V}$ D/S = "H" (1/2duty) OSC1 is Open OSC2 is connected to OSCR Other inputs are "H" or "L" No load | — | — | 3 | mA | V_{DD} |
| | I_{LCD1} | $V_{DD} = 5.5\text{V}$ D/S = "L" (Static) OSC1 is Open OSC2 is connected to OSCR Other inputs are "H" or "L" No load | — | — | 200 | μA | V_{LCD} |
| | I_{LCD2} | $V_{DD} = 5.5\text{V}$ D/S = "H" (1/2duty) OSC1 is Open OSC2 is connected to OSCR Other inputs are "H" or "L" No load | — | — | 1 | mA | V_{LCD} |

*1: Applicable to the DATA IN, LOAD IN, SEG-TEST IN, M/S, D/S, and OSC I/E pins.

*2: Applicable to the CLOCK IN, OSC1, and BLANK IN pins.

*3: Applicable to the voltage drop when the current flows into or out of one COM pin.

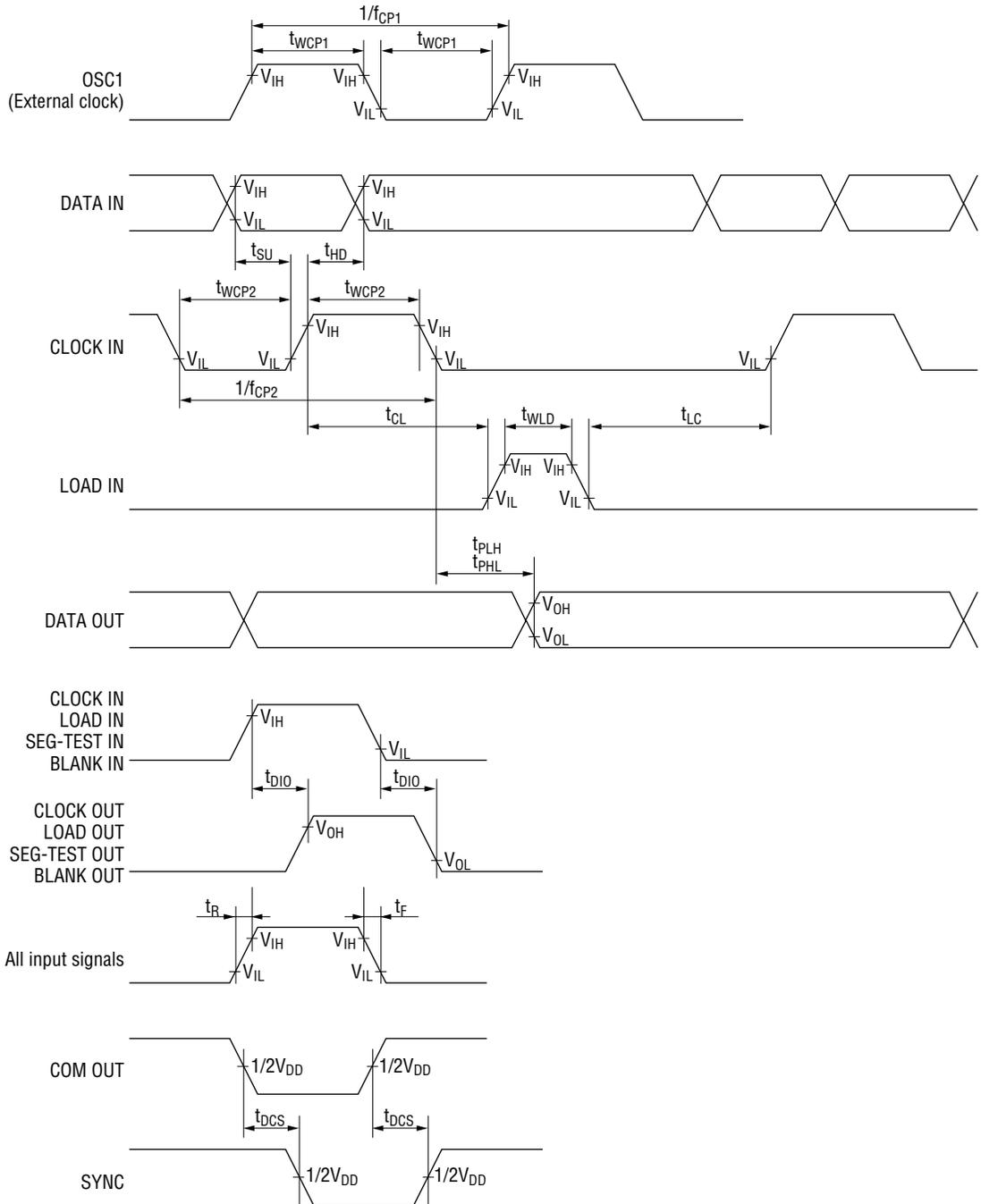
*4: The LCD display data of "0" and "1" are input alternately.

