Character VFD Module
Y-Series
C++ Sample Code
(Control VFD Module with Host System)

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Noritake Co., Inc.
2635 Clearbrook Drive Arlington Height, IL 60005
www.noritake-elec.com

1 Getting Started

1.1 Introduction

Using this C++ sample code enables you to control the CU24043−Y1A Y-Series Vacuum Florescent Display module (Fig. 1-1) with a host system.
Since all the Y-Series VFD modules share the same features and command sets, the starter guide is able to apply to any Y-Series VFD module with/without minor hardware/software modifications. For further technical inquiries and the latest Y-Series lineup information, please contact your local sales representative or visit our website at www.noritake-elec.com/Y-series.htm.

Fig. 1-1

Product image, including color, may differ from actual product appearance.

1.2 Features of Y-Series VFD Module

The Y-Series is a 5×8 matrix character VFD module designed to reduce development cost and time. The module requires only a single 5VDC power supply and works with virtually any host system as long as one of the following interfaces is available:

- **8-bit parallel 5VDC CMOS Level (CUXXXXX−Y1A model and CUXXXXX−Y100 model)**
- **Synchronous serial 5VDC CMOS Level (CUXXXXX−Y1A model)**
- **Asynchronous serial 5VDC CMOS Level (CUXXXXX−Y1A model)**
- **Asynchronous serial RS232 Level (CUXXXXX−Y100 model)**

With simple hex-code command sets, the module provides various functions such as highlighting characters, blinking characters, underling characters, font magnification, etc. which conventional character displays do not have. Additionally, various fonts including basic ASCII font, international font, symbols and user-definable font can be easily displayed.

1.3 Precautions

A VFD module is a precision and fragile instrument, so it is necessary to handle it with scrupulous care. Some main points of handling it are as follows:

- **Because the edges of a VFD glass-envelop are not smooth, it is necessary to handle carefully to avoid injuries to your hands.**
- **Avoid touching conductive electrical parts, because a VFD module uses high voltage exceeding 30 ～ 50 volts.**
- **Do not unplug the power and/or data cables of a VFD module during operating condition because unrecoverable damage may result.**
- **A VFD module needs electrostatic free packaging and protection from electrostatic charges during handling and usage.**

Before open the package, please refer to your specific module specification "Notice for the Cautious Handling VFD Modules".

2 Parallel Communications

The VFD module has an 8-bit parallel 5VDC CMOS level interface. Fig. 2-1 shows a block diagram of the parallel communication. Refer to your specific module specification "Parallel Interface".

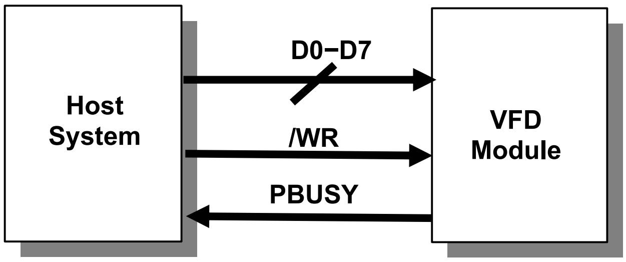
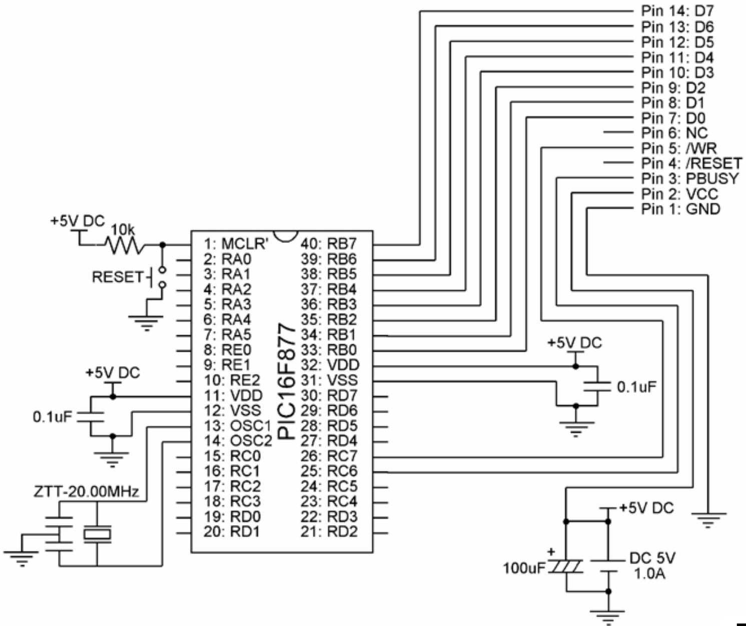
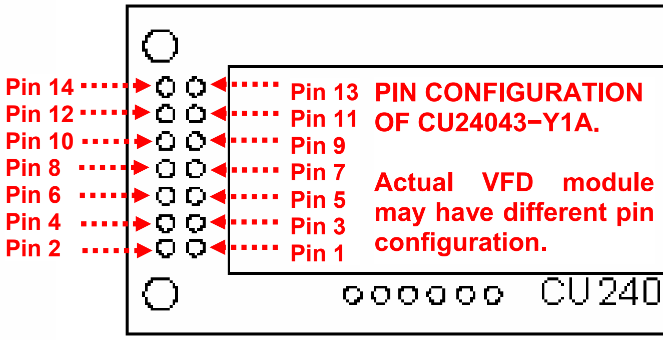


Fig. 2-1

2.1 Sample Circuit

Fig. 2-2 shows a sample circuit containing the PIC microcontroller PIC16F877.





Note: This figure shows the pin configuration of the CU24043−Y1A. <u>Please make sure the pin configuration of your specific module before connecting.</u>

Fig. 2-2

2.2 Accessories

Noritake provides these parallel interface accessories. For further information, please contact your local sales representative.

