

FEATURES

- Internal Memory
 - Character Generator ROM: 8320 bits
 - Character Generator RAM: 512 bit
 - Display Data RAM: 80 x 8 bits for 80 digits
- Internal automatic reset circuit at power ON
- Internal oscillation circuit
- Power Supply Voltage: +5V ± 10%
- LCD Driving Voltage for display: 0 ~ -5V(V₅)
- Duty factor selection (selected by programs)
 - 1/8 duty: 5 x 7 dots format 1 line,
 - 1/11 duty: 5 x 10 dots format 1 line
 - 1/16 duty: 5 x 7 dots format 2 line
- Bare chip available
- Pin-to-Pin replacement for KS0066, HD44780, SED1278

FUNCTION

- Character type dot matrix LCD driver & controller
- Internal driver: 16 common and 40 segment signal output
- Display character format: 5 x 7 dots + cursor, 5 x 10 dots + cursor
- Easy interface with a 4-bit or 8-bit MPU
- Display character pattern:
 - 5 x 7 dots format: 192 kinds, 5 x 10 dots format: 32 kinds
- The special character pattern can be programmable by Character Generator RAM directly
- A customer character pattern can be programmable by mask option
- Wide range of instruction function:
 - Display clear, Cursor home, Display ON/OFF, Display shift
 - Cursor ON/OFF, Display character blink, Cursor shift

DESCRIPTION

The IZ0066 is a dot matrix liquid crystal display controller & driver LSI that displays alphanumerics, characters and symbols. It drives dot matrix LCD under microcomputer control. All functions needed for dot matrix LCD drive are internally provided on one chip.

ORDERING INFORMATION

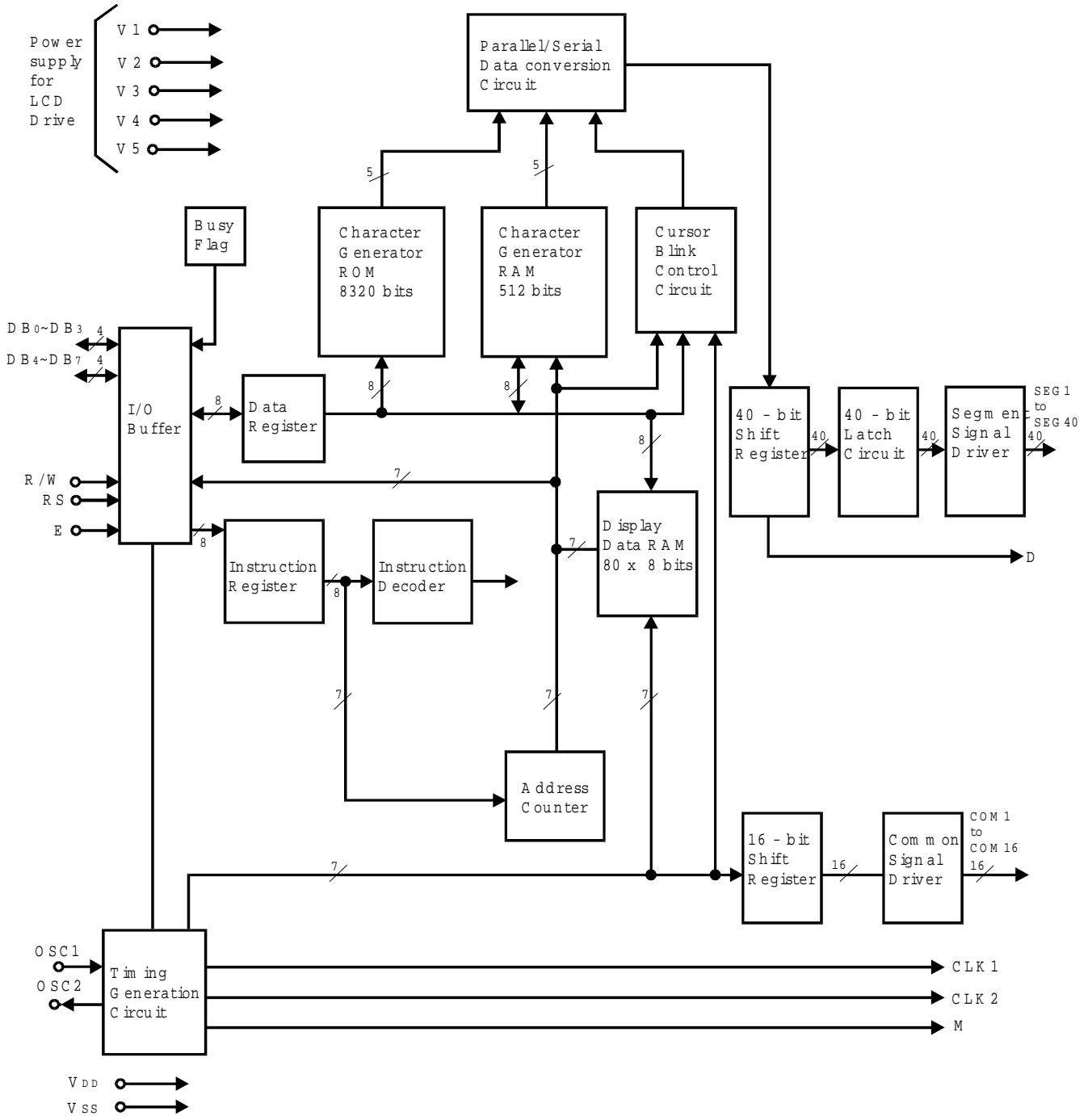
| Type | CGROM | | |
|-------------|-----------------------------|---------|----------|
| IZ0066 - 00 | English | Numeral | Japanese |
| IZ0066 - 01 | English | Numeral | Cyrillic |
| IZ0066 - XX | Custom font (XX – ROM code) | | |

