
LCD CONTROLLER DRIVER

INTRODUCTION

The NT7066U is a dot matrix LCD driver & controller LSI which is fabricated by low CMOS technology.

FUNCTION

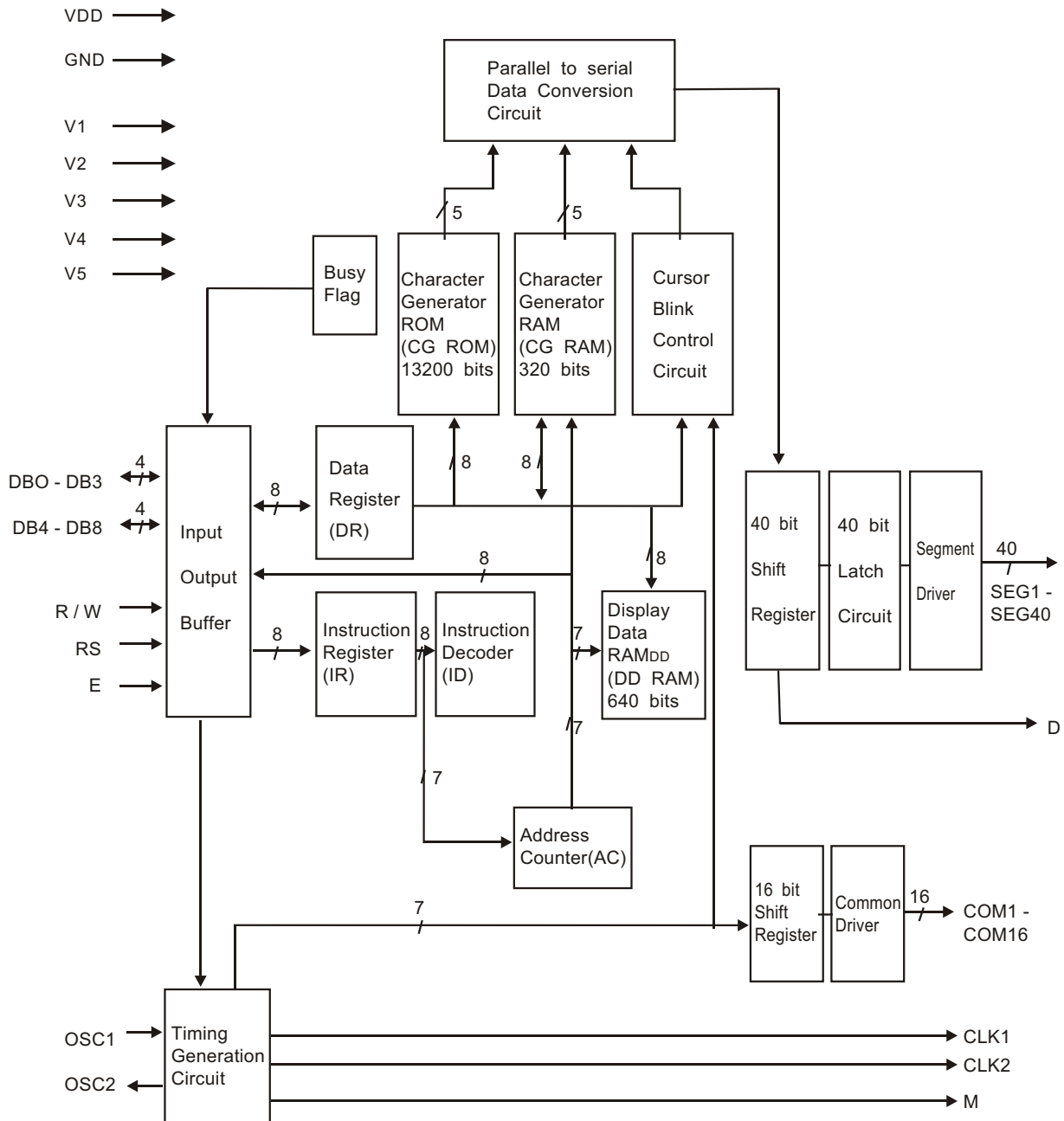
- Character type dot matrix LCD driver & controller
- Internal driver : 16 common and 40 segment signal output
- Display character format; 5 x 7 dots + cursor, 5 x 10 dots + cursor
- Easy interface with a 4 bit or 8 bit MPU
- Display character pattern: refer to table 2.
- 5 x 7 dots format 208 kinds, 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.
- Automatic power on reset function.
- It can drive a maximum 80 character by using the NT7065B or NT7063 type.
- It is possible to read both Character Generator and Display Data RAM from MPU.

FEATURES

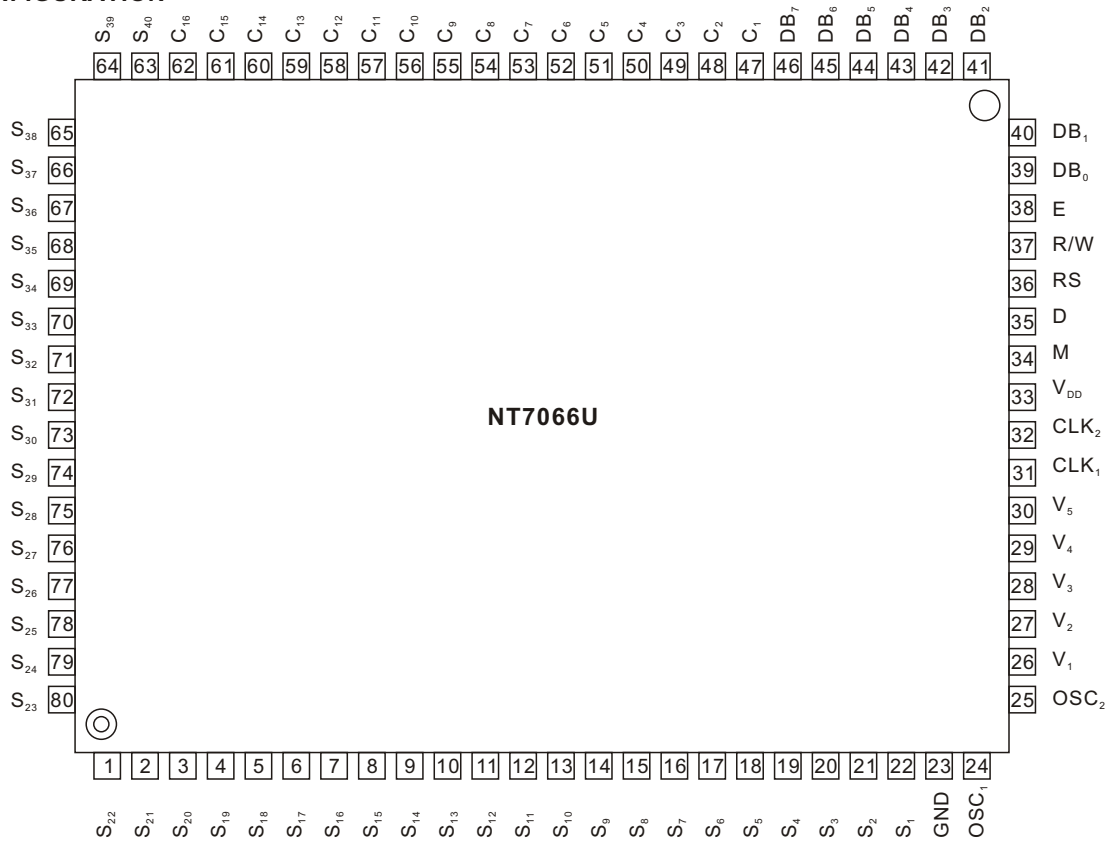
- Internal Memory
- Character Generator ROM: 13200 bits
- Character Generator RAM: 320 bits
- Display Data RAM: 80 x 8bits for 80 digits
- Power Supply Voltage; 2.7V~5.5V
- LCD supply voltage 3~13V($V_{DD}-V_s$)
- CMOS process
- 1/8 duty, 1/11 duty or 1/16 duty: selectable
- (1/8 duty ; 5 x 7 dots format 1 line, 1/11 duty ; 5 x 10 dots format 1 line, 1/16 duty : 5x7 format 2 line)
- Bare chip available.