Fig. 2-3: 14-Wire Cable

Fig. 2-4: 14-Pin Male Header

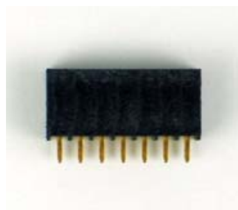


Fig. 2-5: 14-Pin Female Header

2.3 Sample Code

Example 2-1 is a C++ sample code for Fig. 2-2 (8-bit Parallel Interface). It initializes the module and executes a demonstration (displaying all Common Font Set characters). The code has been compiled with the CCS C++ Complier only and may need minor editing to work with other compilers. Refer to your specific module specification “Parallel Interface”.

```
#include <16F877.h>                //for PIC16F877
#fuses HS,NOWDT,NOPROTECT,PUT,BROWNOUT,NOLVP
#use delay(clock = 20000000)  //for 20MHz clock
#use fast_io(B)                    //use B port fast I/O
#use fast_io(C)                    //use C port fast I/O

//define output ports
#define D0     PIN_B0
#define D1     PIN_B1
#define D2     PIN_B2
#define D3     PIN_B3
#define D4     PIN_B4
#define D5     PIN_B5
#define D6     PIN_B6
#define D7     PIN_B7
#define PBUSY  PIN_C6
#define WR    PIN_C7

//Variable declaration
int n, data;

//Prototype of functions
void executing_demo( );
void parallel_out(int data);

void main( )
{
  //Initialize a PIC and a display.
  delay_ms(1000);               //warm up delay
  set_tris_b(0x00);             //B0 ~ B7 = output
  set_tris_c(0x40);             //C6 = input, C7 = output
  output_b(0x00);               //B0 ~ B7 = 0
  output_high(WR);              //WR = 1
  parallel_out(0x1B);   //display initialization
  parallel_out(0x40);
  //Execute a demonstration.
  executing_demo( );
}

void executing_demo( )
{
  for(data = 0x20; data <= 0x7F; data++)
    parallel_out(data);
}
```

```
void parallel_out(int data)
{
  //if PBUSY == 1, wait until PBUSY == 0
  while(input(PBUSY) == 1)
  {
  }
  output_low(WR);               //WR = 0
  if((data & 0x01) == 0x01)     //if bit_0 (LSB)  == 1, D0 = 1
    output_high(D0);
  else                          //if bit_0 (LSB)  == 0, D0 = 0
    output_low(D0);
  if((data & 0x02) == 0x02)     //if bit_1 == 1, D1 = 1
    output_high(D1);
  else                          //if bit_1 == 0, D1 = 0
    output_low(D1);
  if((data & 0x04) == 0x04)     //if bit_2 == 1, D2 = 1
    output_high(D2);
  else                          //if bit_2 == 0, D2 = 0
    output_low(D2);
  if((data & 0x08) == 0x08)     //if bit_3 == 1, D3 = 1
    output_high(D3);
  else                          //if bit_3 == 0, D3 = 0
    output_low(D3);
  if((data & 0x10) == 0x10)     //if bit_4 == 1, D4 = 1
    output_high(D4);
  else                          //if bit_4 == 0, D4 = 0
    output_low(D4);
  if((data & 0x20) == 0x20)     //if bit_5 == 1, D5 = 1
    output_high(D5);
  else                          //if bit_5 == 0, D5 = 0
    output_low(D5);
  if((data & 0x40) == 0x40)     //if bit_6 == 1, D6 = 1
    output_high(D6);
   else                         //if bit_6 == 0, D6 = 0
    output_low(D6);
  if((data & 0x40) == 0x80)     //if bit_7 (MSB) == 1, D7 = 1
    output_high(D7);
  else                          //if bit_7 (MSB) == 0, D7 = 0
    output_low(D7);
  output_high(WR);              //WR = 1 to clock in data
  delay_us(20);                 //wait 20us
}
```

Example 2-1

3 Serial Communications

The CUXXXXX−Y1A model has an asynchronous/synchronous serial 5VDC CMOS level interface. Either the asynchronous or synchronous mode is selectable by the jumper setting. The CUXXXXX−Y100 model has an asynchronous serial RS232 level interface.

3.1 Asynchronous Serial Communications

Fig. 3-1 shows a block diagram of the asynchronous serial interface. The asynchronous mode is the default setting, so changing jumper setting is not required to use this mode. One of the four baud rates (9600 bps, 19,200 bps, 38,400 bps or 115,200 bps) is selectable with Jumper 0 and 1. The default baud rate is 38,400 bps. Refer to your specific module specification "Serial Interface" and "Jumper Setting".

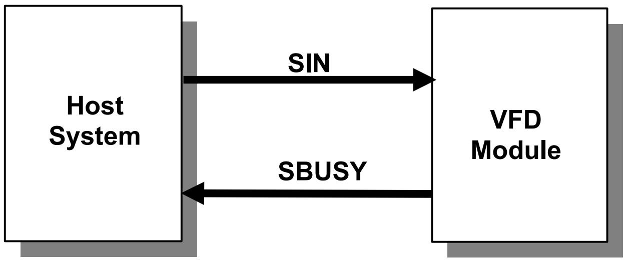
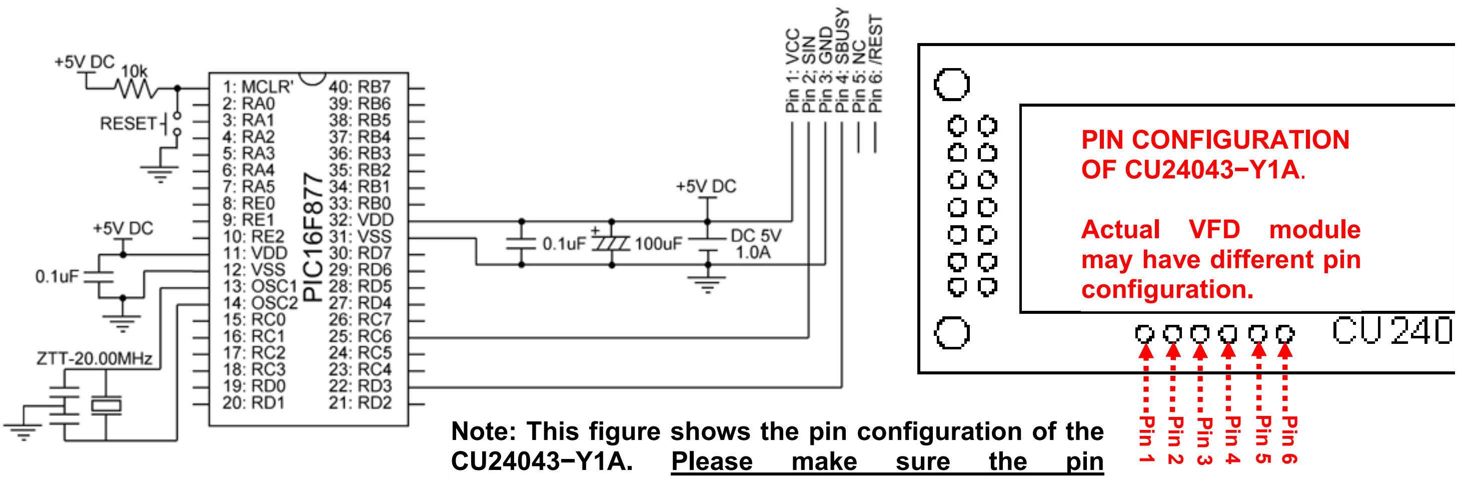


Fig. 3-1

3.1.1 Sample Circuit

Fig. 3-2 shows a sample circuit containing the PIC microcontroller PIC16F877.