ABSOLUTE MAXIMUM RATINGS

| Characteristic | Symbol | Value | Unit |
|-----------------------|---------------------------------|--|------|
| Power Supply Voltage | V _{DD} | - 0.3 ~ 7.0 | V |
| Driver Supply Voltage | V ₁ ~ V ₅ | V _{DD} - 13.5 ~ V _{DD} + 0.3 | V |
| Input Voltage | V _I | -0.3 ~ V _{DD} + 0.3 | V |
| Operating Temperature | T _a | - 20 ~ + 75 | °C |
| Storage Temperature | T _{stg} | - 55 ~ + 125 | °C |

Notes: Must keep the relation of V_{DD} ≥ V₁ ≥ V₂ ≥ V₃ ≥ V₄ ≥ V₅

BLOCK DIAGRAM

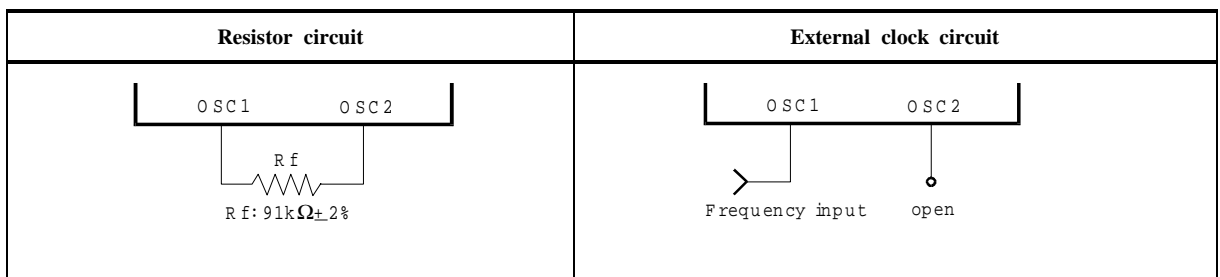


ELECTRICAL CHARACTERISTICS

(Ta = 25°C, V_{DD} = +5V, V_{SS} = 0V unless otherwise specified)

| Characteristic | | Symbol | Test Condition | Applicable Terminals | Min | Typ | Max | Unit | |
|--|---------------|-------------------|---|--|---------------------------------|--------------------|-----------------|------|--------------------|
| Operating Voltage | | V _{DD} | | | 4.5 | | 5.5 | V | |
| Operating Current (*1) | | I _{DD} | Internal oscillation or external clock f _{osc} = 270KHz | | | 0.35 | 0.6 | | |
| HIGH Input Voltage | | V _{IH} | | E, DB ₀ ~ DB ₇ , R/W, RS | 2.2 | | V _{DD} | V | |
| | | | | OSC1 | V _{DD} -1.0 | | V _{DD} | | |
| LOW Input Voltage | | V _{IL} | | E, DB ₀ ~ DB ₇ , R/W, RS | -0.3 | | 0.6 | V | |
| | | | | OSC1 | -0.2 | | 1.0 | | |
| HIGH Output Voltage | | V _{OH} | I _{OH} = -0.205 mA | DB ₀ ~ DB ₇ | 2.4 | | | V | |
| | | | | I _{OH} = -40μA | CLK1, CLK2, M, D | 0.9V _{DD} | | | |
| LOW Output Voltage | | V _{OL} | I _{OL} = 1.2mA | DB ₀ ~ DB ₇ | | | 0.4 | V | |
| | | | | I _{OL} = 40μA | CLK1, CLK2, M, D | | | | 0.1V _{DD} |
| Driver Voltage Descending | | V _{COM} | I _O = ± 0.1mA | COM1 ~ COM16 | | | 1.0 | V | |
| | | V _{SEG} | | SEG1 ~ SEG40 | | | 1.0 | | |
| Input Leakage Current | | I _{LKG} | V _{IN} = 0V ~ V _{DD} | E | -1 | | 1 | μA | |
| Input LOW Current | | I _{IL} | V _{CC} = 5V (test pull up R) | RS, R/W, DB ₀ ~ DB ₇ | -50 | -125 | -250 | μA | |
| External Clock | Frequency(*1) | f _{EC} | | OSC1 | 125 | 250 | 350 | KHz | |
| | Duty | DUTY | | | 46 | 50 | 55 | | % |
| | Rise time | t _R | | | | | 0.2 | | μs |
| | Fall time | t _F | | | | | 0.2 | | μs |
| Internal Clock Frequency(*1) | | f _{OSC1} | Rf = 91KΩ ± 2% | OSC1, OSC2 | 190 | 270 | 350 | KHz | |
| Ceramic Resonator Oscillation Frequency (*1) | | f _{OSC2} | | | 245 | 250 | 255 | | |
| LCD Driving Voltage (*2) | | V _{LCD1} | V _{DD} - V ₅ | 1/5 bias | V ₁ ~ V ₅ | 4.6 | | 10.0 | V |
| | | V _{LCD2} | | | | 1/4 bias | 3.0 | | |