ORDERING INFORMATION

Part No.	Package	Remarks
NT7066U-F00	Chip form	English-Japanese character fonts
NT7066U-F01	Chip form	English-European character fonts



PIN CONFIGURATION



PIN DESCRIPTION

PIN(No)	INPUT/ OUTPUT	NAME	DESCRIPTION	INTERFACE
VDD(33)	-	Operating Voltage	for logical circuit(+3V±10%,+5V±10%)	Power Supply
VSS(GND) (23)			0V(GND)	
V1~V5(26~30)		Driver Supply Voltage	Bias voltage level for LCD driving.	
S1~S40 (1~22,63~80)	Output	Segment output	Segment signal output for LCD drive.	LCD
C1~C16 (47~62)	Output	Common output	Common signal output for LCD drive.	LCD
OSC1,OSC2 (24,25)	Input(OSC1), Output(OSC2)	Oscillator	When use internal oscillator, connect external Rf resistor. If external clock is used, connect it to OSC1.	External Resistor/ Oscillator(OSC1)
CLK1,CLK2 (31,32)	Output	Extension driver Latch(CLK1)/ Shift(CLK2)clock	Each outputs extension driver latch clock and extension driver shift clock.	Extension driver
M(34)	Output	Alternated signal for LCD driver output	Outputs the alternating signal to convert LCD driver waveform to AC.	Extension driver
D(35)	Output	Display data interface	Outputs extension driver data (the 41th dot's data)	Extension driver
RS(36)	Input	Register select	Used as register selection input. When RS = "High", Data register is selected. When RS = "Low", Instruction register is selected.	MPU
R/W(37)	Input	Read · Write	Used as read/write selection input. When R/W = "High", read operation. When R/W = "Low",write operation.	MPU
E(38)	Input	Read · write enable	Read · write enable signal.	MPU
DB0~DB3 (39~42)	Input · Output	Data bus 0~7	When 8-bit bus mode, used as low order bidirectional data bus. During 4-bit bus mode open these pins.	MPU
DB4~DB7 (43~46)			When 8-bit bus mode, used as high order bidirectional data bus. In case of 4-bit bus mode, used as both high and low order. DB7 is used for Busy Flag output.	

FUNCTION DESCRIPTION

System Interface

This chip has all two kinds of interface type with MPU : 4-bit and 8-bit bus.
4-bit bus and 8-bit bus is selected by DL bit in the instruction register.

During read or write operation,two 8-bit registers are used.one is data register(DR),
the other is instruction register(IR).

The data register(DR) is used as temporary data storage place for being written into or
read from DDRAM/CGRAM, target RAM is selected by RAM address setting instruction.
Each internal operation, reading from or writing into RAM, is done automatically.
So to speak, after MPU reads DR data, the data in the next DDRAM/CGRAM address is
transferred into DR automatically. Also after MPU writes data to DR, the data in DR is
transferred into DDRAM/CGRAM automatically.

The Instruction register(IR) is used only to store instruction code transferred from MPU.
MPU cannot use it to read instruction data.

To select register, use RS input pin in 4-bit/8-bit bus mode.

Table 1. Various kinds of operations according to RS and R/W bits.

RS	R/W	Operation
L	L	Instruction Write operation (MPU writes Instruction code into IR)
L	H	Read Busy Flag(DB7)and address counter(DB0~DB6)
H	L	Data Write operation(MPU writes data into DR)
H	H	Data Read operation(MPU reads data from DR)

Busy Flag(BF)

When BF = "High", it indicates that the internal operation is being processed. So during
this time the next instruction cannot be accepted. BF can be read, when RS =Low and
Before executing the next instruction,be sure that BF is not High.

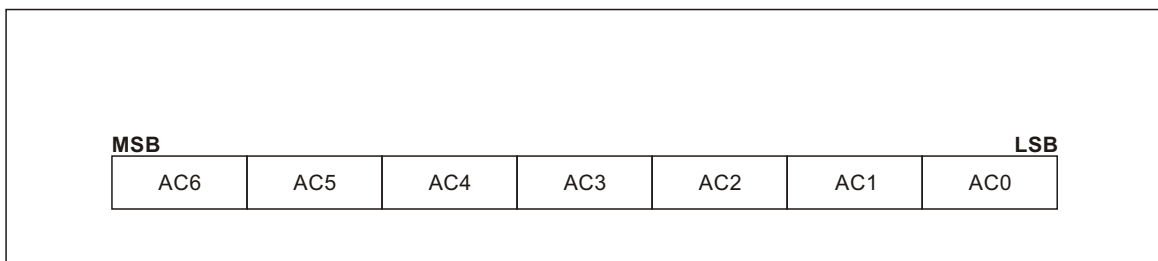
Address Counter(AC)

Address Counter(AC) stores DDRAM/CGRAM address, transferred from IR.
After writing into(reading from)DDRAM/CGRAM, AC is automatically increased(decreased)by 1.
When RS = "Low" and R/W = "High", AC can be read through DB0~DB6 ports.

Display Data RAM(DDRAM)

DDRAM stores display data of maximum 80 x 8 bits(80 characters).
DDRAM address is set in the address counter(AC) as a hexadecimal number. (refer to Fig-1.)

Fig-1. DDRAM Address



1) 1 line display

In case of 1 line display, the address range of DDRAM is 00H ~ 4FH.
Extension driver will be used. Fig-2 shows the example that 40 segment extension driver is added.

2) 2 line display

In case of 2 line display, the address range of DDRAM is 00H ~ 27H, 40H ~ 67H.
Extension driver will be used. Fig-3 shows the example that 40 segment extension driver is added.

Fig-2. 1-line x 24ch. display with 40 SEG. extension driver.

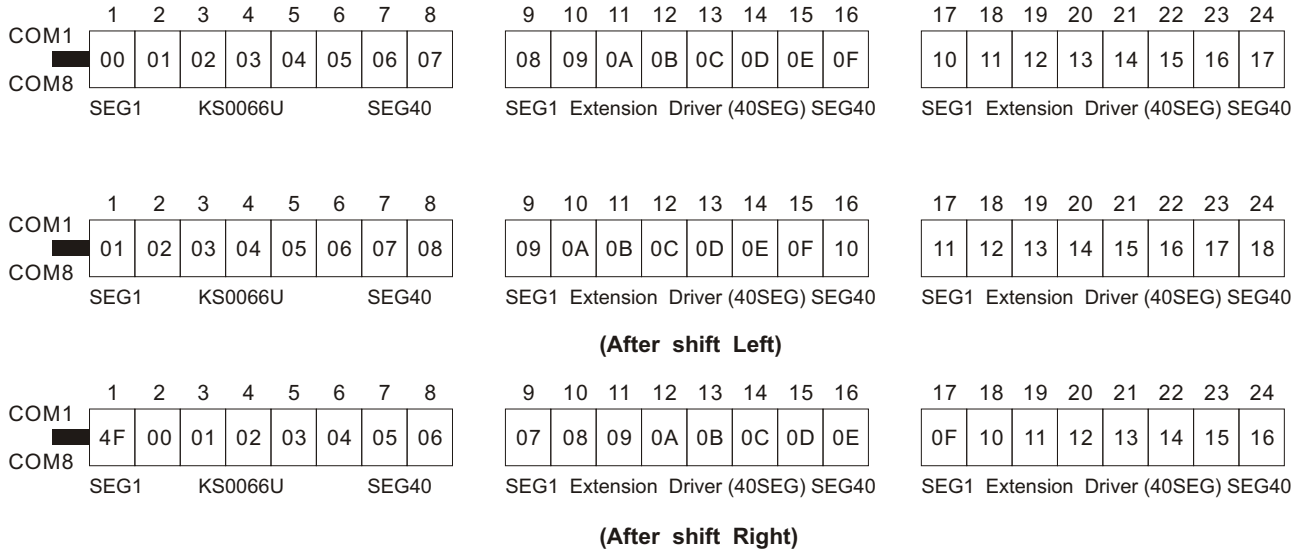
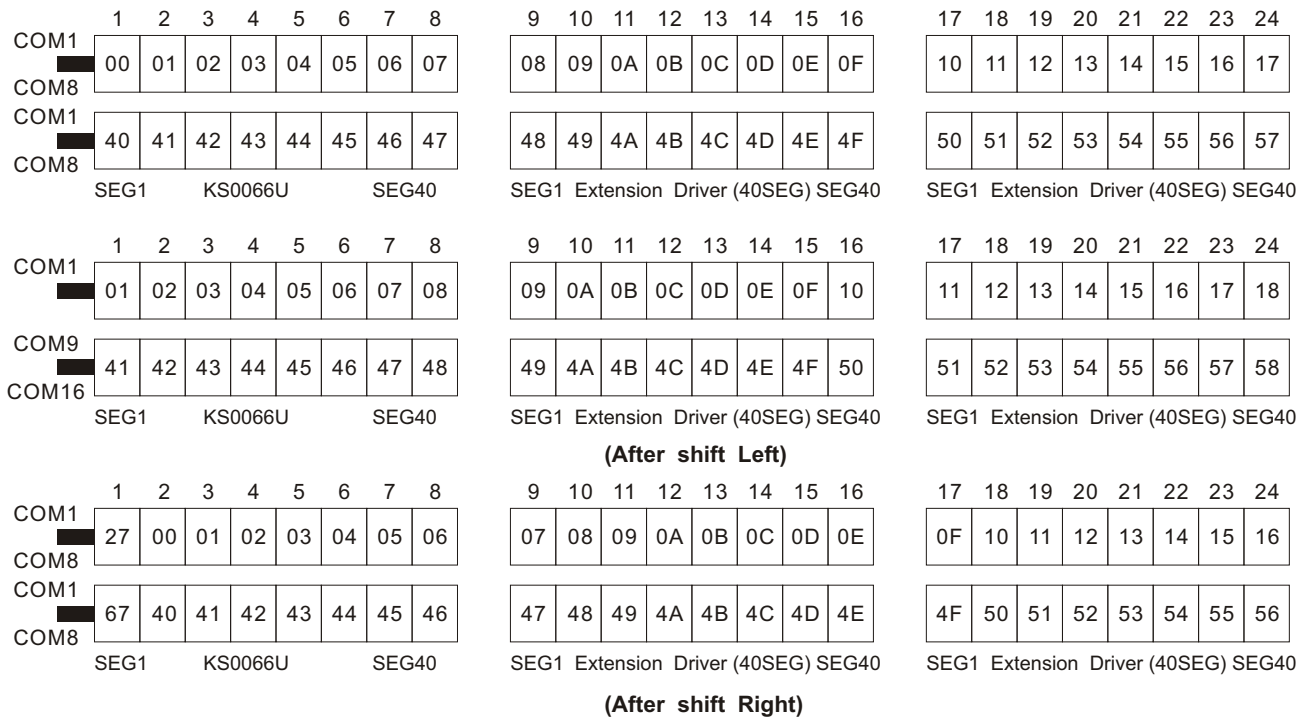