Note: This figure shows the pin configuration of the CU24043−Y1A. Please make sure the pin configuration of your specific module before connecting.

Fig. 3-2

3.1.2 Accessories

Noritake provides these serial interface accessories. For further information, please contact your local sales representative.

Fig. 3-3: 6-Wire Cable

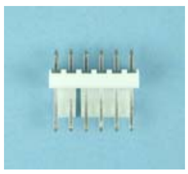


Fig. 3-4: 6-Pin Straight Header W/Lock

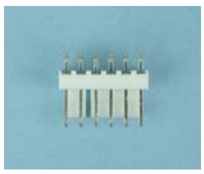


Fig. 3-5: 6-Pin Right-Angle Header W/Lock

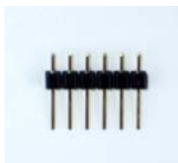


Fig. 3-6: 6-Pin Header

3.1.3 Sample Code

Example 3-1 is a C++ sample code for Fig. 3-2 (Asynchronous Serial Interface). It initializes the module and executes a demonstration (displaying all Common Font Set characters). The code has been compiled with the CCS C++ Complier only and may need minor editing to work with other compilers. Refer to your specific module specification "Serial Interface" and "Jumper Setting".

```
#include <16F877.h>                                   //for PIC16F877
#fuses HS,NOWDT,NOPROTECT,PUT,BROWNOUT,NOLVP
#use delay(clock = 20000000)                          //for 20MHz clock
//use EUSART module, baud rate = 38,400bps, format: Start (1bit) + Data (8bit) + Stop (1bit)
#use rs232(BAUD = 38400, XMIT = PIN_C6, RCV = PIN_C7)
#use fast_io(D)                                       //use D port fast I/O

//define output ports
#define SBUSY  PIN_D3

//Variable declaration
int n, data;

//Prototype of functions
void executing_demo( );
void asynchro_out(int data);

void main( )
{
  //Initialize a PIC and a display.
  delay_ms(1000);               //warmup delay
  set_tris_d(0x04);             //D3 = input
  asynchro_out(0x1B);           //display initialization
  asynchro_out(0x40);
  //Execute a demonstration.
  executing_demo( );
}

void executing_demo( )
{
  for(data = 0x20; data <= 0x7F; data++)
    asynchro_out(data);
}

void asynchro_out(int data)
{
  //if SBUSY == 1, wait until SBUSY == 0
  while(input(SBUSY) == 1)
  {
  }
  putc(data);                   //send 8-bit Asynchronous Serial data
}
```

Example 3-1

3.2 Synchronous Serial Communications

Fig. 3-7 shows a block diagram of the synchronous serial 5VDC CMOS level interface. The synchronous mode is not a default setting, so changing jumper setting is required. Refer to your specific module specification “Serial Interface” and “Jumper Setting”.

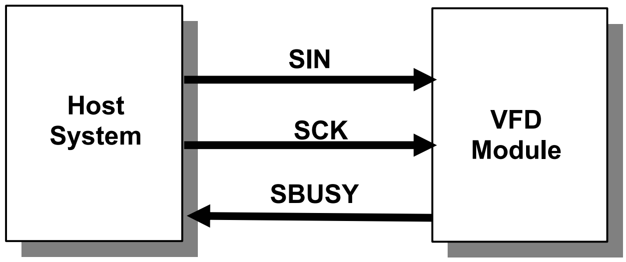
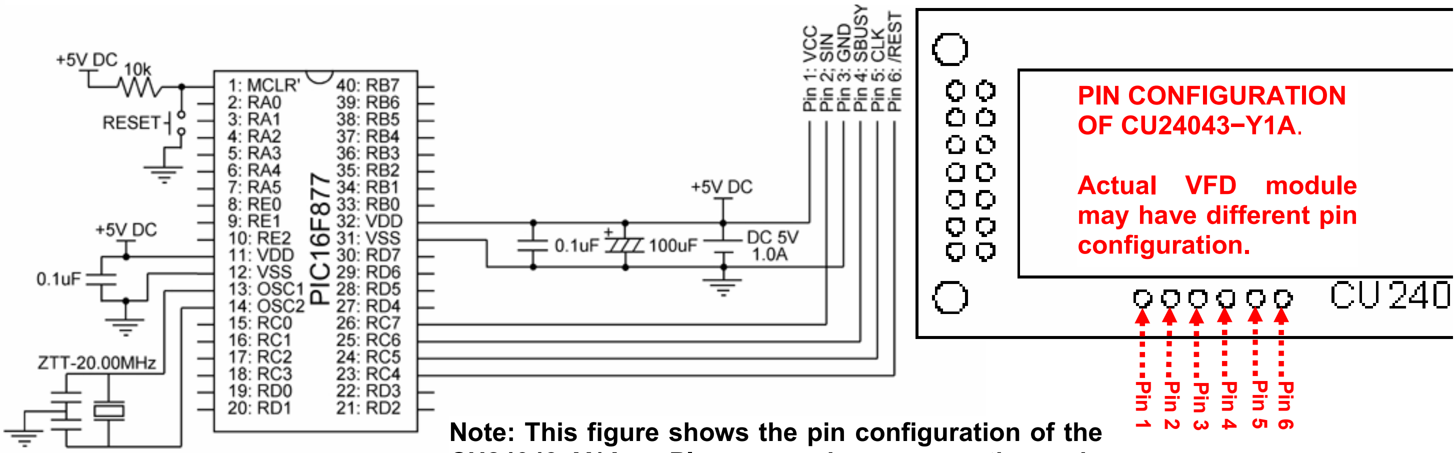


Fig. 3-7

3.2.1 Sample Circuit

Fig. 3-8 shows a sample circuit containing a PIC microcontroller.