Notes: *1). Oscillation circuit



*2). Input the voltage listed in table below to V₁ ~ V₅

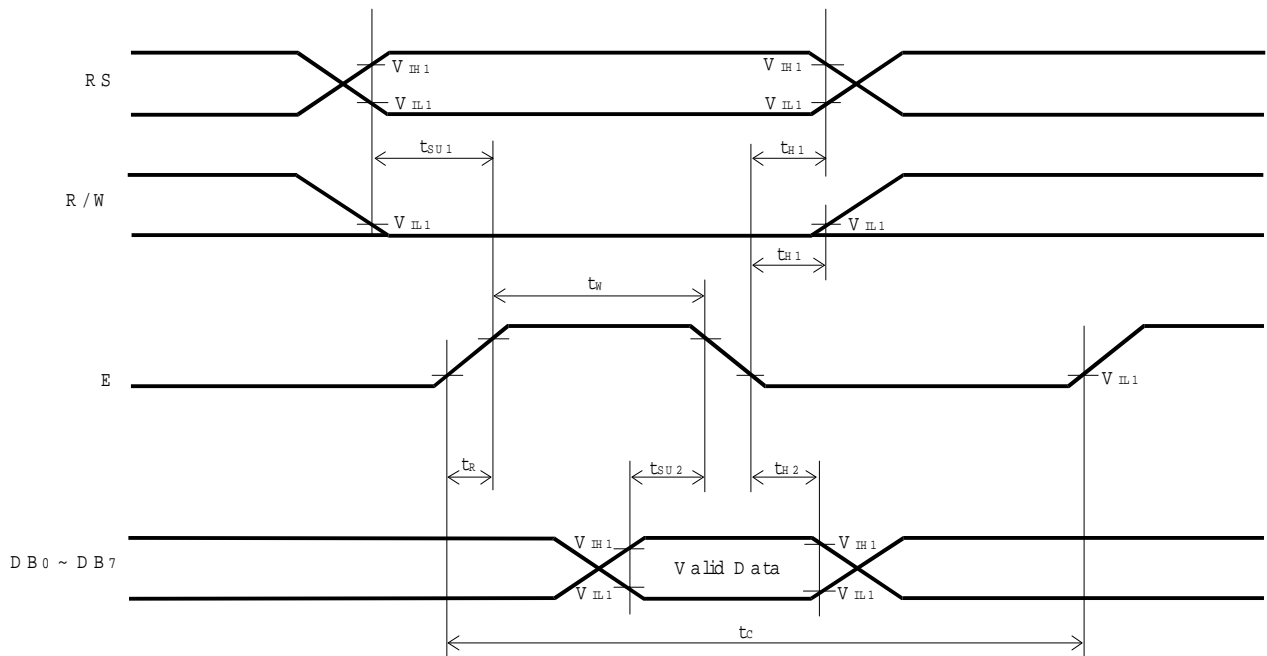
| Power supply | Duty | 1/8, 1/11 | 1/16 |
|----------------|------|--|--|
| | Bias | 1/4 | 1/5 |
| V ₁ | | V _{DD} - V _{LCD} /4 | V _{DD} - V _{LCD} /5 |
| V ₂ | | V _{DD} - V _{LCD} /2 | V _{DD} - 2V _{LCD} /5 |
| V ₃ | | V _{DD} - V _{LCD} /2 | V _{DD} - 3V _{LCD} /5 |
| V ₄ | | V _{DD} - 3V _{LCD} /4 | V _{DD} - 4V _{LCD} /5 |
| V ₅ | | V _{DD} - V _{LCD} | V _{DD} - V _{LCD} |

*V_{LCD} is the LCD driving voltage, refer to the initial set of the instruction code.

AC CHARACTERISTICS ($V_{DD} = 5V$, $V_{SS} = 0V$, $T_a = 25^\circ C$)