Switching Characteristics

(V_{DD} = 2.7 to 5.5V, V_{LCD} = 4.5 to 16V, T_j = -40 to +85°C)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Applicable pin |
|---|--------------------------------------|--|------|------|------|------|--|
| OSC IN Clock frequency (external input) | f _{CP1} | The clock is input to the OSC1 pin. The pins OSC2 and OSCR are left open. OSC I/E = "L" | — | — | 25.6 | kHz | OSC1 |
| Clock pulse width (external input) | t _{WCP1} | | 50 | — | — | μs | OSC1 |
| External Rf clock frequency (internal oscillations) | f _{OSC1} | An Rf of 120k Ω ±2% is connected between OSC1 and OSC2. OSCR is left open. OSC I/E = "H" | 2.0 | 8.5 | 15.0 | kHz | OSC1, OSC2 |
| Internal Rf clock frequency (with the built-in oscillator) | f _{OSC2} | OSC1 open. OSC2 and OSCR shorted. OSC I/E tied to V _{DD} or any "H" level. | 7.7 | 12.8 | 20.5 | kHz | OSC1, OSCR, OSC2 |
| Data clock frequency | f _{CP2} | | — | — | 1 | MHz | CLOCK IN |
| Data clock pulse width | t _{WCP2} | | 100 | — | — | ns | CLOCK IN |
| Data setup time | t _{SU} | | 50 | — | — | ns | DATA IN |
| Data hold time | t _{HD} | | 50 | — | — | ns | CLOCK IN |
| CLOCK to LOAD Period | t _{CL} | | 100 | — | — | ns | CLOCK IN |
| LOAD to CLOCK Period | t _{LC} | | 100 | — | — | ns | LOAD IN |
| LOAD Pulse width | t _{WLD} | | 100 | — | — | ns | LOAD IN |
| CLOCK IN to DATA OUT delay time | t _{PLH} t _{PHL} | C _L =15pF | — | — | 70 | ns | CLOCK IN DATA OUT |
| IN to OUT delay time | t _{DIO} | No load | — | — | 40 | ns | CLOCK IN/OUT LOAD IN/OUT SEG-TEST IN/OUT BLANK IN/OUT |
| COM OUT to SYNC delay time | t _{DCS} | C _L =15pF | — | — | 40 | ns | COM OUT SYNC |
| Input signal rise time | t _R | | — | — | 50 | ns | All inputs other than the OSCR input |
| Input signal fall time | t _F | | — | — | 50 | ns | |

TIMING DIAGRAM



FUNCTIONAL DESCRIPTION

The ML9060 is an LCD driver LSI with an internal shift register and a set of internal data latches and is capable of driving LCD displays of up to 160 segments in the static mode or 320 segments in the 1/2 duty mode. The display data is read into the shift register serially from the DATA IN pin at the rising edge of the CLOCK IN input signal. The display data is transferred internally to the data latches at the High level of the LOAD IN input signal and is output to the segments via the segment drivers in this IC. The display data in the shift register is output via the DATA OUT pin in synchronization with the falling edge of the CLOCK IN input signal. The display data should be input in the sequence of SEG160, SEG159, ... , SEG2, SEG1 for proper display of data.

Description of Pin Functions

• M/S

This is the input pin for selecting either the Master mode or the Slave mode. This LSI goes into the master mode when this pin is High and enters the Slave mode when this pin is Low.

• D/S

This input pin is for selecting either the dynamic display mode at 1/2 duty (D mode - "H" input) or the static display mode (S mode - "L" input).

Note that the internal bias resistor is made ON in the dynamic (D) mode and is turned OFF in the static mode (S).

• OSC I/E

This is the input pin for selecting whether to use the external clock input mode, or the internal Rf oscillation mode or the external Rf oscillation mode.

When this pin is tied to the "H" level, the internal Rf oscillation mode or the external Rf oscillation is used. When this pin is tied to the "L" level, the external clock input is used for the operation of the LSI.

In the slave mode of operation of this LSI, any input to this pin will be ignored. Hence, tie this pin to V_{DD} or GND in the slave mode.

• OSC1, OSCR, OSC2

These are the pins for the oscillator for generating the common signal.

In the Master mode (M/S pin = "H"):

It is possible to select from among the three modes - internal Rf oscillation mode, external Rf oscillation mode, and the external clock input mode. During the static display operation mode, a common signal with 1/128th the frequency of the clock oscillator is output via the COM OUT pin.

During the 1/2 duty dynamic display operation mode, a common signal with 1/64th the frequency of the clock oscillator is output via the COM OUT pin.

- Internal Rf oscillation mode: Tie the OSC I/E pin to "H", short the pins OSCR and OSC2, and leave the pin OSC1 open.
- External Rf oscillation mode: Tie the OSC I/E pin to "H", connect an external resistor Rf between the pins OSC1 and OSC2, and leave the pin OSCR open.
- External clock input mode: Tie the OSC I/E pin to "L", leave open the pins OSCR and OSC2, and input the external clock signal to the pin OSC1.

In the Slave mode (M/S pin = "L"):

Leave open the pins OSCR and OSC2 and connect the pin OSC1 to the COM OUT pin of the ML9060 which has been set in the master mode. The common signal that is input to the pin OSC1 will be used as the internal common signal and is also output via a buffer from the COM OUT pin.

• COM OUT

This is the common signal output pin. Connect this pin to the OSC1 pin of the ML9060 that is set in the slave mode.

During operation in the master mode (M/S pin = "H") for static display, a common signal with 1/128th the frequency of the oscillator is output.

During operation in the master mode (M/S pin = "H") for 1/2 duty dynamic display, a common signal with 1/64th the frequency of the oscillator is output.