Note: This figure shows the pin configuration of the CU24043−Y1A. Please make sure the pin configuration of your specific module before connecting.

Fig. 3-8

3.2.2 Accessories

Noritake provides these serial interface accessories. For further information, please contact your local sales representative.

Fig. 3-9: 6-Wire Cable

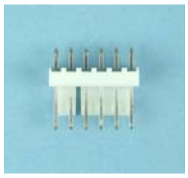


Fig. 3-10: 6-Pin Straight Header W/Lock

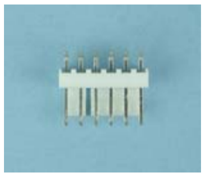


Fig. 3-11: 6-Pin Right-Angle Header W/Lock

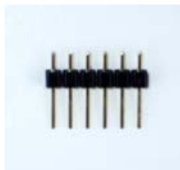


Fig. 3-12: 6-Pin Header

3.2.3 Sample Code

Example 3-2 is a C++ sample code for Fig. 3-8 (Synchronous Serial Interface). It initializes the module and executes a demonstration (displaying all Common Font Set characters). The code has been compiled with the CCS C++ Complier only and may need minor editing to work with other compilers. Refer to your specific module specification "Serial Interface" and "Jumper Setting".

```
#include <16F877.h>              //for PIC16F877
#fuses HS,NOWDT,NOPROTECT,PUT,BROWNOUT,NOLVP
#use delay(clock = 20000000)  //for 20MHz clock
#use fast_io(C)                  //use C port fast I/O

//define output ports
#define REST   PIN_C4
#define CLK    PIN_C5
#define SBUSY  PIN_C6
#define SIN    PIN_C7

//Variable declaration
int n, data;

//Prototype of functions
void executing_demo( );
void synchro_out(int data);

void main( )
{
  //Initialize a PIC and a display.
  delay_ms(1000);                //warmup delay
  set_tris_c(0x40);
  //C4 = output, C5 = output, C6 = input, C7 = output
  output_low(SIN);               //SIN = 0
  output_high(CLK);              //CLK = 1
  output_low(REST);              //REST = 0, display reset
  delay_us(1000);                //wait 1ms
  output_high(REST);             //REST = 1
  //Execute a demonstration.
  executing_demo( );
}

void executing_demo( )
{
  for(data = 0x20; data <= 0x7F; data++)
    synchro_out(data);
}

void synchro_out(int data)
{
  //if SBUSY == 1, wait until SBUSY == 0
  while(input(SBUSY) == 1)
  {
  }
  output_low(CLK);               //CLK = 0
  if((data & 0x01) == 0x01)      //if bit_0 (LSB) == 1, D0 = 1
    output_high(SIN);
  else                           //if bit_0 (LSB) == 0, D0 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  output_low(CLK);
  if((data & 0x02) == 0x02)      //if bit_1 == 1, D1 = 1
    output_high(SIN);
  else                           //if bit_1 == 0, D1 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  output_low(CLK);
  if((data & 0x04) == 0x04)      //if bit_2 == 1, D2 = 1
    output_high(SIN);
  else                           //if bit_2 == 0, D2 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  output_low(CLK);
  if((data & 0x08) == 0x08)      //if bit_3 == 1, D3 = 1
    output_high(SIN);
  else                           //if bit_3 == 0, D3 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  output_low(CLK);
  if((data & 0x10) == 0x10)      //if bit_4 == 1, D4 = 1
    output_high(SIN);
  else                           //if bit_4 == 0, D4 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  output_low(CLK);
  if((data & 0x20) == 0x20)      //if bit_5 == 1, D5 = 1
    output_high(SIN);
  else                           //if bit_5 == 0, D5 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  output_low(CLK);
  if((data & 0x40) == 0x40)      //if bit_6 == 1, D6 = 1
    output_high(SIN);
  else                           //if bit_6 == 0, D6 = 0
    output_low(SIN);
  output_high(CLK);
  output_low(CLK);
  if((data & 0x80) == 0x80)      //if bit_7 (MSB) == 1, D7 = 1
    output_high(SIN);
  else                           //if bit_7 (MSB) == 0, D7 = 0
    output_low(SIN);
  output_high(CLK);              //CLK = 1 to clock in data
  delay_us(17);                  //wait 17us
}
```

Example 3-2

4 Sample Command Sets

4.1 Displaying Characters

The VFD module contains three font sizes: a 1×1 regular font size (5×8 pixel), a 1×2 magnified font size (5×16 pixel) and a 2×2 magnified font size (10×16 pixel). A character is displayed at the current cursor position, and the position is set by using 'Cursor set' command. The cursor position is incremented after each character is displayed. Refer to your specific module specification "Display Area-End of Line Behavior". The following command set displays characters shown in Fig. 4-1.

