AN12936

PCA9959 programming guide

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Document information

Information	Content
Keywords	SPI-bus, PCA9959, RGB and White LEDs, 24-channel x 6-bit brightness, 64 grids for gradation control.
Abstract	This document describes the PCA9959 programming guide which is the supporting document for the 24-channel SPI serial bus 63 mA/5.5 V constant current LED driver PCA9959

Revision history

Rev	Date	Description
v.1.0	20200817	Initial version

1 Introduction

The PCA9959 is a daisy-chain SPI-compatible 4-wire serial bus controlled 24-channel constant preset current LED driver optimized for dimming and blinking 63 mA Red/Green/Blue/Amber (RGBA) LEDs.

PCA9959 supports up to four groups of LED gradation control, with each LED channel assigned to one of groups. For each group, PCA9959 supports 64-grid brightness control, with the time duration of each grid adjustable from 2.5 μs to 1 ms. Each LED output can be off, on, set at its individual preset current value within each grid. Once gradation control enabled, PCA9959 will automatically change each LED preset current with the setup from grid0 to grid63, once finished, it can hold at grid63 or repeat from grid0 as configured.

This programming guide provides step by step instructions to configure all related registers and build up 8 grids and 8 LED channel gradation demo source code.

2 8 grids and 8 LED gradation demo source code

The following sections explain how to create the source code using 8 grids and 8 LED channels to do an LED gradation demo.

2.1 General registers setting

- **GRID_DUR (08h): Grid duration control register.**
  Bit[7:6] = 11b: Time step -> 20us
  Bit[5:0] = 0x18: DURCNT = 24
  Code:
  GRID_DUR_reg = 0xd8;

SPI_Write(GRID_DUR_W,GRID_DUR_reg);

- **SIDE_CTL(0Ah): Side control register**

Bit[7] = 0b: Side 0 to be written.

Bit[6] = 0b: Side 0 to be executed.

Code:

SIDE_CTL_reg = 0x00;

SPI_Write(SIDE_CTL_W,SIDE_CTL_reg);

- **PAGE_SEL(0Bh): Page select register**
  Bit[7] = 0b: Choose page 0 to access register 0x20 to 0x7F.
  Code:

PAGE_SEL_reg = 0x00;

SPI_Write(PAGE_SEL_W,PAGE_SEL_reg);

2.2 GDxx_Gy (20h – 5Fh): GRID and Group registers setting

- **GD0_Gy (20h): GRID0 and Group register.**
  Bit[7:6] = 00b: LEDs in Group 3 is OFF.
  Bit[5:4] = 00b: LEDs in Group 2 is OFF.
  Bit[3:2] = 01b: LEDs in Group 1 drives preset currents in CHx_CFG3 register.

Bit[1:0] = 00b: LEDs in Group 0 is OFF.
Code:

```
GRID0_reg = 0x04;

SPI_Write(GRID0_W,GRID0_reg);
```

- **GD1-7_Gy (21h – 27h): GRID1-7 and Group register.**
  Uses same settings and below code.
  Code:

```
GRID2_reg = 0x04;

SPI_Write(GRID2_W,GRID2_reg);

GRID3_reg = 0x04;

SPI_Write(GRID3_W,GRID3_reg);

GRID4_reg = 0x04;

SPI_Write(GRID4_W,GRID4_reg);

GRID5_reg = 0x04;

SPI_Write(GRID5_W,GRID5_reg);

GRID6_reg = 0x04;

SPI_Write(GRID6_W,GRID6_reg);

GRID7_reg = 0x04;

SPI_Write(GRID7_W,GRID7_reg);
```

2.3 Page_SEL (0Bh): Page select register

- **PAGE_SEL(0Bh): Page select register**
  Bit[7] = 1b: Choose page 1 to access register 0x20 to 0x7F.
  Code:

```
PAGE_SEL_reg = 0x80;

SPI_Write(PAGE_SEL_W,PAGE_SEL_reg);
```

2.4 CHx_CFGy (20h – 7Ah): LED channel configuration registers

- **CH0_CFG1(20h): LED CH0 configuration register byte 1**
  Bit[2:1] = 01b: LED CH0 is assigned to Group 1.
  Bit[0] = 1b: LED CH0 enable
  Code:

```
CH0_CFG1_reg = 0x03;

SPI_Write(CH0_CFG1_W,CH0_CFG1_reg);
```

- **CH0_CFG2(21h): LED CH0 configuration register byte 2**
  Bit[5:0] = 0x0b: LED CH0 preset current setting 1.
  Code:

```
CH0_CFG2_reg = 0x0b;

SPI_Write(CH0_CFG2_W,CH0_CFG2_reg);
```

- **CH0_CFG2(22h): LED CH0 configuration register byte 3**
  Bit[5:0] = 0x2c: LED CH0 preset current setting 2.
  Code:

CH0_CFG2_reg = 0x2c;

SPI_Write(CH0_CFG2_W,CH0_CFG2_reg);

- **CH0_CFG2(23h): LED CH0 configuration register byte 4**
  Bit[5:0] = 0x04: LED CH0 preset current setting 3.
  Code:

CH0_CFG2_reg = 0x04;

SPI_Write(CH0_CFG2_W,CH0_CFG2_reg);

- **CH1-7_CFG1-4 (24h – 3Fh): LED CH1-7 configuration register**
  Repeat same settings for LED channel 1-7.