During operation in the slave mode (M/S pin = "L"), the common signal that is input at the pin OSC1 is output from this pin via a buffer.

• SYNC

This is the I/O pin for common signal synchronization.

This pin becomes the synchronization signal output pin during operation in the master mode (M/S pin = "H") for 1/2 duty dynamic display.

This pin becomes the synchronization signal input pin during operation in the slave mode (M/S pin = "L") for 1/2 duty dynamic display.

For cascade operation in the 1/2 duty display mode, connect the SYNC pins of all ML9060 ICs used together.

During operation in the static display mode, this pin is tied to the "L" level inside the IC. Connect this pin either to GND or leave it open.

• DATA IN

This is the display data input pin. Input the display data in the sequence of SEG160, SEG159, ..., SEG2, SEG1. The segment is turned ON when the display data is "H" and OFF when "L".

• DATA OUT

This is the display data output pin. During the static display mode of operation, the data of the 160th stage of the shift register is output from this pin. During the 1/2 duty dynamic display mode, the data of the 320th stage of the shift register is output from this pin.

• CLOCK IN

This is the input pin for the shift clock of the display data. The display data that is input at the DATA IN pin is input serially to the shift register at the rising edge of the CLOCK IN signal. Also, the display data in the shift register is output from the DATA OUT pin at the falling edge of the CLOCK IN signal.

• CLOCK OUT

This is the output pin for the shift clock of the display data. The shift clock signal that is input to the CLOCK IN pin is output via a buffer from this pin.

• LOAD IN

This is the input pin for the display data load signal.

The display data in the shift register is output as such to the segment driver when this signal is at the "H" level. When this signal is made "L", the shift register is isolated from the segment drivers, and the display data of the shift register just before this pin goes "L" is retained in the data latches and transferred to the segment drivers.

• LOAD OUT

This is the output pin for the display data load signal. The load signal that is input to the LOAD IN pin is output from this pin via a buffer.

• SEG-TEST IN

This is the input pin for making all segments ON. When this pin is "H", all segment outputs (SEG1 to SEG160) become ON irrespective of the display data and the Blank signal. When this pin is made "L", each of the segment outputs (SEG1 to SEG160) become ON or OFF according to the display data.

• SEG-TEST OUT

This is the output pin for making all segments ON. The segment ON signal that is input to the SEG-TEST IN pin is output via a buffer.

• BLANK IN

This is the input pin for making all segments OFF. When this pin is "H", all segment outputs (SEG1 to SEG160) become OFF irrespective of the display data. When this pin is made "L", each of the segment outputs (SEG1 to SEG160) becomes ON or OFF according to the display data. The BLANK IN is valid when the segment ON signal is "L".

• BLANK OUT

This is the output pin for making all segments OFF. The segment OFF signal that is input to the BLANK IN pin is output via a buffer.

• SEG1 to SEG160

These are the signal outputs for driving the LCD segments and are connected to the corresponding segment pins of the LCD panel.

In the Static display mode:

The SEG_n output corresponds to bit n of the display data in the data latch A. The display data in the data latch B becomes invalid. In the segment ON condition, a signal with a phase opposite to that of the COM OUT signal is output from these pins. In the segment OFF condition, a signal with a phase identical to that of the COM OUT signal is output from these pins.

In the 1/2 duty dynamic display mode:

The SEG_n output corresponds to bit n of the display data in the data latch A when COM A has been selected and to bit n of the display data in the data latch B when COM B has been selected. In the segment display ON condition, a signal opposite in phase to that of the selected COM output is output from these pins. In the segment display OFF condition, a signal identical in phase to that of the selected COM output is output from these pins.

• COM A, COM B

These are the outputs for LCD display and are connected to the common pins of the LCD panel.

In the Static display mode:

COM A and COM B both output a signal with the same phase as that of the COM OUT signal.

In the 1/2 duty dynamic display mode:

COM A and COM B change their states at every cycle of the COM OUT signal and repeat the selected and non-selected modes always opposing each other in phase. A signal with the same phase as that of the COM OUT signal is output in the selected mode. A voltage equal to $1/2V_{LCD}$ is output in the non-selected mode.

When COM A is in the selected mode (that is, COM B is in the non-selected mode), the segment outputs (SEG1 to SEG160) output signals corresponding to the display data in the data latch A. When COM B is in the selected mode (that is, COM A is in the non-selected mode), the segment outputs (SEG1 to SEG160) output signals corresponding to the display data in the data latch B.

• V_{DD}

This is the power supply input pin for the logic circuits.