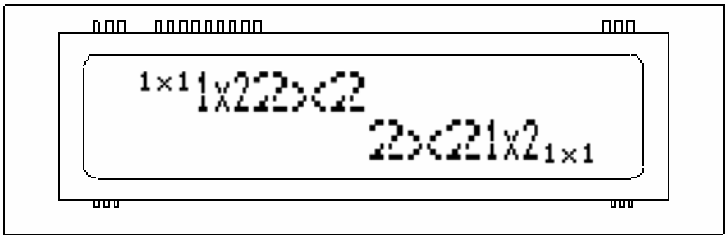


Fig. 4-1

```
void displaying_characters( )
{
  const int command_set [60] = {
   0x31, 0x78, 0x31,                           //Character Code
   0x1F, 0x28, 0x67, 0x40, 0x01, 0x02,  //Character Size
   0x31, 0x78, 0x32,                           //Character Code
   0x1F, 0x28, 0x67, 0x40, 0x02, 0x02,  //Character Size
   0x32, 0x78, 0x32,                           //Character Code
   0x1F, 0x24, 0x0C, 0x00, 0x02, 0x00, //Cursor Position
   0x1F, 0x28, 0x67, 0x40, 0x02, 0x02, //Character Size
   0x32, 0x78, 0x32,                           //Character Code
   0x1F, 0x28, 0x67, 0x40, 0x01, 0x02,  //Character Size
   0x31, 0x78, 0x32,                           //Character Code
   0x1F, 0x24, 0x15, 0x00, 0x03, 0x00,  //Cursor Position
   0x1F, 0x28, 0x67, 0x40, 0x01, 0x01,  //Character Size
   0x31, 0x78, 0x31};                          //Character Code
  for(n = 0; n < 60; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-1

4.2 Blinking Characters

The VFD module features an individual matrix (character) blinking function. The following command set displays characters shown in Fig. 4-2.

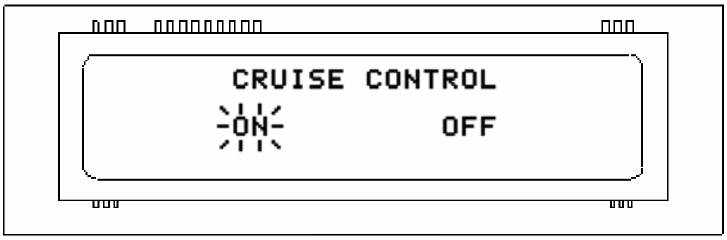


Fig. 4-2

```
void blinking_characters( )
{
  const int command_set [41] = {
   0x1F, 0x24, 0x05, 0x00, 0x00, 0x00,  //Cursor Position
   0x43, 0x52, 0x55, 0x49, 0x53, 0x45, 0x20, 0x43, 0x4f,
   0x4E, 0x54, 0x52, 0x4f, 0x4C,          //Character Code
   0x1F, 0x24, 0x05, 0x00, 0x02, 0x00,  //Cursor Position
   0x1B, 0x42,                                 //Blink Character
   0x4F, 0x4E,                                 //Character Code
   0x1F, 0x24, 0x10, 0x00, 0x02, 0x00,  //Cursor Position
   0x1B, 0x41,                                 //Blink Character
   0x4F, 0x46, 0x46};                         //Cursor Position
  for(n = 0; n < 41; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-2

4.3 Underlining Characters

The VFD module features an individual matrix (character) underlining function. The following command set displays characters shown in Fig. 4-3.

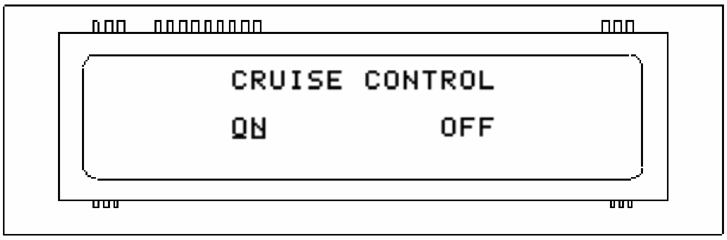


Fig. 4-3

```
void underlining_characters( )
{
  const int command_set [41] = {
   0x1F, 0x24, 0x05, 0x00, 0x00, 0x00, //Cursor Position
   0x43, 0x52, 0x55, 0x49, 0x53, 0x45, 0x20, 0x43, 0x4f,
   0x4E, 0x54, 0x52, 0x4f, 0x4C,           //Character Code
   0x1F, 0x24, 0x05, 0x00, 0x02, 0x00, //Cursor Position
   0x1B, 0x55,                         //Underline Character
   0x4F, 0x4E,                         //Character Code
   0x1F, 0x24, 0x10, 0x00, 0x02, 0x00, //Cursor Position
   0x1B, 0x57,                         //Underline Character
   0x4F, 0x46, 0x46};                  //Character Code
  for(n = 0; n < 41; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-3

4.4 Highlighting Characters

The VFD module features the individual character brightness control function. Individual character brightness is a relative value of over all display brightness. In order to make highlighted characters conspicuous, higher over all display brightness and lower non-highlighted character brightness are recommended. The following command set displays characters shown in Fig. 4-4.

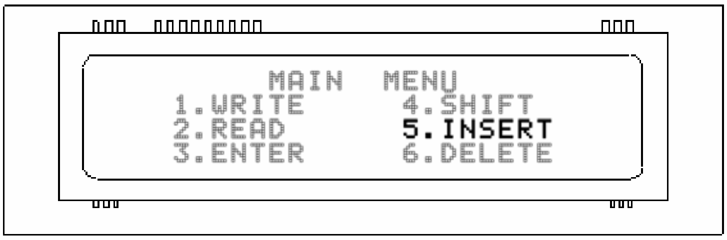


Fig. 4-4

```
void highlighting_characters( )
{
  const int command_set [123] = {
   0x1F, 0x58, 0x08,                   //Display Brightness
   0x1F, 0x24, 0x07, 0x00, 0x00, 0x00, //Cursor Position
   0x1F, 0x28, 0x67, 0x50, 0x03, 0x00, 0x00,
   //Character Brightness
   0x4D, 0x41, 0x49, 0x4E,             //Character Code
   0x1F, 0x24, 0x0D, 0x00, 0x00, 0x00, //Cursor Position
   0x4D, 0x45, 0x4E, 0x55,             //Character Code
   0x1F, 0x24, 0x02, 0x00, 0x01, 0x00, //Cursor Position
   0x31, 0x2E, 0x57, 0x52, 0x49, 0x54, 0x45,
   //Character Code
   0x1F, 0x24, 0x0E, 0x00, 0x01, 0x00, //Cursor Position
   0x34, 0x2E, 0x53, 0x48, 0x49, 0x46, 0x54,
   //Character Code
   0x1F, 0x24, 0x02, 0x00, 0x02, 0x00, //Cursor Position
   0x32, 0x2E, 0x52, 0x45, 0x41, 0x44, //Character Code
   0x1F, 0x24, 0x0E, 0x00, 0x02, 0x00, //Cursor Position
   0x1F, 0x28, 0x67, 0x50, 0x08, 0x00, 0x00,
   //Character Brightness
   0x35, 0x2E, 0x49, 0x4E, 0x53, 0x45, 0x52, 0x54,
   //Character Code
   0x1F, 0x24, 0x02, 0x00, 0x03, 0x00, //Cursor Position
   0x1F, 0x28, 0x67, 0x50, 0x03, 0x00, 0x00,
   //Character Brightness
   0x33, 0x2E, 0x45, 0x4E, 0x54, 0x45, 0x52,
   //Character Code
   0x1F, 0x24, 0x0E, 0x00, 0x03, 0x00, //Cursor Position
   0x36, 0x2E, 0x44, 0x45, 0x4C, 0x45, 0x54, 0x45};
   //Character Code
  for(n = 0; n < 123; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-4