Fig-3. 2-line x 24ch. display with 40 SEG. extension driver.



CGROM (Character Generator ROM)

CGROM has 5 x 8 dot, 208 character, 5 x 11 dot, 32 character pattern.(refer to Table 2)

CGRAM (Character Generator RAM)

CGRAM has up to 5 x 8 dot, 8 characters. By writing font data to CGRAM, user defined character can be used. (refer to Table3)

Timing Generation Circuit

Timing generation circuit generates clock signals for the internal operations.

LCD Driver Circuit

LCD Driver circuit has 16 common and 40 segment signals for LCD driving.

Data from CGRA/CGROM is transferred to 40 bit segment latch serially, and then it is stored to 40 bit shift latch. When each common is selected by 16 bit common register, segment data also output through segment driver from 40 bit segment latch.

In case of 1-line display mode, COM1 ~ COM8 have 1/8 duty or COM1 ~ COM11 have 1/11 duty, and in 2-line mode, COM1 ~ COM16 have 1/16 duty ratio.

Cursor/Blink Control Circuit

It controls cursor/blink ON/OFF at cursor position.

Table 2.1 Standard Character Pattern (F00)

Upper 4bit lower 4bit	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HLLL	HLLH	HHLL	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HLLL	(5)															
HLLH	(6)															
HHLL	(7)															
HHHL	(8)															
HHHH	(8)															

Table 2.2 Standard Character Pattern (F01)

Upper 4bit / lower 4bit	LLLL	LLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HLLH	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HLLH	(5)															
HHLH	(6)															
HHHL	(7)															
HHHH	(8)															

Table 3. Relationship between Character Code(DDRAM) and Character Pattern(CGRAM)

Character Code(DDRAM data)	CGRAM address						CGRAM data								Pattern number								
	D7	D9	D5	D7	D3	D2	D1	D0	A5	A4	A3	A2	A1	A0		P7	P6	P5	P4	P3	P2	P1	P0
0 0 0 0 X 0 0 0	0	0	0	0	X	0	0	0	0	0	0	0	0	0	X	X	X	0	1	1	1	0	Pattern 1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0	0	1	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0	1	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0	1	1	⋮	⋮	⋮	1	1	1	1	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	0	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	0	1	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	1	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	1	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	1	1	⋮	⋮	⋮	0	0	0	0	0		
0 0 0 0 X 1 1 1	0	0	0	0	X	1	1	1	1	1	1	0	0	0	X	X	X	1	0	0	0	1	Pattern 8
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0	0	1	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0	1	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0	1	1	⋮	⋮	⋮	1	1	1	1	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	0	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	0	1	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	1	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	1	0	⋮	⋮	⋮	1	0	0	0	1		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	1	1	⋮	⋮	⋮	0	0	0	0	0		

8"X" : don't care

INSTRUCTION DESCRIPTION

OUTLINE

To overcome the speed difference between internal clock of NT7066U and MPU clock, NT7066U performs internal operation by storing control information to IR or DR.

The internal operation is determined according to the signal from MPU, composed of read/write and data bus. (refer to Table 5)

Instruction can be divided largely four kinds,

- (1)NT7066U functions to internal RAM
- (2)address set instructions to internal RAM
- (3)data transfer instructions with internal RAM
- (4)others.

The address of internal RAM is automatically increased or decreased by 1.

*Note : During internal operation, Busy Flag (DB7) is read High.

Busy Flag check must precede the next instruction.

Contents

- 1) Clear Display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code)to all DDRAM address, and set DDRAM address to "00H" into AC (address counter). Return cursor to the original status, namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

- 2) Return Home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	-

Return Home is cursor return home instruction.

Set DDRAM address to "00H" into the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM does not change.

3) Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Set the moving direction of cursor and display.

I/D : Increment / decrement of DDRAM address (cursor or blink)

When I/D = "High", cursor/blink moves to right and DDRAM address is increased by 1.

When I/D = "Low", cursor/blink moves to left and DDRAM address is decreased by 1.

* CGRAM operates the same as DDRAM, when read from or write to CGRAM.

SH : Shift of entire display

When DDRAM read (CGRAM read / write) operation or SH = "Low", shift of entire display is not performed.

If SH = "High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1" : shift left, I/D = "0" : shift right).

4) Display ON/OFF Control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display / cursor / blink ON / OFF 1 bit register.

D : Display ON/OFF control bit

When D = "High", entire display is turned on.

When D = "Low", display is turned off, but display data is remained in DDRAM.

C : Cursor ON/OFF control bit

When C = "High", cursor is turned on.

When C = "Low", Cursor is disappeared in current display, but I/D register remains its data.

B : Cursor Blink ON/OFF control bit

When B = "High", cursor blink is on, that performs alternate between all the high data and display character at the cursor position.

When B = "Low", blink is off.

5) Cursor or Display Shift

RS	R/L	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	-	-

Without Writing or reading of display data, shift right/left cursor position or display.
 This instruction is used to correct or search display data. (refer to Table 4)
 During 2-line mode display, cursor moves to the 2nd line after 40th digit of 1st line.
 Note that display shift is performed simultaneously in all the line.
 When displayed data is shifted repeatedly, each line shifted individually.
 When display shift is performed, the contents of address counter are not changed.

Table 4. Shift patterns according to S/C and R/L bits

S/C	R/L	Operation
0	0	Shift cursor to the left, AC is decreased by 1
0	1	Shift cursor to the right, AC is increased by 1
1	0	Shift all the display to the left, cursor moves according to the display
1	1	Shift all the display to the right, cursor moves according to the display

6) Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	-	-

DL : Interface data length control bit

When DL = "High", it means 8-bit bus mode with MPU.
 When DL = "Low", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit mode.
 When 4-bit bus mode, it needs to transfer 4-bit data by two times.

N : Display line number control bit

When N = "Low", it means 1-line display mode.
 When N = "High", 2-line display mode is set.

F : Display font type control bit

When F = "Low", it means 5 x 8 dots format display mode
 When F = "High", 5x11 dots format display mode.

7) Set CGRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC.

This instruction makes CGRAM data available from MPU.

8) Set DDRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU.

When 1-line display mode (N = 0), DDRAM address is from "00H" to "4FH".

In 2-line display mode (N = 1), DDRAM address is the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

9) Read Busy Flag & Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether NT7066U is in internal operation or not. If the resultant BF is High, it means the internal operation is in progress and you have to wait until BF to be Low, and then the next instruction can be performed. In this instruction you can read also the value of address counter.

10) Write data to RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, CGRAM, is set by the previous address set instruction : DDRAM address set, CGRAM address set. RAM set instruction can also determine the AC direction to RAM.

After write operation, the address is automatically increased/decreased by 1, according to the entry mode.

11) Read data from RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If address set instruction of RAM is not performed before this instruction, the data that read first is invalid, because the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, you can get correct RAM data from the second, but the first data would be incorrect, because there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction : it also transfer RAM data to output data register.

After read operation address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

* In case of RAM write operation, after this AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but you can read only the previous data by read instruction.

Table 5. Instruction Table

Instruction	Instruction Code										Description	Execution time (fosc=270KHz)	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.53ms
Return Home	0	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and make shift of entire display enable.	39 μ s
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	39 μ s
Cursor or Display Shift	0	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	39 μ s
Function Set	0	0	0	0	0	1	DL	N	F	x	x	Set interface data length (DL : 4-bit/8-bit), numbers of display line (N : 1-line/2-line), display font type(F : 5 x 8 dots/ 5 x 11 dots)	39 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter.	39 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address counter.	39 μ s
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Write data into internal RAM (DDRAM/CGRAM).	43 μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Write data from internal RAM (DDRAM/CGRAM).	43 μ s

8"X" : don't care

INTERFACE WITH MPU

1) Interface with 8-bits MPU

When interfacing data length is 8-bit, transfer is performed at a time through 8 ports, from DB0 to DB7.