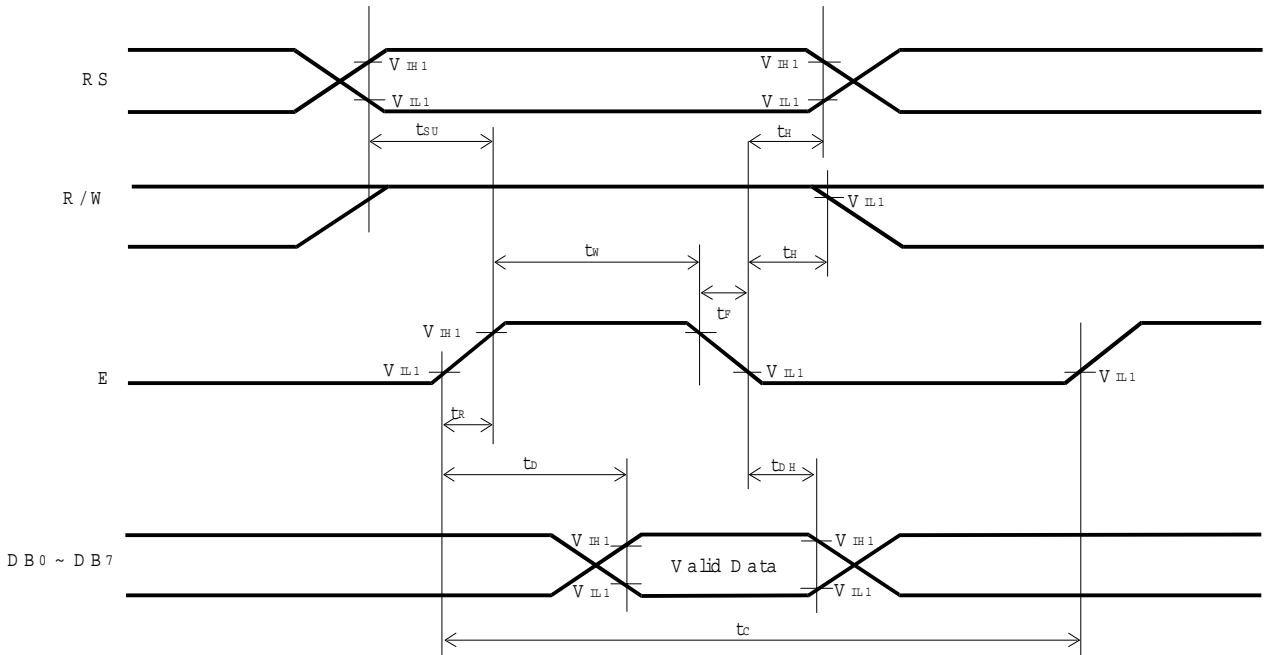
(1) Write mode (Writing data from MPU to IZ0066)

| Characteristic | Symbol | Test pin | Min | Typ | Max | Unit |
|---------------------------|-----------|-----------------------------------|-----|-----|-----|------|
| E Cycle Time | t_c | E | 500 | | | ns |
| E Rise Time | t_r | E | | | 25 | ns |
| E Fall Time | t_f | E | | | 25 | ns |
| E Pulse Width (High, Low) | t_w | E | 220 | | | ns |
| R/W and RS Set-up Time | t_{SU1} | R/W, RS | 40 | | | ns |
| R/W and RS Hold Time | t_{H1} | R/W, RS | 10 | | | ns |
| Data Set-up Time | t_{SU2} | DB ₀ ~ DB ₇ | 60 | | | ns |
| Data Hold Time | t_{H2} | DB ₀ ~ DB ₇ | 10 | | | ns |



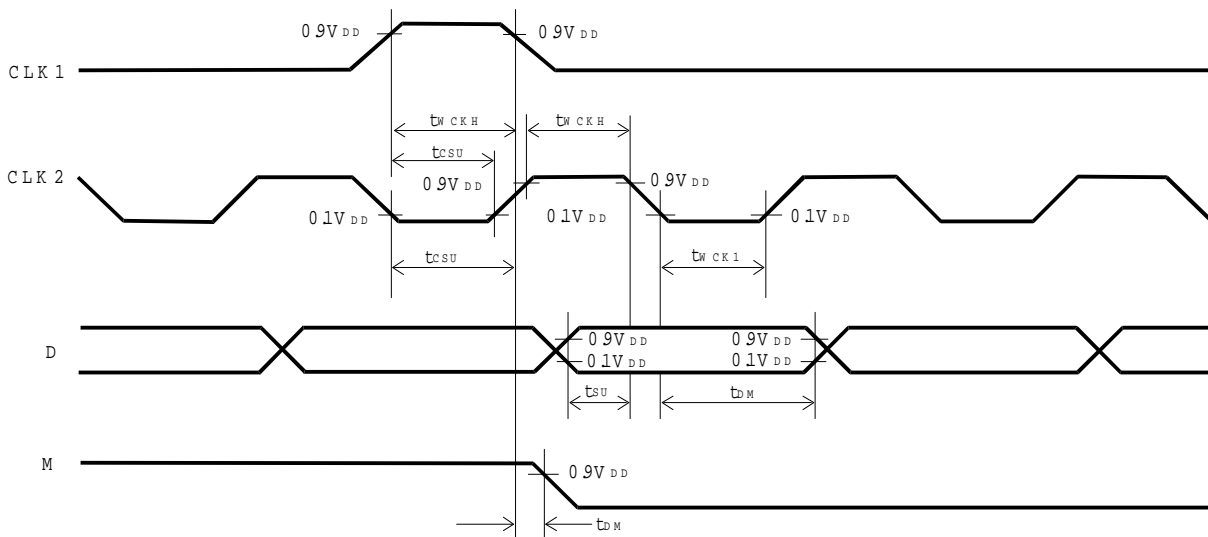
(2) Read mode (Reading data from IZ0066 to MPU)

| Characteristic | Symbol | Test pin | Min | Typ | Max | Unit |
|---------------------------|-----------|-----------------------------------|-----|-----|-----|------|
| E Cycle Time | t_c | E | 500 | | | ns |
| E Rise Time | t_r | E | | | 25 | ns |
| E Fall Time | t_f | E | | | 25 | ns |
| E Pulse Width (High, Low) | t_w | E | 220 | | | ns |
| R/W and RS Set-up Time | t_{SU1} | R/W, RS | 40 | | | ns |
| R/W and RS Hold Time | t_{H1} | R/W, RS | 10 | | | ns |
| Data Output Delay Time | t_D | DB ₀ ~ DB ₇ | | | 120 | ns |
| Data Hold Time | t_{H2} | DB ₀ ~ DB ₇ | 20 | | | ns |