4.5 User-Definable Font – RAM

User-definable font – RAM is stored (maximum 16 characters) and displayed in a horizontal orientation. A user-definable font can be stored into RAM location 20h to FFh. Example 4-5 defines two symbols (Fig. 4-6 and Fig. 4-7), and Example 4-6 displays the symbols and some characters (Fig. 4-5). <u>An initialization of the module clears all definded RAM user fonts.</u>

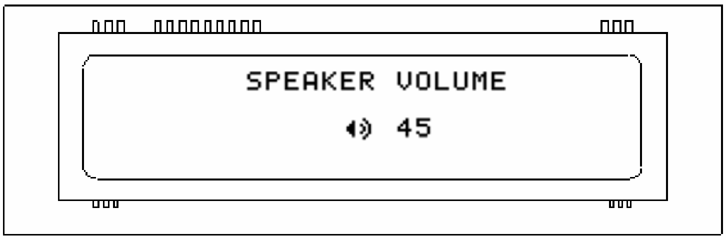


Fig. 4-5

DEFINING FONTS (Fig. 4-6 and Fig. 4-7)

```
void defining_ram_user_font( )
{
  const int command_set [17] = {
   0x1B, 0x26, 0x01,              //Define RAM User Font
   0x50,                          //Starting Character Code
   0x51,                          //Ending Character Code
   0x05,          //The Number of bytes for a Character
   0x00,                          //BYTE 1 DATA
   0x62,                          //BYTE 2 DATA
   0xCE,                          //BYTE 3 DATA
   0x31,                          //BYTE 4 DATA
   0x04,                          //BYTE 5 DATA
   0x05,          //The Number of bytes for a Character
   0x82,                          //BYTE 1 DATA
   0x24,                          //BYTE 2 DATA
   0xA5,                          //BYTE 3 DATA
   0x12,                          //BYTE 4 DATA
   0x11};                         //BYTE 5 DATA
  for(n = 0; n < 17; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-5

DISPLAYING CHARACTERS (Fig. 4-5)

```
void displaying_ram_user_font( )
{
  const int command_set [42] = {
   0x1F, 0x24, 0x05, 0x00, 0x00, 0x00,  //Cursor Position
   0x53, 0x50, 0x45, 0x41, 0x4B, 0x45, 0x52, 0x20, 0x56,
   0x4F, 0x4C, 0x55, 0x4D, 0x45,
   //Character Code
   0x1B, 0x25, 0x01,              //Enable RAM User Font
   0x1F, 0x24, 0x0A, 0x00, 0x02, 0x00, //Cursor Position
   0x50, 0x51,                          //Character Code
   0x1B, 0x25, 0x00,              //Disable RAM User Font
   0x1F, 0x24, 0x0D, 0x00, 0x02, 0x00, //Cursor Position
   0x34, 0x35};                         //Character Code
  for(n = 0; n < 42; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-6

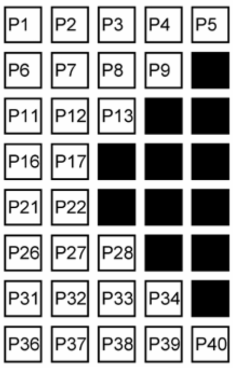


Fig. 4-6

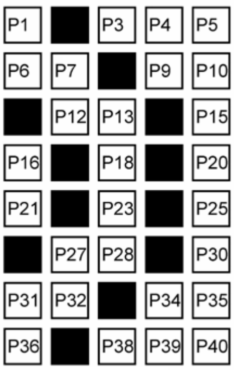


Fig. 4-7

Each bit value is logic level one, in Fig. 4-6, Fig. 4-7 and Table 4-1, if a pixel is ON, whereas the value is logic level zero if a pixel is OFF. The character code address location of Fig. 4-6 and Fig. 4-7 are 50h and 51h respectively in this example.

	B7 (MSB)	B6	B5	B4	B3	B2	B1	B0 (LSB)
BYTE 1	P8	P7	P6	P5	P4	P3	P2	P1
BYTE 2	P16	P15	P14	P13	P12	P11	P10	P9
BYTE 3	P24	P23	P22	P21	P20	P19	P18	P17
BYTE 4	P32	P31	P30	P29	P28	P27	P26	P25
BYTE 5	P40	P39	P38	P37	P36	P35	P34	P33

Table 4-1

4.6 User-Definable Font – Flash ROM

User-definable font – Flash ROM is stored (224 characters: 20h ~ FFh) and displayed in a horizontal orientation. All 224 character data has to be defined at once, so dummy blank data is stored in the unused memory space. Example 4-7 defines two symbols (Fig. 4-9 and Fig. 4-10), and Example 4-8 displays the symbols and some characters (Fig. 4-8). <u>An initialization of the module does not clear defined ROM user fonts.</u>

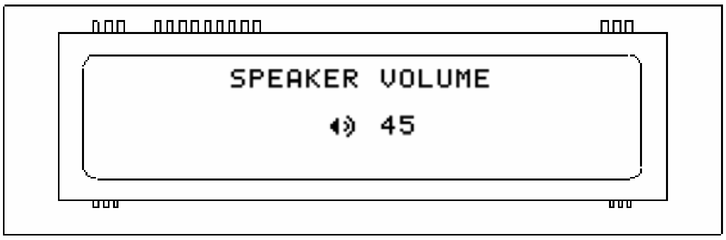


Fig. 4-8

DEFINING FONTS (Fig. 4-9 and Fig. 4-10)

```
void defining_rom_user_font( )
{
  const int command_set [1137] = {
   0x1F, 0x28, 0x65, 0x01, 0x49, 0x4E, //User Setup Mode
   0x1F, 0x28, 0x65, 0x14,          //Define ROM User Font
   0x00,                            //BYTE 1 DATA
   0x62,                            //BYTE 2 DATA
   0xCE,                            //BYTE 3 DATA
   0x31,                            //BYTE 4 DATA
   0x04,                            //BYTE 5 DATA
   0x82,                            //BYTE 1 DATA
   0x24,                            //BYTE 2 DATA
   0xA5,                            //BYTE 3 DATA
   0x12,                            //BYTE 4 DATA
   0x11,                            //BYTE 5 DATA
   0x00, 0x00, 0x00, 0x00, 0x00,    //Dummy Blank Data
   ·····Input 5×220 = 1,100 0x00s as dummy blank data·····
   0x00, 0x00, 0x00, 0x00, 0x00,    //Dummy Blank Data
   0x1F, 0x28, 0x65, 0x02, 0x4F, 0x55, 0x54};
                                    //User Setup Mode
  for(n = 0; n < 1137; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-7

DISPLAYING CHARACTERS (Fig. 4-8)