Example of timing sequence is shown below.

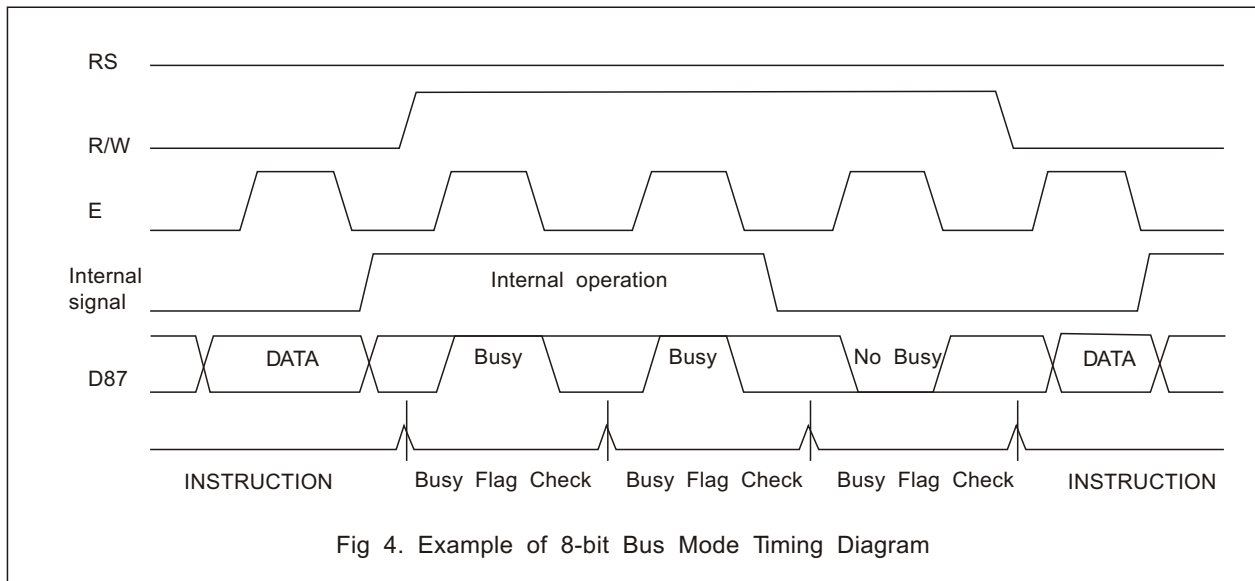


Fig 4. Example of 8-bit Bus Mode Timing Diagram

2) Interface with 4-bits MPU

When interfacing data length is 4-bit, only 4 ports, from DB4 to DB7, are used as data bus. At first higher 4-bit (in case of 8-bit bus mode, the contents of DB4-DB7) are transferred, and then lower 4-bit (in case of 8-bit bus mode, the contents of DB0-BD3) are transferred. So transfer is performed by two times. Busy Flag outputs "High" after the second transfer are ended.

Example of timing sequence is shown below.

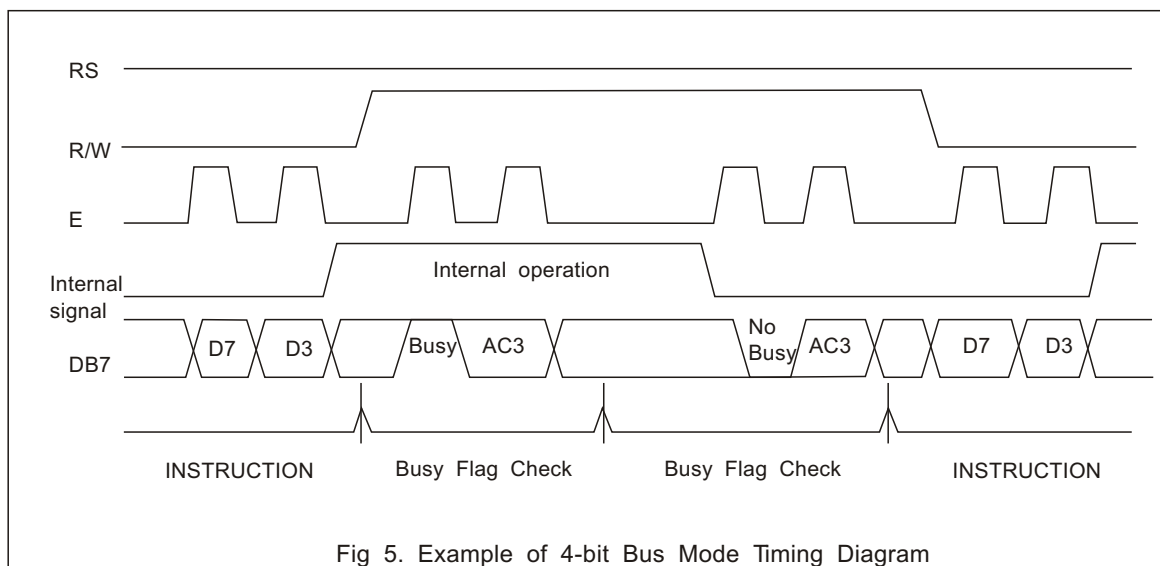
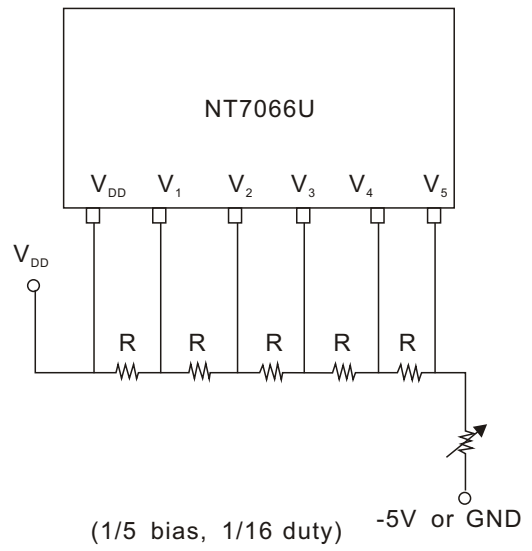
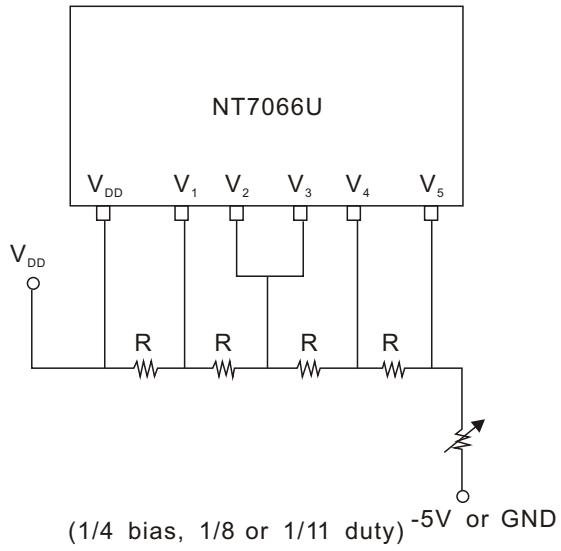


Fig 5. Example of 4-bit Bus Mode Timing Diagram

BIAS VOLTAGE DIVIDE CIRCUIT



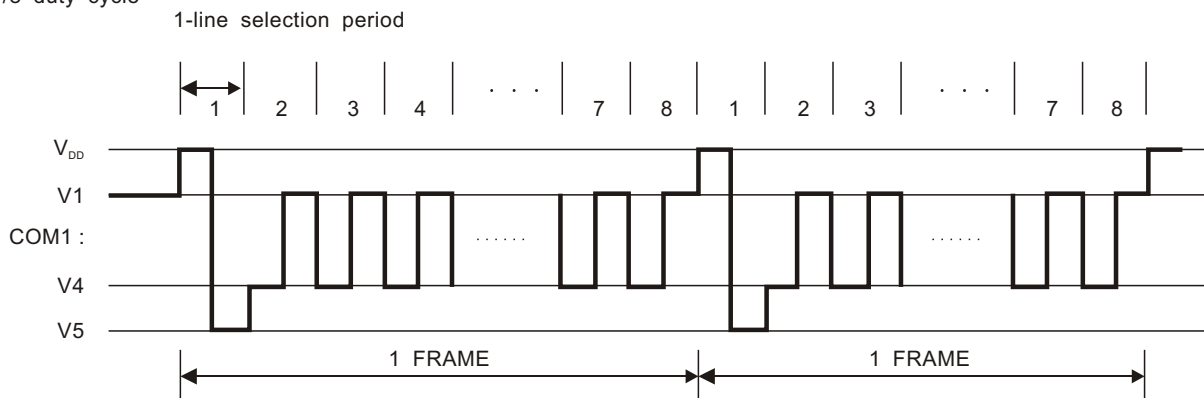
INITIALIZING

When the power is turned on, NT7066U is initialized automatically by power on reset circuit. During the initialization, the following instructions are executed, and BF(Busy Flag)is kept "High"(busy state) to the end of initialization.