(3) Interface mode with IZ0065

| Characteristic | Symbol | Test pin | Min | Typ | Max | Unit |
|------------------------|------------|----------|-------|-----|------|------|
| Clock Pulse Width High | t_{WCKH} | CLK | 800 | | | ns |
| Clock Pulse Width Low | t_{WCKL} | CLK | 800 | | | ns |
| Data Set-up Time | t_{SU} | D | 300 | | | ns |
| Data Hold Time | t_{DH} | D | 300 | | | ns |
| Clock Set-up Time | t_{CSU} | CLK | 500 | | | ns |
| M Delay Time | t_{DM} | M | -1000 | | 1000 | ns |



TERMINAL DESCRIPTION

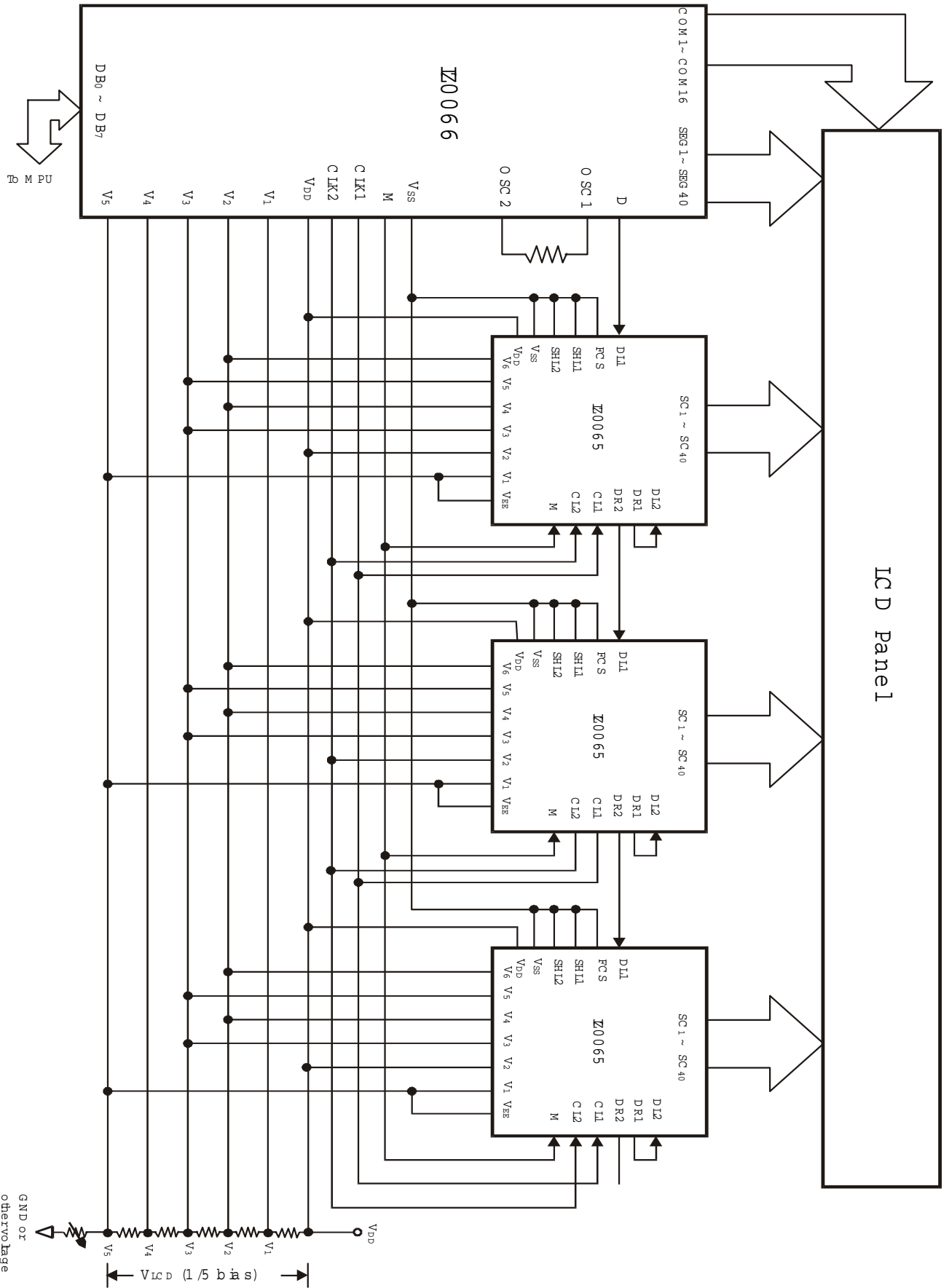
| Pin | INPUT/OUTPUT | Name | DESCRIPTION | INTERFACE | | | | |
|-----------------------------------|---|--|--|------------------------------------|------|---|-----|---------------|
| V _{DD} | Power | Operating Voltage | For logical circuit (+5V ± 10%) | Power Supply | | | | |
| V _{SS} | | | 0V(GND) | | | | | |
| V ₁ – V ₅ | | Negative Supply Voltage | Bias voltage level for LCD driving | | | | | |
| SEG1 – SEG40 | Output | Segment output | Segment signal output for LCD driving | LCD | | | | |
| COM1 – COM16 | Output | Common output | Common signal output for LCD driving | LCD | | | | |
| OSC1 | Input | Oscillator | Both pin connected to Rf resistor or ceramic resonator for internal oscillator circuit. In case of external frequency use only, the frequency is input to OSC1 terminal. | Resistor or Ceramic Resonator | | | | |
| OSC2 | Output | | | | | | | |
| CLK1 | Output | Data latch clock | Clock output terminal for the serially transferred data to be latched to the driver. | IZ0065 | | | | |
| CLK2 | | Data shift clock | Clock output terminal used when D terminal data output shifts the inside of the driver. | | | | | |
| M | | Alternated signal for LCD driver output | The alternating signal to convert LCD drive waveform to AC. | | | | | |
| D | | Display data interface | Character pattern data, which is corresponding to each common signal, is supplied to driver serially. <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>High</td> <td>Selection</td> </tr> <tr> <td>Low</td> <td>Non selection</td> </tr> </table> | | High | Selection | Low | Non selection |
| High | Selection | | | | | | | |
| Low | Non selection | | | | | | | |
| E | Input | Enable | Start anable signal to read or write the data | MPU | | | | |
| R/W | | Read/Write | R/W signal input is used to select the read/write mode <table border="1" style="margin-left: auto; margin-right: auto;"> <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 | | | | | | | |
| RS | Register select | Register selection input <table border="1" style="margin-left: auto; margin-right: auto;"> <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) | | | | | | | |
| DB ₀ – DB ₇ | Input/Output | Data interface | Used for data transfer between the MPU and IZ0066. These terminals are for data bus with bidirectional three-state. Initial 4 bit (DB ₀ -DB ₃) are not used during 4 bit operation (DB ₇ can be used as a busy flag) | | | | | |