```
void displaying_rom_user_font( )
{
  const int command_set [42] = {
   0x1F, 0x24, 0x05, 0x00, 0x00, 0x00, //Cursor Position
   0x53, 0x50, 0x45, 0x41, 0x4B, 0x45, 0x52, 0x20, 0x56,
   0x4F, 0x4C, 0x55, 0x4D, 0x45,       //Character Code
   0x1B, 0x74, 0xFF,                   //Select Font Type
   0x1F, 0x24, 0x0A, 0x00, 0x02, 0x00, //Cursor Position
   0x20, 0x21,                         //Character Code
   0x1B, 0x74, 0x00,                   //Select Font Type
   0x1F, 0x24, 0x0D, 0x00, 0x02, 0x00  //Cursor Position
   0x34, 0x35};                        //Character Code
  for(n = 0; n < 42; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-8

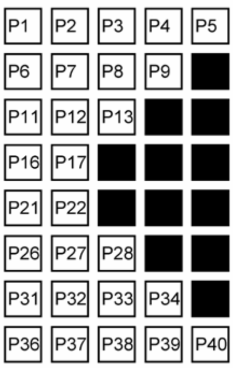


Fig. 4-9

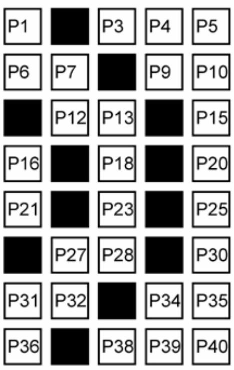


Fig. 4-10

Each bit value is logic level one, in Fig. 4-9, Fig. 4-10 and Table 4-2, if a pixel is ON, whereas the value is logic level zero if a pixel is OFF. The character code address location of Fig. 4-9 and Fig. 4-10 are 20h and 21h respectively in this example.

	B7 (MSB)	B6	B5	B4	B3	B2	B1	B0 (LSB)
BYTE 1	P8	P7	P6	P5	P4	P3	P2	P1
BYTE 2	P16	P15	P14	P13	P12	P11	P10	P9
BYTE 3	P24	P23	P22	P21	P20	P19	P18	P17
BYTE 4	P32	P31	P30	P29	P28	P27	P26	P25
BYTE 5	P40	P39	P38	P37	P36	P35	P34	P33

Table 4-2

4.7 Alternative Magnifed Font

Only under 2×2 Font Magnification mode, 28 characters such as '!', '1', '(', etc. can also be displayed in Alternative Magnified font instead of Common font. Refer to your specific module specification "Select/Deselect Alternative Magnified Font" and Font Specification DS−1519−0002 "Alternative Magnified Font".

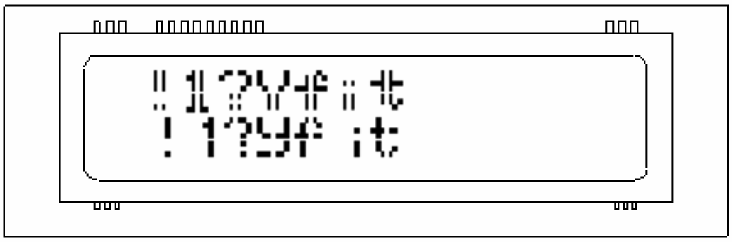


Fig. 4-11

```
void alternative_magnified_font( )
{
  const int command_set [36] = {
   0x1F, 0x28, 0x67, 0x40, 0x02, 0x02,  //Character Size
   0x21, 0x31, 0x3F, 0x59, 0x66, 0x69, 0x74,
   //Character Code
   0x1F, 0x24, 0x00, 0x00, 0x02, 0x00,  //Cursor Position
   0x1F, 0x28, 0x67, 0x06, 0x01,         //Alternative Font
   0x21, 0x31, 0x3F, 0x59, 0x66, 0x69, 0x74,
   //Character Code
   0x1F, 0x28, 0x67, 0x06, 0x00};        //Common Font
  for(n = 0; n < 36; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-9

4.8 Alternative 5×7 Font

These five characters 'g', 'j', 'p', 'q' and 'y' can also be displayed in Alternative 5×7 Matrix font instead of Common Refer to your specifc moule specification "Select/Deselect 5×8 Matrix Font" and Font Specification DS−1519−0002 "Alternative 5×7 Matrix Font".

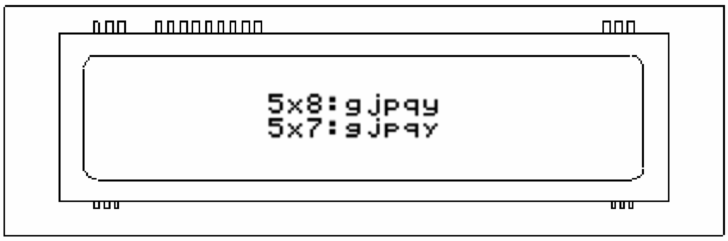


Fig. 4-12

```
void alternative_5x7_font( )
{
  const int command_set [40] = {
   0x1F, 0x24, 0x07, 0x00, 0x01, 0x00,  //Cursor Position
   0x35, 0x78, 0x38, 0x3A, 0x67, 0x6A, 0x70, 0x71, 0x79,
   //Character Code
   0x1F, 0x24, 0x07, 0x00, 0x02, 0x00,  //Cursor Position
   0x1F, 0x28, 0x67, 0x04, 0x80,         //Alternative Font
   0x35, 0x78, 0x37, 0x3A, 0x67, 0x6A, 0x70, 0x71, 0x79,
   //Character Code
   0x1F, 0x28, 0x67, 0x04, 0x81};        //Common Font
  for(n = 0; n < 40; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-10

4.9 Displaying Symbols (Character Code Type)

One of the 10 charcter code types is selectable, and its symbols and characters are added to Common font set. Refer to your specific module specification “Specify character code type” and Font Specification DS−1519−0002 “Character Code Type”.