1. Display Clear instruction
Write "20H" to all DDRAM
2. Set Functions instruction
DL=1 : 8-bit bus mode
N =1 : 2-line display mode
F =0 : 5 x 8 font type
3. Control Display ON/OFF instruction
D=0 : Display OFF
C=0 : Cursor OFF
B=0 : Blink OFF
4. Set Entry Mode instruction
I/D=1 : Increment by 1
SH=0 : No entire display shift

FRAME FREQUENCY

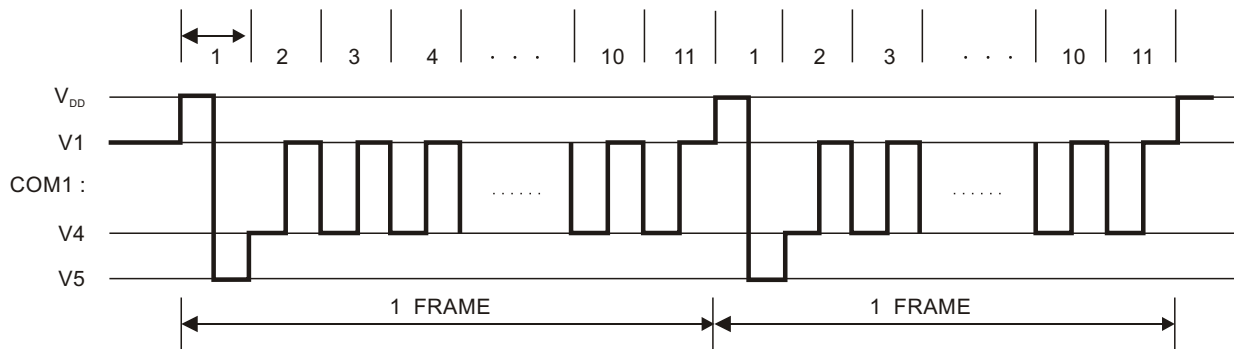
1) 1/8 duty cycle



Line selection period = 400 clocks
 One Frame = 400 x 8 x 3.7 μs = 11850 μs = 11.9ms (1 clock=3.7 μs, fosc=270kHz)
 Frame frequency = 1/11.9ms = 84.3 Hz

2) 1/11 duty cycle

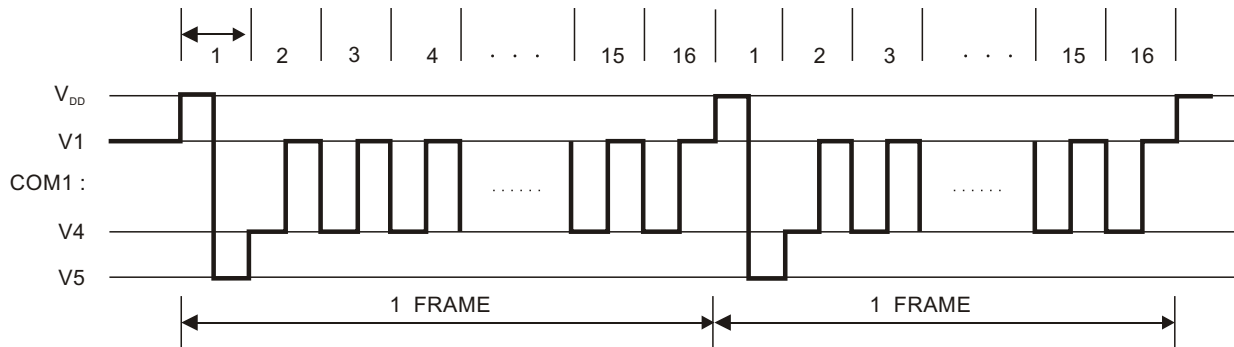
1-line selection period



Line selection period = 400 clocks
 One Frame = $400 \times 11 \times 3.7 \mu\text{s} = 16300 \mu\text{s} = 16.3\text{ms}$ (1 clock = $3.7 \mu\text{s}$, $f_{osc} = 270\text{kHz}$)
 Frame frequency = $1/16.3\text{ms} = 61.4\text{Hz}$

3) 1/16 duty cycle

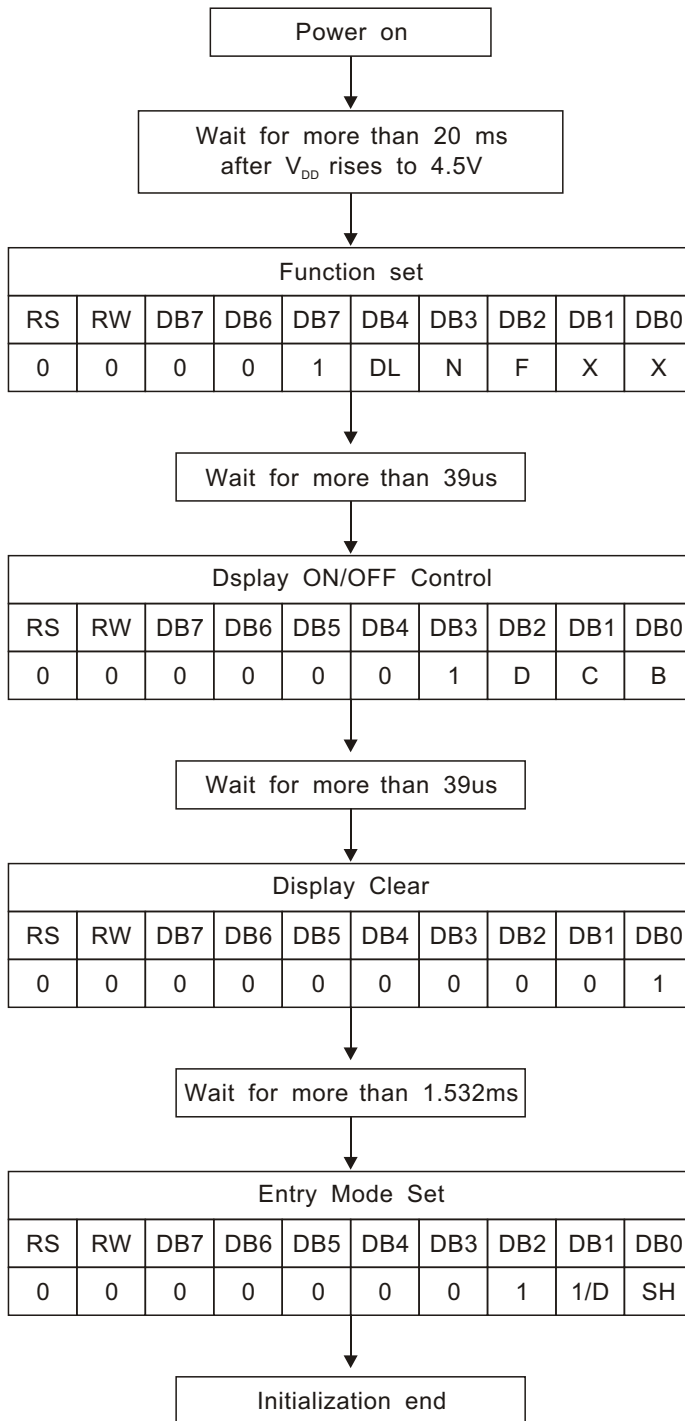
1-line selection period



Line selection period = 200 clocks
 One Frame = $200 \times 16 \times 3.7 \mu\text{s} = 11850 \mu\text{s} = 11.9\text{ms}$ (1 clock = $3.7 \mu\text{s}$, $f_{osc} = 270\text{kHz}$)
 Frame frequency = $1/11.9\text{ms} = 84.3\text{Hz}$