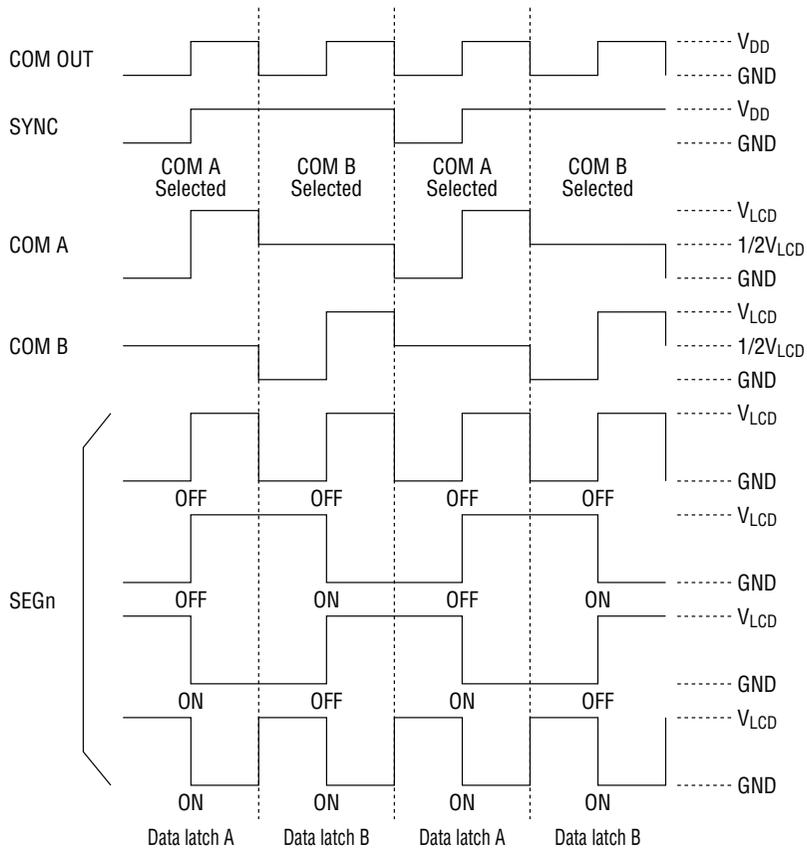
• V_{LCD}

This is the power supply input pin for the LCD drivers.

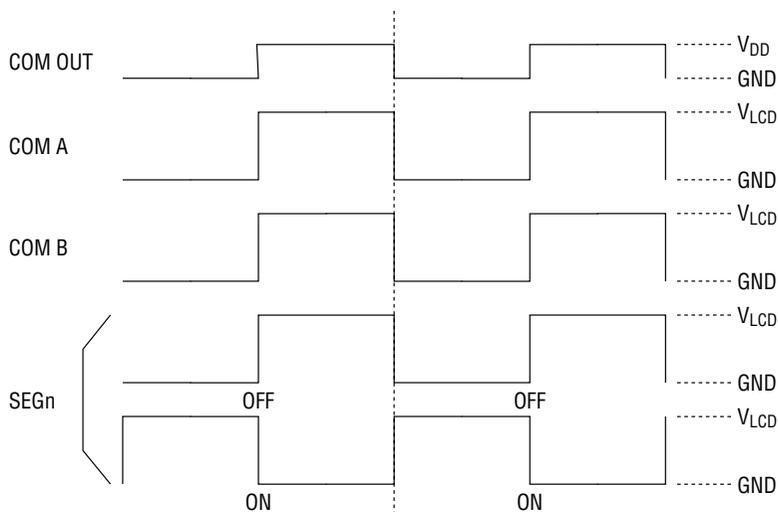
• GND

This is the ground pin for all circuits.

**Segment Output and Common Output Waveforms
In the 1/2 duty display mode:**

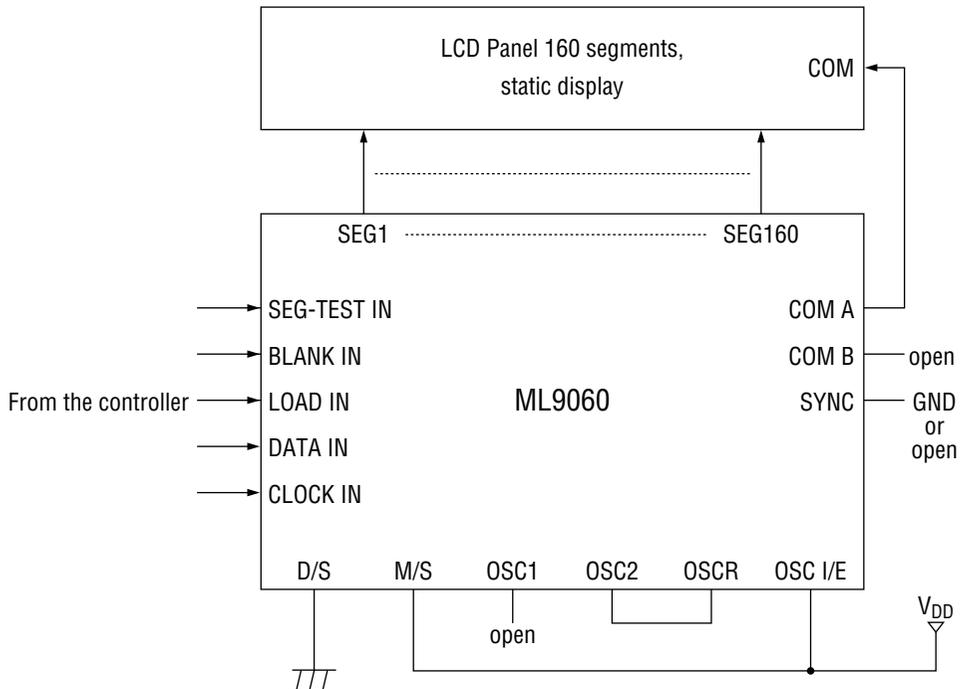


In the static display mode:

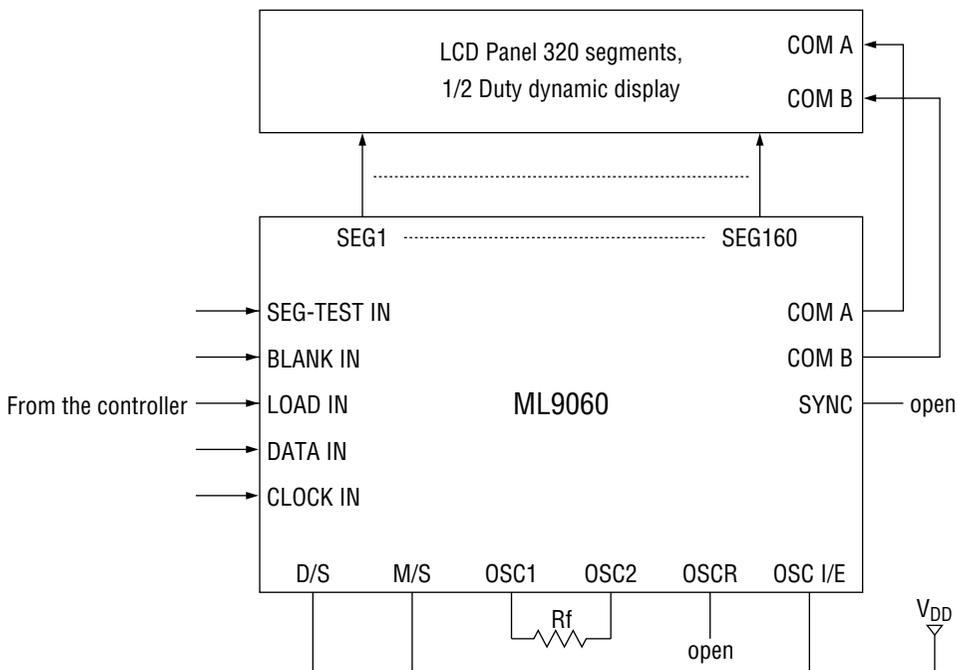


APPLICATION CIRCUIT EXAMPLES

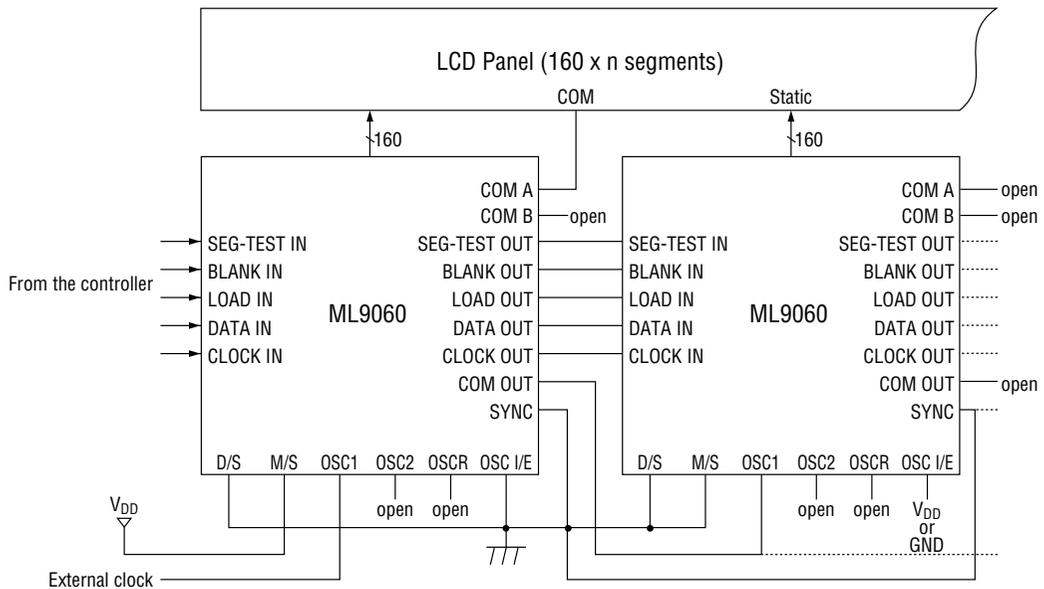
When a single ML9060 is used - Static display mode (internal Rf oscillation mode)



When a single ML9060 is used - 1/2 duty dynamic display mode (external Rf oscillation mode)