CONTROL and DISPLAY COMMANDS

| Command | RS | R/W | DB ₇ | DB ₆ | DB ₅ | DB ₄ | DB ₃ | DB ₂ | DB ₁ | DB ₀ | Execution time (f _{osc} =250KHz) | Remark | | | | | | | | | | | | | | | | | | |
|--------------------------|----|------------------------|-----------------|---|--|-----------------|-----------------|-----------------|-----------------------------|--|---|---|------|---|------------------|-------|---|------------------|-----|---|--------------------|--|---|------------------------|---|---|-------------|--|---|--------------|
| DISPLAY CLEAR | L | L | L | L | L | L | L | L | L | H | 1.64 ms | | | | | | | | | | | | | | | | | | | |
| RETURN HOME | L | L | L | L | L | L | L | L | H | X | 1.64 ms | Cursor move to first digit | | | | | | | | | | | | | | | | | | |
| ENTRY MODE SET | L | L | L | L | L | L | L | H | I/D | SH | 40µs | *I/D: set cursor move direction <table border="1"> <tr> <td>I/D</td> <td>H</td> <td>Increase</td> </tr> <tr> <td></td> <td>L</td> <td>Decrease</td> </tr> </table> *SH: Specifies shift of display <table border="1"> <tr> <td>SH</td> <td>H</td> <td>Display is shifted</td> </tr> <tr> <td></td> <td>L</td> <td>Display is not shifted</td> </tr> </table> | I/D | H | Increase | | L | Decrease | SH | H | Display is shifted | | L | Display is not shifted | | | | | | |
| I/D | H | Increase | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Decrease | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SH | H | Display is shifted | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Display is not shifted | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DISPLAY ON/OFF | L | L | L | L | L | L | H | D | C | B | 40µs | *Display <table border="1"> <tr> <td>D</td> <td>H</td> <td>Display on</td> </tr> <tr> <td></td> <td>L</td> <td>Display off</td> </tr> </table> *Cursor <table border="1"> <tr> <td>C</td> <td>H</td> <td>Cursor on</td> </tr> <tr> <td></td> <td>L</td> <td>Cursor off</td> </tr> </table> *Blinking <table border="1"> <tr> <td>B</td> <td>H</td> <td>Blinking on</td> </tr> <tr> <td></td> <td>L</td> <td>Blinking off</td> </tr> </table> | D | H | Display on | | L | Display off | C | H | Cursor on | | L | Cursor off | B | H | Blinking on | | L | Blinking off |
| D | H | Display on | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Display off | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | H | Cursor on | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Cursor off | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | H | Blinking on | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Blinking off | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIFT | L | L | L | L | L | H | S/C | R/L | X | X | 40µs | <table border="1"> <tr> <td>SC</td> <td>H</td> <td>Display shift</td> </tr> <tr> <td></td> <td>L</td> <td>Cursor move</td> </tr> </table> <table border="1"> <tr> <td>R/L</td> <td>H</td> <td>Right shift</td> </tr> <tr> <td></td> <td>L</td> <td>Left shift</td> </tr> </table> | SC | H | Display shift | | L | Cursor move | R/L | H | Right shift | | L | Left shift | | | | | | |
| SC | H | Display shift | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Cursor move | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R/L | H | Right shift | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Left shift | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SET FUNCTION | L | L | L | L | H | DL | N | F | X | X | 40µs | <table border="1"> <tr> <td>DL</td> <td>H</td> <td>8 bits interface</td> </tr> <tr> <td></td> <td>L</td> <td>4 bits interface</td> </tr> </table> <table border="1"> <tr> <td>N</td> <td>H</td> <td>2 line display</td> </tr> <tr> <td></td> <td>L</td> <td>1 line display</td> </tr> </table> <table border="1"> <tr> <td>F</td> <td>H</td> <td>5x10 dots</td> </tr> <tr> <td></td> <td>L</td> <td>5x7 dots</td> </tr> </table> | DL | H | 8 bits interface | | L | 4 bits interface | N | H | 2 line display | | L | 1 line display | F | H | 5x10 dots | | L | 5x7 dots |
| DL | H | 8 bits interface | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | 4 bits interface | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N | H | 2 line display | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | 1 line display | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | H | 5x10 dots | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | 5x7 dots | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SET CG RAM ADDRESS | L | L | L | H | CG RAM address (corresponds to cursor address) | | | | | 40µs | CG RAM Data is sent and received after this setting | | | | | | | | | | | | | | | | | | | |
| SET DD RAM ADDRESS | L | L | H | DD RAM address | | | | | 40µs | DD RAM Data is sent and received after this setting | | | | | | | | | | | | | | | | | | | | |
| READ BUSY FLAG & ADDRESS | L | H | BF | Address Counter used for CG RAM address Both DD & | | | | | 0µs | <table border="1"> <tr> <td>BF</td> <td>H</td> <td>Busy</td> </tr> <tr> <td></td> <td>L</td> <td>Ready</td> </tr> </table> -Reads BF indication internal operating is being performed. -Reads address counter contents | BF | H | Busy | | L | Ready | | | | | | | | | | | | | | |
| BF | H | Busy | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | L | Ready | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WRITE DATA | H | L | Write Data | | | | | 46µs | Write data DD or CG RAM | | | | | | | | | | | | | | | | | | | | | |
| READ DATA | H | H | Read Data | | | | | 46µs | Read data from DD or CG RAM | | | | | | | | | | | | | | | | | | | | | |