INITIALIZING BY INSTRUCTION

1) 8-bit interface mode



Condition : fosc = 270KHz

DL	0	4-bit interface
	1	8-bit interface

N	0	1-line mode
	1	2-line mode

F	0	5 x 8 Dots
	1	5 x 11 Dots

D	0	display off
	1	display on

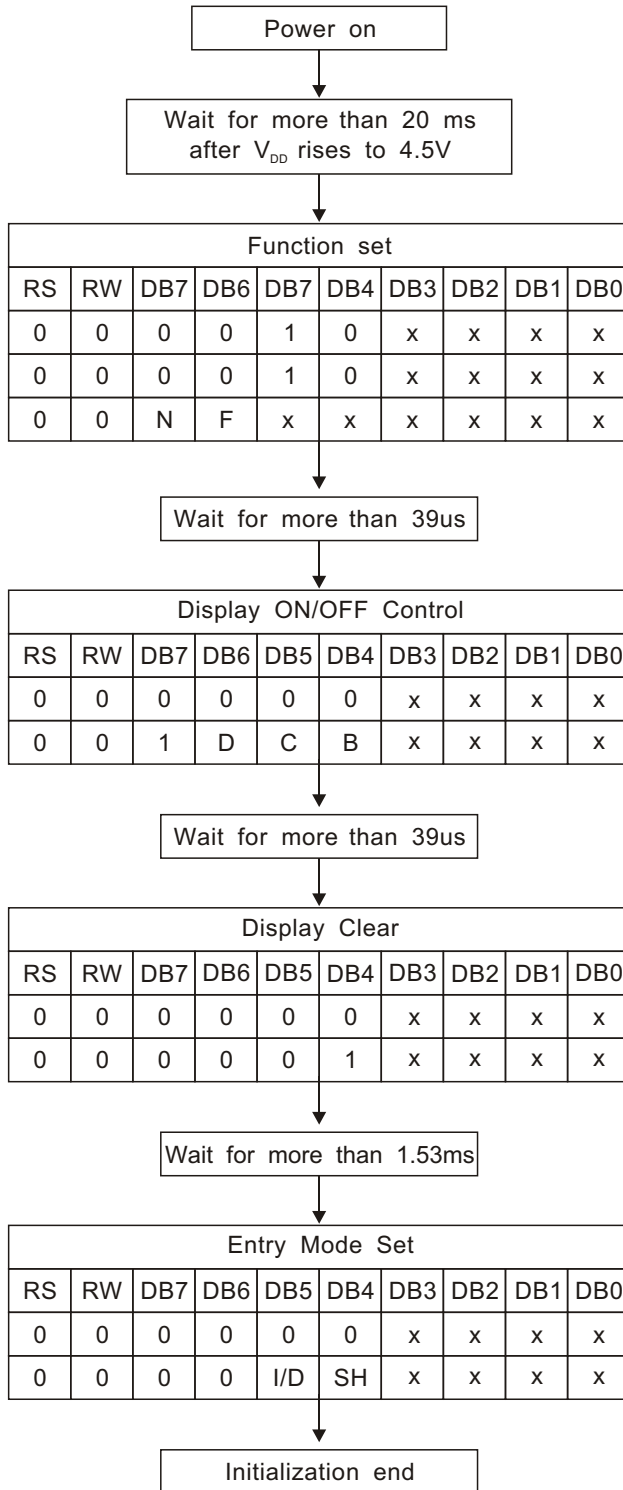
C	0	cursor off
	1	cursor on

B	0	blink off
	1	blink on

I/D	0	decrement mode
	1	increment mode

SH	0	entire shift off
	1	entire shift on

2) 4-bit interface mode



Condition : fosc = 270KHz

DL	0	4-bit interface
	1	8-bit interface
N	0	1-line mode
	1	2-line mode

F	0	5 x 8 Dots
	1	5 x 11 Dots

D	0	display off
	1	display on

C	0	cursor off
	1	cursor on

B	0	blink off
	1	blink on

I/D	0	decrement mode
	1	increment mode

SH	0	entire shift off
	1	entire shift on

MAXIMUM ABSOLUTE LIMIT**Maximum Absolute Power Ratings**

Characteristic	Symbol	Unit	Value
Operating Voltage	V_{DD}	V	-0.3~+7.0
Power Supply Voltage	V_{LCD}	V	$V_{DD}-15.0\sim V_{DD}+0.3$
Input Voltage	V_{IN}	V	-0.3~ $V_{DD}+0.3$

※Voltage greater than above may damage the circuit ($V_{DD} \geq V1 \geq V2 \geq V3 \geq V4 \geq V5$)

Temperature Characteristics

Characteristic	Symbol	Unit	Value
Operating Temperature	T_{OPR}	°C	-30~+85
Storage Temperature	T_{STG}	°C	-55~+125

ELECTRICAL CHARACTERISTICS

 DC characteristics ($V_{DD} = 4.5V \sim 5.5V$, $T_a = -30 \sim +85^\circ C$)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	V_{DD}	-	4.5	-	5.5	V
Operating Current	I_{DD}	Internal oscillation or external clock ($V_{DD} = 5.0V$, $f_{osc} = 270KHz$)	-	-	0.6	mA
Input Voltage(1) (except OSC1)	V_{IH1}	-	3.5	-	V_{DD}	V
	V_{IL1}	-	-0.3	-	0.6	
Input Voltage(2) (OSC1)	V_{IH2}	-	$V_{DD}-1.0$	-	V_{DD}	V
	V_{IL2}	-	-0.2	-	1.0	
Output Voltage(1) (DB0 to DB7)	V_{OH1}	$I_{OH} = -0.205mA$	2.4	-	-	V
	V_{OL1}	$I_{OL} = 1.2mA$	-	-	0.4	
Output Voltage(2) (except DB0 to DB7)	V_{OH2}	$I_o = -40 \mu A$	$0.9V_{DD}$	-	-	V
	V_{OL2}	$I_o = 40 \mu A$	-	-	$0.1V_{DD}$	
Voltage Drop	V_{dCOM}	$I_o = \pm 0.1mA$	-	-	1	V
	V_{dSEG}		-	-	1	
Input Leakage current	I_{LKG}	$V_{IN} = 0V \sim V_{DD}$	-1	-	1	μA
Input Low Current	I_{IL}	$V_{IN} = 0V$, $V_{DD} = 5V$ (PULL UP)	-50	-	-125	
Internal Clock (external R_i)	f_{OSC1}	$R_f = 91k\Omega \pm 2\%$ ($V_{DD} = 5V$)	190	270	350	kHz
External Clock	f_{OSC}	-	125	270	410	kHz
	duty		45	50	55	%
	t_R , t_F		-	-	0.2	μs
LCD Driving Voltage	V_{LCD}	$V_{DD}-V_5$ (1/5, 1/4 bias)	3.0	-	13.0	V

($V_{DD} = 2.7V \sim 4.5V, T_a = -30 \sim +85^\circ C$)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	V_{DD}	-	2.7	-	4.5	V
Operating Current	I_{DD}	Internal oscillation or external clock ($V_{DD} = 3.0V, f_{osc} = 270KHz$)	-	-	0.3	mA
Input Voltage(1) (except OSC1)	V_{IH1}	-	$0.7V_{DD}$	-	V_{DD}	V
	V_{IL1}	-	-0.3	-	0.55	
Input Voltage(2) (OSC1)	V_{IH2}	-	$0.7V_{DD}$	-	V_{DD}	V
	V_{IL2}	-	-	-	$0.2V_{DD}$	
Output Voltage(1) (DB0 to DB7)	V_{OH1}	$I_{OH} = -0.1mA$	$0.75V_{DD}$	-	-	V
	V_{OL1}	$I_{OL} = 0.1mA$	-	-	$0.2V_{DD}$	
Output Voltage(2) (except DB0 to DB7)	V_{OH2}	$I_o = -40 \mu A$	$0.8V_{DD}$	-	-	V
	V_{OL2}	$I_o = 40 \mu A$	-	-	$0.2V_{DD}$	
Voltage Drop	V_{dCOM}	$I_o = \pm 0.1mA$	-	-	1	V
	V_{dSEG}		-	-	1	
Input Leakage current	I_{LKG}	$V_{IN} = 0V \sim V_{DD}$	-1	-	1	μA
Input Low Current	I_{IL}	$V_{IN} = 0V, V_{DD} = 3V$ (PULL UP)	-10	-	-120	
Internal Clock (external Rf)	f_{OSC1}	$Rf = 75k\Omega \pm 2\%$ ($V_{DD} = 3V$)	190	270	350	kHz
External Clock	f_{OSC}	-	125	270	410	kHz
	duty		45	50	55	%
	t_R, t_F		-	-	0.2	μs
LCD Driving Voltage	V_{LCD}	$V_{DD} - V_5$ (1/5, 1/4 bias)	3.0	-	13.0	V

AC Characteristics

 ($V_{DD} = 4.5V \sim 5.5V$, $T_a = -30 \sim +85^{\circ}C$)

Mode	Characteristic	Symbol	Min	Typ	Max	Unit
Write Mode (refer to Fig-6)	E Cycle Time	t_c	500	-	-	ns
	E Rise / Fall Time	t_{R, t_F}	-	-	20	
	E Pulse Width (High, Low)	t_w	230	-	-	
	R/W and RS Setup Time	t_{su1}	40	-	-	
	R/w and RS Hold Time	t_{h1}	10	-	-	
	Data Setup Time	t_{su2}	60	-	-	
	Data Hold Time	t_{h2}	10	-	-	
Read Mode (refer to Fig-7)	E Cycle Time	t_c	500	-	-	ns
	E Rise / Fall Time	t_{R, t_F}	-	-	20	
	E Pulse Width (High, Low)	t_w	230	-	-	
	R/W and RS Setup Time	t_{su}	40	-	-	
	R/W and RS Hold Time	t_h	10	-	-	
	Data Output Delay Time	t_d	-	-	120	
	Data Hold Time	t_{DH}	5	-	-	