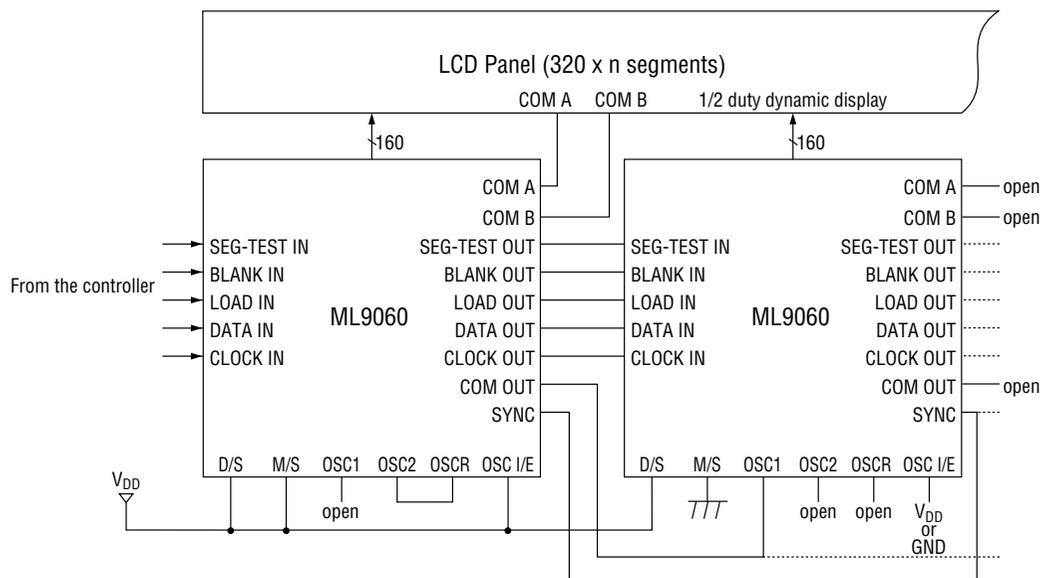


Cascade Connection - Static display mode (external clock input mode)



Note: Take care about the resistance and capacitance of wiring for cascade connection.

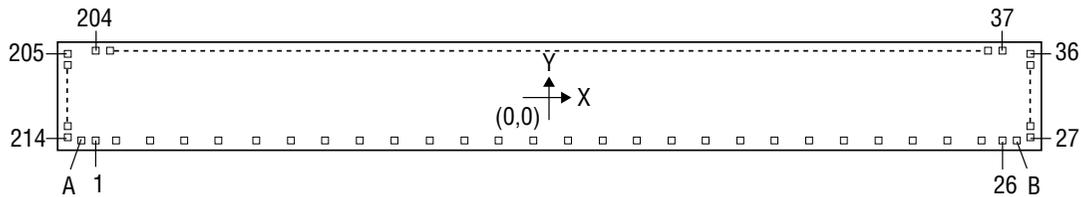
Cascade Connection - 1/2 duty dynamic display mode (internal Rf oscillation mode)



Note: Take care about the resistance and capacitance of wiring for cascade connection.

PAD CONFIGURATION**Pad Layout (Pattern side)**

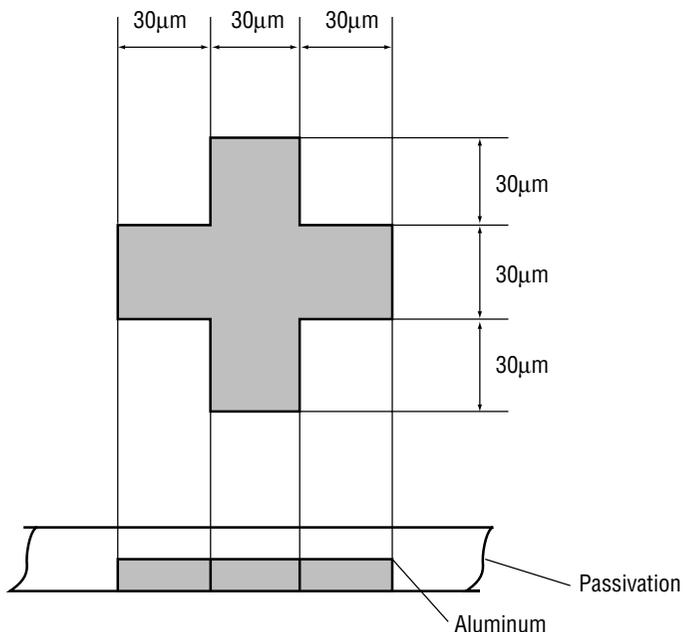
| | |
|------------------------------|----------------------------|
| Chip size | : 14.50 × 1.63mm |
| Chip thickness | : 625 μ m ± 30 μ m |
| Minimum bump pitch | : 80 μ m |
| Bump height | : 15 μ m ± 5 μ m |
| Bump height inside the chip: | max. – min. ≤ 4 μ m |
| Bump hardness | : max. 100 (HV: 25 g LOAD) |



* : The substrate of the chip should either be connected to the GND level or be left open.

Bump and Alignment Mark Dimensions (Pattern side)

| | |
|-----------------------------|-------------------|
| PAD No.1 to 26, 37 to 204 | : 50 × 80 μ m |
| PAD No.27 to 36, 205 to 214 | : 80 × 50 μ m |
| Alignment marks A and B | : Shown below |