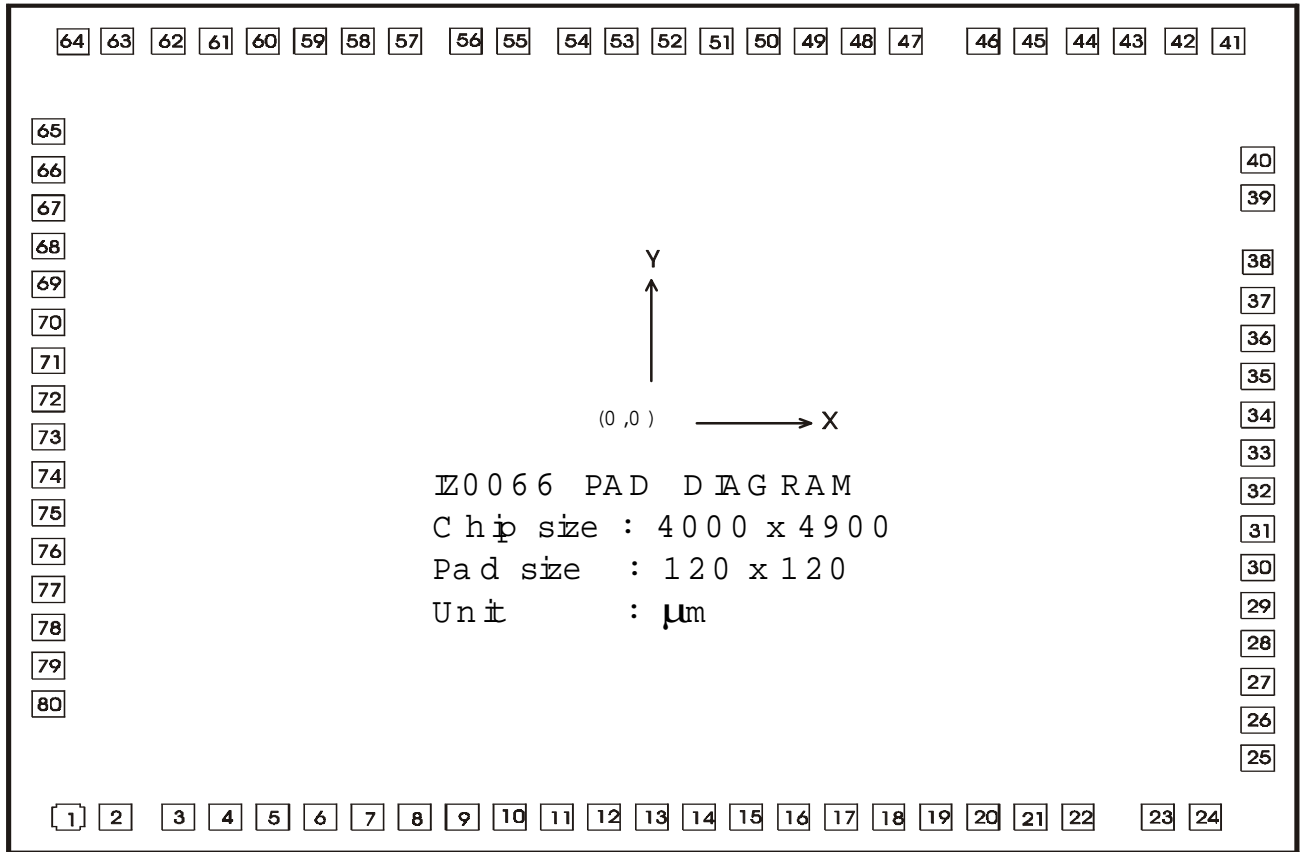
Note: X – Don't care.