 ($V_{DD} = 2.7 \sim 4.5V$, $T_a = -30 \sim +85^{\circ}C$)

Mode	Characteristic	Symbol	Min	Typ	Max	Unit
Write Mode (refer to Fig-6)	E Cycle Time	t_c	1000	-	-	ns
	E Rise / Fall Time	t_{R, t_F}	-	-	25	
	E Pulse Width (High, Low)	t_w	450	-	-	
	R/W and RS Setup Time	t_{su1}	60	-	-	
	R/w and RS Hold Time	t_{h1}	20	-	-	
	Data Hold Time	t_{su2}	195	-	-	
	Data Hold Time	t_{h2}	10	-	-	
Read Mode (refer to Fig-7)	E Cycle Time	t_c	1000	-	-	ns
	E Rise / Fall Time	t_{R, t_F}	-	-	25	
	E Pulse Width (High, Low)	t_w	450	-	-	
	R/W and RS Setup Time	t_{su}	60	-	-	
	R/W and RS Hold Time	t_h	20	-	-	
	Data Output Delay Time	t_d	-	-	360	
	Data Hold Time	t_{DH}	5	-	-	

($V_{DD} = 2.7V \sim 4.5V, T_a = -30 \sim +85^\circ C$)

Mode	Characteristic	Symbol	Min	Typ	Max	Unit
Interface Mode with	Clock Pulse Width (High, Low)	t_c	800	-	-	ns
	Clock Rise / Fall Time	t_F, t_R	-	-	25	
Extension Driver (refer Fig-8)	Clock Setup Time	t_{su1}	500	-	-	
	Data Setup Time	t_{su2}	300	-	-	
	Data Hold Time	t_{DH}	300	-	-	
	M Delay Time	t_{DM}	-1000	-	1000	

Fig-6. Write Mode Timing Diagram

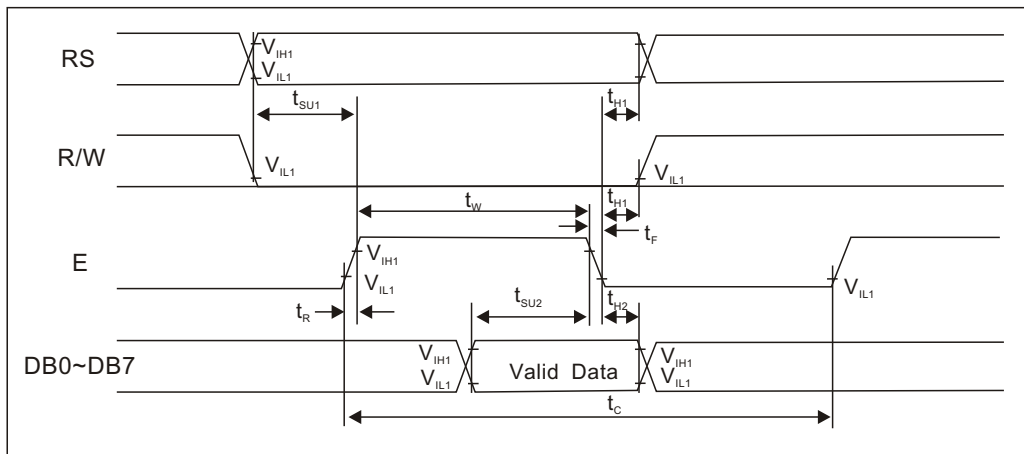


Fig-7. Read Mode Timing Diagram

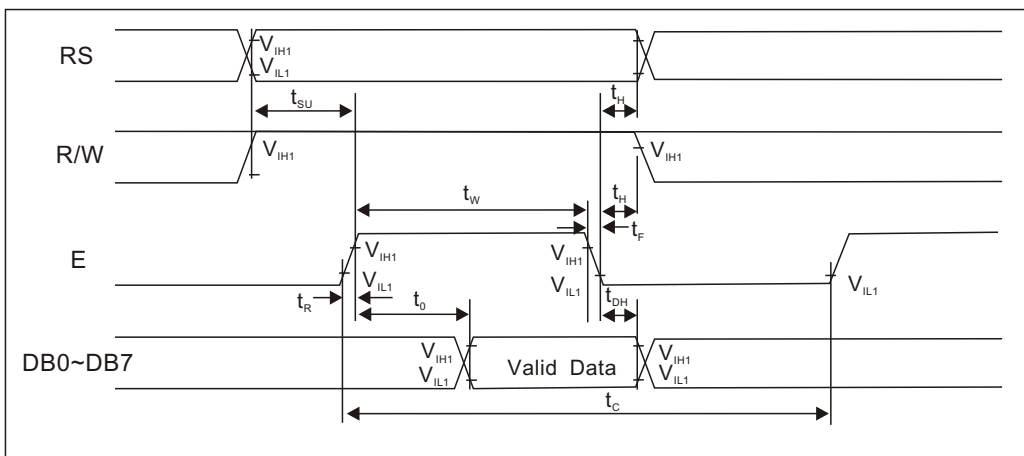
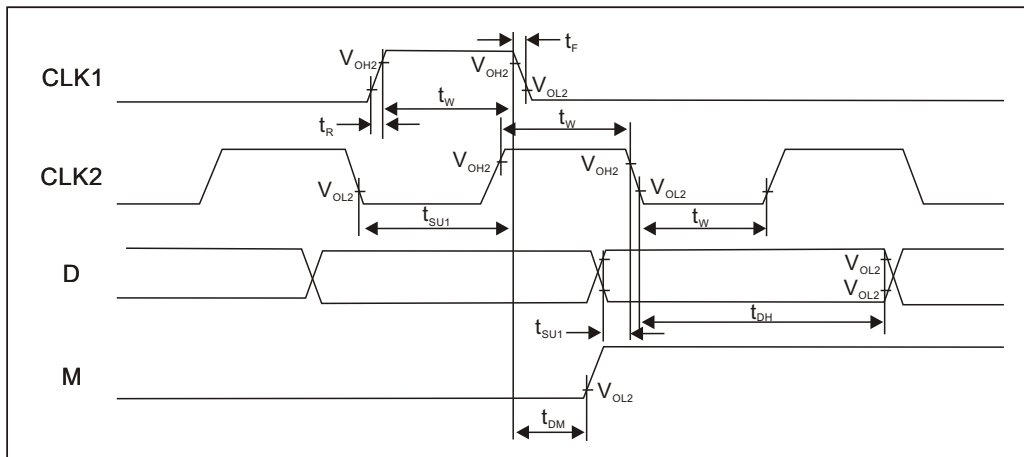
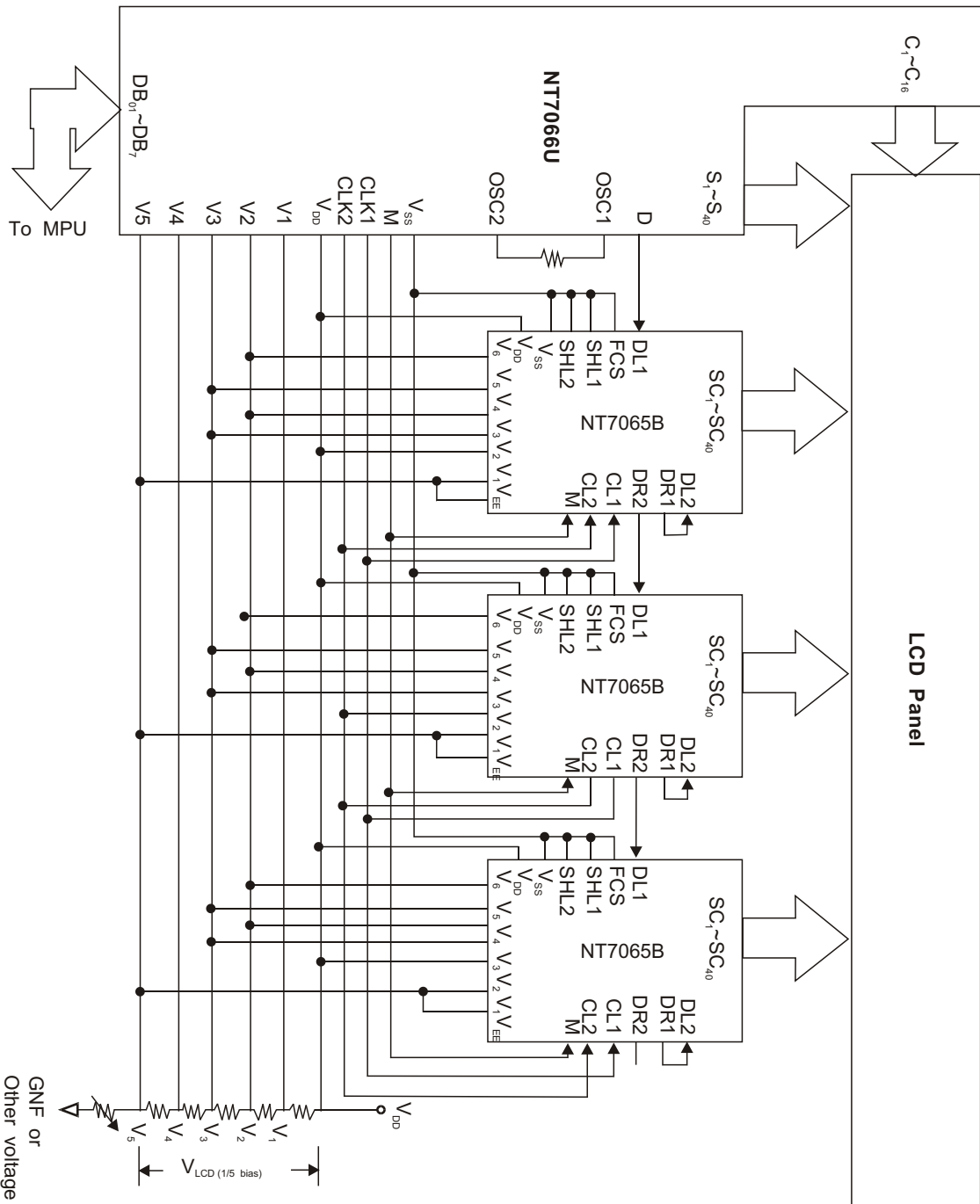