Pad Center Coordinates

| Pad No. | Pad name | X-coordinate (μm) | Y-coordinate (μm) | Pad No. | Pad name | X-coordinate (μm) | Y-coordinate (μm) |
|---------|------------------|-----------------------------------|-----------------------------------|---------|-------------|-----------------------------------|-----------------------------------|
| 1 | NC | -6680 | -636 | 21 | OSC2 | 4008 | -636 |
| 2 | NC | -6146 | -636 | 22 | OSCR | 4542 | -636 |
| 3 | SYNC | -5611 | -636 | 23 | OSC1 | 5077 | -636 |
| 4 | NC | -5077 | -636 | 24 | NC | 5611 | -636 |
| 5 | COMOUT | -4542 | -636 | 25 | NC | 6146 | -636 |
| 6 | NC | -4008 | -636 | 26 | NC | 6680 | -636 |
| 7 | V _{LCD} | -3474 | -636 | 27 | NC | 7121 | -435 |
| 8 | V _{LCD} | -2939 | -636 | 28 | NC | 7121 | -355 |
| 9 | V _{LCD} | -2405 | -636 | 29 | DATA IN | 7121 | -275 |
| 10 | NC | -1870 | -636 | 30 | NC | 7121 | -195 |
| 11 | GND | -1336 | -636 | 31 | CLOCK IN | 7121 | -115 |
| 12 | GND | -802 | -636 | 32 | LOAD IN | 7121 | -35 |
| 13 | GND | -267 | -636 | 33 | SEG-TEST IN | 7121 | 45 |
| 14 | D/S | 267 | -636 | 34 | BLANK IN | 7121 | 125 |
| 15 | OSC I/E | 802 | -636 | 35 | NC | 7121 | 205 |
| 16 | M/S | 1336 | -636 | 36 | NC | 7121 | 285 |
| 17 | V _{DD} | 1870 | -636 | 37 | NC | 6680 | 636 |
| 18 | V _{DD} | 2405 | -636 | 38 | NC | 6600 | 636 |
| 19 | V _{DD} | 2939 | -636 | 39 | NC | 6520 | 636 |
| 20 | NC | 3474 | -636 | 40 | COMA | 6440 | 636 |

NC: No Connection

| Pad No. | Pad name | X-coordinate (μm) | Y-coordinate (μm) | Pad No. | Pad name | X-coordinate (μm) | Y-coordinate (μm) |
|---------|----------|-----------------------------------|-----------------------------------|---------|----------|-----------------------------------|-----------------------------------|
| 41 | COM B | 6360 | 636 | 86 | SEG45 | 2760 | 636 |
| 42 | SEG1 | 6280 | 636 | 87 | SEG46 | 2680 | 636 |
| 43 | SEG2 | 6200 | 636 | 88 | SEG47 | 2600 | 636 |
| 44 | SEG3 | 6120 | 636 | 89 | SEG48 | 2520 | 636 |
| 45 | SEG4 | 6040 | 636 | 90 | SEG49 | 2440 | 636 |
| 46 | SEG5 | 5960 | 636 | 91 | SEG50 | 2360 | 636 |
| 47 | SEG6 | 5880 | 636 | 92 | SEG51 | 2280 | 636 |
| 48 | SEG7 | 5800 | 636 | 93 | SEG52 | 2200 | 636 |
| 49 | SEG8 | 5720 | 636 | 94 | SEG53 | 2120 | 636 |
| 50 | SEG9 | 5640 | 636 | 95 | SEG54 | 2040 | 636 |
| 51 | SEG10 | 5560 | 636 | 96 | SEG55 | 1960 | 636 |
| 52 | SEG11 | 5480 | 636 | 97 | SEG56 | 1880 | 636 |
| 53 | SEG12 | 5400 | 636 | 98 | SEG57 | 1800 | 636 |
| 54 | SEG13 | 5320 | 636 | 99 | SEG58 | 1720 | 636 |
| 55 | SEG14 | 5240 | 636 | 100 | SEG59 | 1640 | 636 |
| 56 | SEG15 | 5160 | 636 | 101 | SEG60 | 1560 | 636 |
| 57 | SEG16 | 5080 | 636 | 102 | SEG61 | 1480 | 636 |
| 58 | SEG17 | 5000 | 636 | 103 | SEG62 | 1400 | 636 |
| 59 | SEG18 | 4920 | 636 | 104 | SEG63 | 1320 | 636 |
| 60 | SEG19 | 4840 | 636 | 105 | SEG64 | 1240 | 636 |
| 61 | SEG20 | 4760 | 636 | 106 | SEG65 | 1160 | 636 |
| 62 | SEG21 | 4680 | 636 | 107 | SEG66 | 1080 | 636 |
| 63 | SEG22 | 4600 | 636 | 108 | SEG67 | 1000 | 636 |
| 64 | SEG23 | 4520 | 636 | 109 | SEG68 | 920 | 636 |
| 65 | SEG24 | 4440 | 636 | 110 | SEG69 | 840 | 636 |
| 66 | SEG25 | 4360 | 636 | 111 | SEG70 | 760 | 636 |
| 67 | SEG26 | 4280 | 636 | 112 | SEG71 | 680 | 636 |
| 68 | SEG27 | 4200 | 636 | 113 | SEG72 | 600 | 636 |
| 69 | SEG28 | 4120 | 636 | 114 | SEG73 | 520 | 636 |
| 70 | SEG29 | 4040 | 636 | 115 | SEG74 | 440 | 636 |
| 71 | SEG30 | 3960 | 636 | 116 | SEG75 | 360 | 636 |
| 72 | SEG31 | 3880 | 636 | 117 | SEG76 | 280 | 636 |
| 73 | SEG32 | 3800 | 636 | 118 | SEG77 | 200 | 636 |
| 74 | SEG33 | 3720 | 636 | 119 | SEG78 | 120 | 636 |
| 75 | SEG34 | 3640 | 636 | 120 | SEG79 | 40 | 636 |
| 76 | SEG35 | 3560 | 636 | 121 | SEG80 | -40 | 636 |
| 77 | SEG36 | 3480 | 636 | 122 | SEG81 | -120 | 636 |
| 78 | SEG37 | 3400 | 636 | 123 | SEG82 | -200 | 636 |
| 79 | SEG38 | 3320 | 636 | 124 | SEG83 | -280 | 636 |
| 80 | SEG39 | 3240 | 636 | 125 | SEG84 | -360 | 636 |
| 81 | SEG40 | 3160 | 636 | 126 | SEG85 | -440 | 636 |
| 82 | SEG41 | 3080 | 636 | 127 | SEG86 | -520 | 636 |
| 83 | SEG42 | 3000 | 636 | 128 | SEG87 | -600 | 636 |
| 84 | SEG43 | 2920 | 636 | 129 | SEG88 | -680 | 636 |
| 85 | SEG44 | 2840 | 636 | 130 | SEG89 | -760 | 636 |