APPLICATION CIRCUIT



When IZ0065 is externally connected to the IZ0066, you can increase the number of display digits up to 80 characters.

PAD LAYOUT



The chip substrate is connected to V_{DD} .

PAD LOCATION

(Unit: μm)

| Pad No. | Pad Name | X | Y | Pad No. | Pad Name | X | Y | Pad No. | Pad Name | X | Y |
|---------|----------|-------|-------|---------|----------|------|-------|---------|----------|-------|-------|
| 1 | SEG22 | -2221 | -1830 | 28 | V3 | 2299 | -1012 | 55 | COM9 | -530 | 1830 |
| 2 | SEG21 | -2041 | -1830 | 29 | V4 | 2299 | -832 | 56 | COM10 | -710 | 1830 |
| 3 | SEG20 | -1804 | -1830 | 30 | V5 | 2299 | -862 | 57 | COM11 | -941 | 1830 |
| 4 | SEG19 | -1624 | -1830 | 31 | CL1 | 2299 | -472 | 58 | COM12 | -1121 | 1830 |
| 5 | SEG18 | -1444 | -1830 | 32 | CL2 | 2299 | -292 | 59 | COM13 | -1301 | 1830 |
| 6 | SEG17 | -1264 | -1830 | 33 | V_{CC} | 2299 | -112 | 60 | COM14 | -1481 | 1830 |
| 7 | SEG16 | -1084 | -1830 | 34 | M | 2299 | 68 | 61 | COM15 | -1661 | 1830 |
| 8 | SEG15 | -904 | -1830 | 35 | D | 2299 | 248 | 62 | COM16 | -1841 | 1830 |
| 9 | SEG14 | -724 | -1830 | 36 | RS | 2299 | 428 | 63 | SEG40 | -2036 | 1830 |
| 10 | SEG13 | -544 | -1830 | 37 | R/W | 2299 | 608 | 64 | SEG39 | -2216 | 1830 |
| 11 | SEG12 | -364 | -1830 | 38 | E | 2299 | 788 | 65 | SEG38 | -2298 | 1404 |
| 12 | SEG11 | -184 | -1830 | 39 | DB0 | 2299 | 1090 | 66 | SEG37 | -2298 | 1224 |
| 13 | SEG10 | -4 | -1830 | 40 | DB1 | 2299 | 1270 | 67 | SEG36 | -2298 | 1044 |
| 14 | SEG9 | 176 | -1830 | 41 | DB2 | 2188 | 1830 | 68 | SEG35 | -2298 | 864 |
| 15 | SEG8 | 35 | -1830 | 42 | DB3 | 2008 | 1830 | 69 | SEG34 | -2298 | 684 |
| 16 | SEG7 | 536 | -1830 | 43 | DB4 | 1812 | 1830 | 70 | SEG33 | -2298 | 504 |
| 17 | SEG6 | 716 | -1830 | 44 | DB5 | 1632 | 1830 | 71 | SEG32 | -2298 | 324 |
| 18 | SEG5 | 896 | -1830 | 45 | DB6 | 1436 | 1830 | 72 | SEG31 | -2298 | 144 |
| 19 | SEG4 | 1076 | -1830 | 46 | DB7 | 1256 | 1830 | 73 | SEG30 | -2298 | -36 |
| 20 | SEG3 | 1256 | -1830 | 47 | COM1 | 961 | 1830 | 74 | SEG29 | -2298 | -216 |
| 21 | SEG2 | 1436 | -1830 | 48 | COM2 | 781 | 1830 | 75 | SEG28 | -2298 | -396 |
| 22 | SEG1 | 1616 | -1830 | 49 | COM3 | 601 | 1830 | 76 | SEG27 | -2298 | -576 |
| 23 | GND | 1920 | -1830 | 50 | COM4 | 421 | 1830 | 77 | SEG26 | -2298 | -756 |
| 24 | OSC1 | 2100 | -1830 | 51 | COM5 | 241 | 1830 | 78 | SEG25 | -2298 | -936 |
| 25 | OSC2 | 2299 | -1552 | 52 | COM6 | 61 | 1830 | 79 | SEG24 | -2298 | -1116 |
| 26 | V1 | 2299 | -1372 | 53 | COM7 | -119 | 1830 | 80 | SEG23 | -2298 | -1296 |
| 27 | V2 | 2299 | -1192 | 54 | COM8 | -299 | 1830 | | | | |