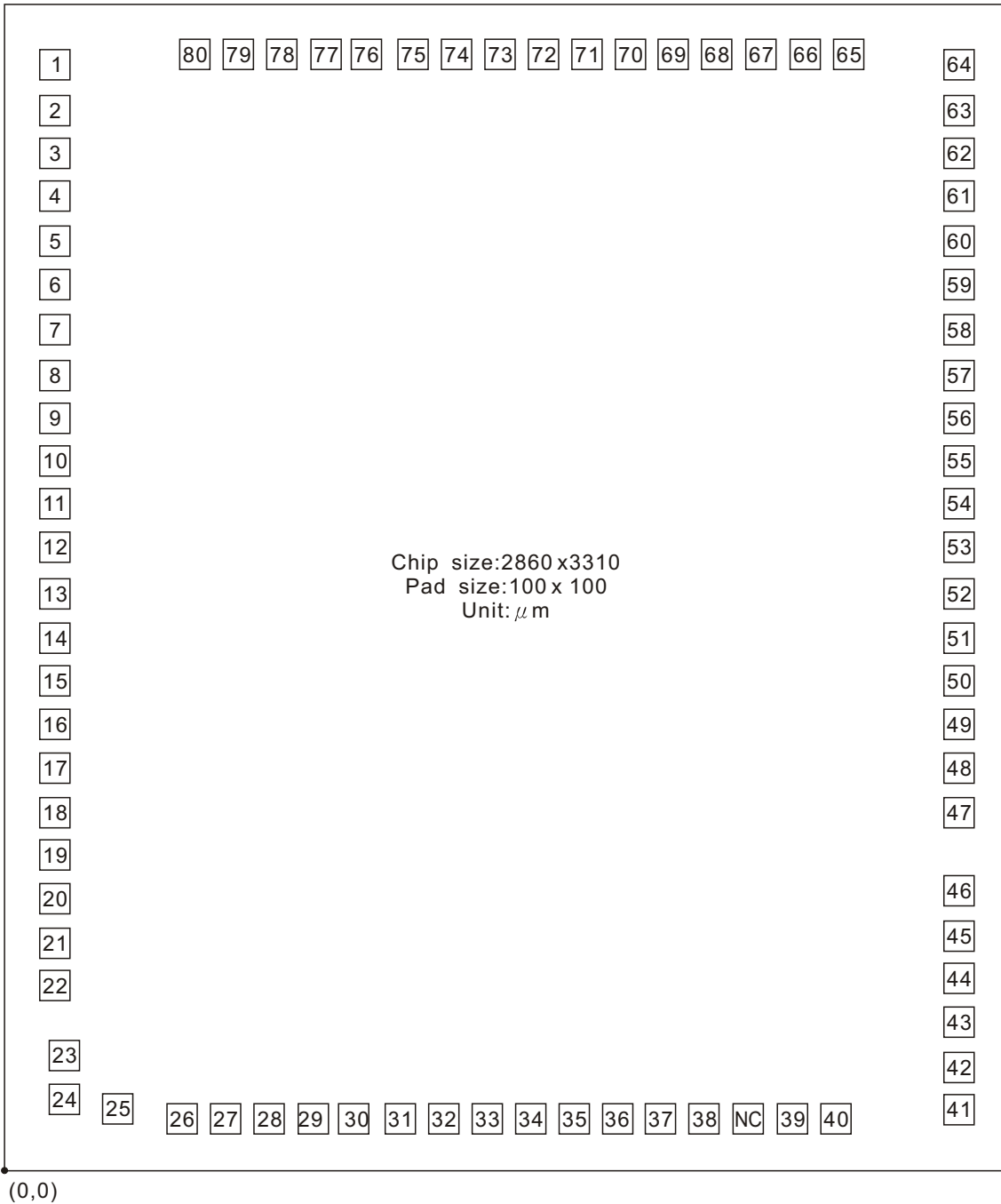
Fig-8. Interface Mode with Extension Driver Timing Diagram





When NT7065B is externally connected to NT7066U, you can increase the number of display digits up to 80 characters.

PAD DIAGRAM



PAD LOCATION

Pad Number	Signal Name	Coordinate		Pad Number	Signal Name	Coordinate	
		X, (um)	Y, (um)			X, (um)	Y, (um)
1	S22	135.0	3136.9	41	DB2	2725.0	168.7
2	S21	135.0	3011.9	42	DB3	2725.0	293.7
3	S20	135.0	2886.9	43	DB4	2725.0	148.7
4	S19	135.0	2761.9	44	DB5	2725.0	543.7
5	S18	135.0	2636.9	45	DB6	2725.0	668.7
6	S17	135.0	2511.9	46	DB7	2725.0	793.7
7	S16	135.0	2386.9	47	C1	2725.0	1015.0
8	S15	135.0	2261.9	48	C2	2725.0	1140.0
9	S14	135.0	2136.9	49	C3	2725.0	1265.0
10	S13	135.0	2011.9	50	C4	2725.0	1390.0
11	S12	135.0	1886.9	51	C5	2725.0	1515.0
12	S11	135.0	1761.9	52	C6	2725.0	1640.0
13	S10	135.0	1636.9	53	C7	2725.0	1765.0
14	S9	135.0	1511.9	54	C8	2725.0	1890.0
15	S8	135.0	1386.9	55	C9	2725.0	2015.0
16	S7	135.0	1261.9	56	C10	2725.0	2140.0
17	S6	135.0	1136.9	57	C11	2725.0	2265.0
18	S5	135.0	1011.9	58	C12	2725.0	2390.0
19	S4	135.0	886.9	59	C13	2725.0	2515.0
20	S3	135.0	761.9	60	C14	2725.0	2640.0
21	S2	135.0	636.9	61	C15	2725.0	2765.0
22	S1	135.0	511.9	62	C16	2725.0	2890.0
23	GND	162.9	314.8	63	S40	2725.0	3015.0
24	OSC1	162.9	189.8	64	S39	2725.0	3140.0
25	OSC2	316.3	162.9	65	S38	2412.6	3175.0
26	V1	511.0	135.0	66	S37	2287.6	3175.0
27	V2	636.0	135.0	67	S36	2162.6	3175.0
28	V3	761.0	135.0	68	S35	2037.6	3175.0
29	V4	886.0	135.0	69	S34	1912.6	3175.0
30	V5	1011.0	135.0	70	S33	1787.6	3175.0
31	CKL1	1136.0	135.0	71	S32	1662.6	3175.0
32	CKL2	1261.0	135.0	72	S31	1537.6	3175.0
33	VDD	1386.0	135.0	73	S30	1412.6	3175.0
34	M	1511.0	135.0	74	S29	1287.6	3175.0
35	D	1636.0	135.0	75	S28	1162.6	3175.0
36	RS	1761.0	135.0	76	S27	1037.6	3175.0
37	R/W	1886.0	135.0	77	S26	912.6	3175.0
38	E	2011.0	135.0	78	S25	787.6	3175.0
39	DB0	2261.0	135.0	79	S24	662.6	3175.0
40	DB1	2386.0	135.0	80	S23	537.6	3175.0