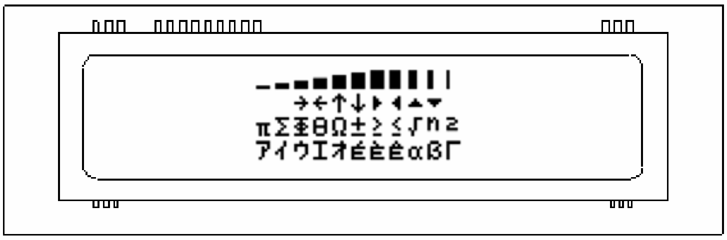


Fig. 4-13

```
void character_code_type( )
{
  const int command_set [77] = {
   0x1F, 0x24, 0x06, 0x00, 0x00, 0x00,  //Cursor Position
   0x1B, 0x74, 0x01,                  //Character Type Code
   0x80, 0x81, 0x82, 0x83, 0x84, 0x85, 0x94, 0x8F, 0x8E,
   0x8D, 0x8C,                                  //Character Code
   0x1F, 0x24, 0x08, 0x00, 0x01, 0x00,  //Cursor Position
   0x97, 0x98, 0x99, 0x9A, 0xE8, 0xE9, 0xEA, 0xEB,
   //Character Code
   0x1F, 0x24, 0x06, 0x00, 0x02, 0x00,  //Cursor Position
   0x1B, 0x74, 0x03,                  //Character Code Type
   0xE3, 0xE4, 0xE8, 0xE9, 0xEA, 0xF1, 0xF2, 0xF3, 0xFB,
   0xFC, 0xFD,                                  //Character Code
   0x1F, 0x24, 0x06, 0x00, 0x03, 0x00,  //Cursor Position
   0x1B, 0x74, 0x01,                  //Character Code Type
   0xB1, 0xB2, 0xB3, 0xB4, 0xB5,         //Character Code
   0x1B, 0x74, 0x04,                  //Character Code Type
   0x90, 0x91, 0x92, 0xE0, 0xE1, 0xE2};   //Character Code
  for(n = 0; n < 77; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-11

4.10 Displaynig Symbols (International Font Set)

One of the 14 international font sets is selectable, and its symbols and characters replaces the coressponding code characters in Common font set. Refer to your specific module specification “Specify International font set” and Font Specification DS−1519−0002 “International Font Set”.

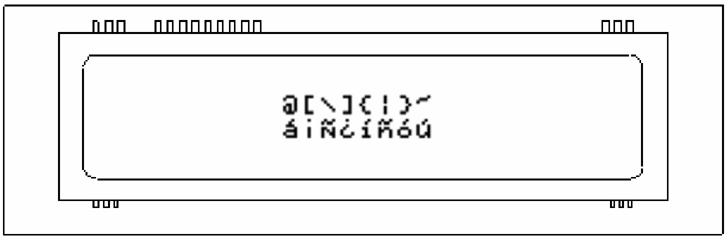


Fig. 4-14

```
void international_font_set( )
{
  const int command_set [31] = {
   0x1F, 0x24, 0x08, 0x00, 0x01, 0x00,  //Cursor Position
   0x40, 0x5B, 0x5C, 0x5D, 0x7B, 0x7C, 0x7D, 0x7E,
   //Character Code
   0x1F, 0x24, 0x08, 0x00, 0x02, 0x00,  //Cursor Position
   0x1B, 0x52, 0x0B,                  //International Font Set
   0x40, 0x5B, 0x5C, 0x5D, 0x7B, 0x7C, 0x7D, 0x7E};
   //Character Code
  for(n = 0; n < 31; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-12

4.11 Displayning Firmware Version

A version number of installed firmware can be displayed by the following command set.

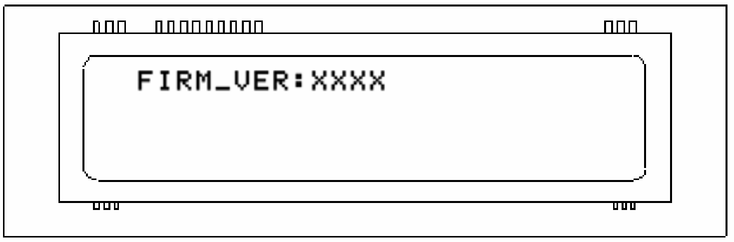


Fig. 4-15

```
void displaying_firmware_version( )
{
  const int command_set [17] = {
   0x1F, 0x28, 0x65, 0x01, 0x49, 0x4E,            //User Setup Mode
   0x1F, 0x28, 0x65, 0x14,                        //Display Firmware Version
   0x1F, 0x28, 0x65, 0x02, 0x4F, 0x55, 0x54};     //Direct Command Mode
  for(n = 0; n < 17; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-13

4.12 Power Save Mode

Even though the module does not display anything, standby power still exists. Power Save Mode minimizes the standby power. The mode is cancelled when the next command is received.

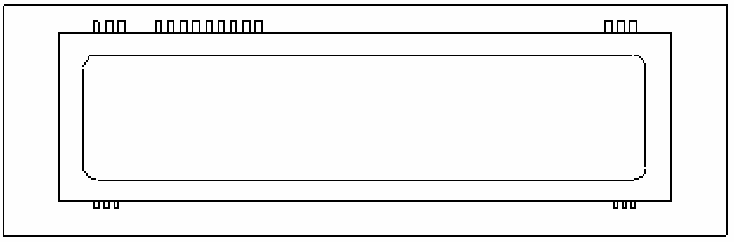


Fig. 4-16

```
void power_save_mode( )
{
  const int command_set [5] = {0x1F, 0x28, 0x61, 0x40, 0x00};
  for(n = 0; n < 5; n++)
  {
    data = command_set [n];
    parallel_out (data);
  }
}
```

Example 4-14

5 Optical Color Filters

The original color of illumination is blue-green (Fig. 5-1), and it has a wide range of the color spectrum. Therefore, the color can be changed with optional color filters easily (Fig. 5-2 and 5-3). Noritake provides optional color filters. For further information, please contact your local sales representative or visit our websit at www.noritake-elec.com/colors.htm.

Fig.5-1 (No Filter)

Fig. 5-2 (With Green Filter)

Fig. 5-3 (With Blue Filter)

Product images, including color, may differ from actual product appearance.

6 Revision History

Version	Date	Revision Description	Prepared	Approved
00	01/29/09	Initial Issued	M. S.	A. N.