| Pad No. | Pad name | X-coordinate (μm) | Y-coordinate (μm) | Pad No. | Pad name | X-coordinate (μm) | Y-coordinate (μm) |
|---------|----------|-----------------------------------|-----------------------------------|---------|-------------|-----------------------------------|-----------------------------------|
| 131 | SEG90 | -840 | 636 | 176 | SEG135 | -4440 | 636 |
| 132 | SEG91 | -920 | 636 | 177 | SEG136 | -4520 | 636 |
| 133 | SEG92 | -1000 | 636 | 178 | SEG137 | -4600 | 636 |
| 134 | SEG93 | -1080 | 636 | 179 | SEG138 | -4680 | 636 |
| 135 | SEG94 | -1160 | 636 | 180 | SEG139 | -4760 | 636 |
| 136 | SEG95 | -1240 | 636 | 181 | SEG140 | -4840 | 636 |
| 137 | SEG96 | -1320 | 636 | 182 | SEG141 | -4920 | 636 |
| 138 | SEG97 | -1400 | 636 | 183 | SEG142 | -5000 | 636 |
| 139 | SEG98 | -1480 | 636 | 184 | SEG143 | -5080 | 636 |
| 140 | SEG99 | -1560 | 636 | 185 | SEG144 | -5160 | 636 |
| 141 | SEG100 | -1640 | 636 | 186 | SEG145 | -5240 | 636 |
| 142 | SEG101 | -1720 | 636 | 187 | SEG146 | -5320 | 636 |
| 143 | SEG102 | -1800 | 636 | 188 | SEG147 | -5400 | 636 |
| 144 | SEG103 | -1880 | 636 | 189 | SEG148 | -5480 | 636 |
| 145 | SEG104 | -1960 | 636 | 190 | SEG149 | -5560 | 636 |
| 146 | SEG105 | -2040 | 636 | 191 | SEG150 | -5640 | 636 |
| 147 | SEG106 | -2120 | 636 | 192 | SEG151 | -5720 | 636 |
| 148 | SEG107 | -2200 | 636 | 193 | SEG152 | -5800 | 636 |
| 149 | SEG108 | -2280 | 636 | 194 | SEG153 | -5880 | 636 |
| 150 | SEG109 | -2360 | 636 | 195 | SEG154 | -5960 | 636 |
| 151 | SEG110 | -2440 | 636 | 196 | SEG155 | -6040 | 636 |
| 152 | SEG111 | -2520 | 636 | 197 | SEG156 | -6120 | 636 |
| 153 | SEG112 | -2600 | 636 | 198 | SEG157 | -6200 | 636 |
| 154 | SEG113 | -2680 | 636 | 199 | SEG158 | -6280 | 636 |
| 155 | SEG114 | -2760 | 636 | 200 | SEG159 | -6360 | 636 |
| 156 | SEG115 | -2840 | 636 | 201 | SEG160 | -6440 | 636 |
| 157 | SEG116 | -2920 | 636 | 202 | NC | -6520 | 636 |
| 158 | SEG117 | -3000 | 636 | 203 | NC | -6600 | 636 |
| 159 | SEG118 | -3080 | 636 | 204 | NC | -6680 | 636 |
| 160 | SEG119 | -3160 | 636 | 205 | NC | -7121 | 285 |
| 161 | SEG120 | -3240 | 636 | 206 | NC | -7121 | 205 |
| 162 | SEG121 | -3320 | 636 | 207 | BLANKOUT | -7121 | 125 |
| 163 | SEG122 | -3400 | 636 | 208 | SEG-TESTOUT | -7121 | 45 |
| 164 | SEG123 | -3480 | 636 | 209 | LOADOUT | -7121 | -35 |
| 165 | SEG124 | -3560 | 636 | 210 | CLOCKOUT | -7121 | -115 |
| 166 | SEG125 | -3640 | 636 | 211 | NC | -7121 | -195 |
| 167 | SEG126 | -3720 | 636 | 212 | DATAOUT | -7121 | -275 |
| 168 | SEG127 | -3800 | 636 | 213 | NC | -7121 | -355 |
| 169 | SEG128 | -3880 | 636 | 214 | NC | -7121 | -435 |
| 170 | SEG129 | -3960 | 636 | | | | |
| 171 | SEG130 | -4040 | 636 | A | '+' ALIGN | -6980 | -640 |
| 172 | SEG131 | -4120 | 636 | B | '+' ALIGN | 6980 | -640 |
| 173 | SEG132 | -4200 | 636 | | | | |
| 174 | SEG133 | -4280 | 636 | | | | |
| 175 | SEG134 | -4360 | 636 | | | | |

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