LED CH1-7: enable

preset current setting 1 = 0x0b

preset current setting 2 = 0x2c

preset current setting 3 = 0x04

2.5 GRD_CTL (09h): Run demo by setting Gradation control register

- **GRID_DUR (09h): Gradation control register**
  Bit[7] = 1b: Gradation starts from Grid0
  Bit[6] = 1b: Recurrence mode
  Code:

GRD_CTL_reg = 0xc0;

SPI_Write(GRD_CTL_W,GRD_CTL_reg);

2.6 Complete 8 grids and 8 LED gradation demo source code

```
/*********************************************************
* @brief main routine for PCA9959 LED controller
* @function 8 grids and 8 LED gradation demo source code
* @return Function should not exit.
*********************************************************/
int main(void)
{
SystemCoreClockUpdate();
/* Initialize board and chip */
Board_Init();
/* SPI initialization */
Init_SPI_PinMux();
/* Setup SPI controllers */
setupMaster();
/***** General register settings *****/
/* Set Grid duration control = 500uS (20uS * 25) */
GRID_DUR_reg = 0xd8;
SPI_Write(GRID_DUR_W,GRID_DUR_reg);
/* Set Side control = Side 0 */
SIDE_CTL_reg = 0x00;
```

```
SPI_Write(SIDE_CTL_W,SIDE_CTL_reg);
/* Set Page select = Page 0 */
PAGE_SEL_reg = 0x00;
SPI_Write(PAGE_SEL_W,PAGE_SEL_reg);
/***** Page 0 Group LED configuration settings *****/
/* GRID0 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID0_reg = 0x04;
SPI_Write(GRID0_W,GRID0_reg);
/* GRID1 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID1_reg = 0x04;
SPI_Write(GRID1_W,GRID1_reg);
/* GRID2 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID2_reg = 0x04;
SPI_Write(GRID2_W,GRID2_reg);
/* GRID3 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID3_reg = 0x04;
SPI_Write(GRID3_W,GRID3_reg);
/* GRID4 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID4_reg = 0x04;
SPI_Write(GRID4_W,GRID4_reg);
/* GRID5 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID5_reg = 0x04;
SPI_Write(GRID5_W,GRID5_reg);
/* GRID6 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID6_reg = 0x04;
SPI_Write(GRID6_W,GRID6_reg);
/* GRID5 setting:
LEDs in Group 0: OFF
LEDs in Group 1: Using preset current 2
LEDs in Group 2: OFF
LEDs in Group 3: OFF */
GRID7_reg = 0x04;
```

```
SPI_Write(GRID7_W,GRID7_reg);
/* Set Page select = Page 1 */
PAGE_SEL_reg = 0x80;
SPI_Write(PAGE_SEL_W,PAGE_SEL_reg);
/***** Page 1 LED channel configuration settings *****/
/* LED Channel 0 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH0_CFG1_reg = 0x03;
SPI_Write(CH0_CFG1_W,CH0_CFG1_reg);
/* LED Channel 0 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH0_CFG2_reg = 0x0b;
SPI_Write(CH0_CFG2_W,CH0_CFG2_reg);
/* LED Channel 0 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH0_CFG3_reg = 0x2c;
SPI_Write(CH0_CFG3_W,CH0_CFG3_reg);
/* LED Channel 0 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH0_CFG4_reg = 0x04;
SPI_Write(CH0_CFG4_W,CH0_CFG4_reg);
/* LED Channel 1 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH1_CFG1_reg = 0x03;
SPI_Write(CH1_CFG1_W,CH1_CFG1_reg);
/* LED Channel 1 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH1_CFG2_reg = 0x0b;
SPI_Write(CH1_CFG2_W,CH1_CFG2_reg);
/* LED Channel 1 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH1_CFG3_reg = 0x2c;
SPI_Write(CH1_CFG3_W,CH1_CFG3_reg);
/* LED Channel 1 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH1_CFG4_reg = 0x04;
SPI_Write(CH1_CFG4_W,CH1_CFG4_reg);
/* LED Channel 2 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH2_CFG1_reg = 0x03;
SPI_Write(CH2_CFG1_W,CH2_CFG1_reg);
/* LED Channel 2 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH2_CFG2_reg = 0x0b;
SPI_Write(CH2_CFG2_W,CH2_CFG2_reg);
/* LED Channel 2 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH2_CFG3_reg = 0x2c;
SPI_Write(CH2_CFG3_W,CH2_CFG3_reg);
/* LED Channel 2 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH2_CFG4_reg = 0x04;
SPI_Write(CH2_CFG4_W,CH2_CFG4_reg);
/* LED Channel 3 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH3_CFG1_reg = 0x03;
```

```
SPI_Write(CH3_CFG1_W,CH3_CFG1_reg);
/* LED Channel 3 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH3_CFG2_reg = 0x0b;
SPI_Write(CH3_CFG2_W,CH3_CFG2_reg);
/* LED Channel 3 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH3_CFG3_reg = 0x2c;
SPI_Write(CH3_CFG3_W,CH3_CFG3_reg);
/* LED Channel 3 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH3_CFG4_reg = 0x04;
SPI_Write(CH3_CFG4_W,CH3_CFG4_reg);
/* LED Channel 4 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH4_CFG1_reg = 0x03;
SPI_Write(CH4_CFG1_W,CH4_CFG1_reg);
/* LED Channel 4 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH4_CFG2_reg = 0x0b;
SPI_Write(CH4_CFG2_W,CH4_CFG2_reg);
/* LED Channel 4 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH4_CFG3_reg = 0x2c;
SPI_Write(CH4_CFG3_W,CH4_CFG3_reg);
/* LED Channel 4 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH4_CFG4_reg = 0x04;
SPI_Write(CH4_CFG4_W,CH4_CFG4_reg);
/* LED Channel 5 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH5_CFG1_reg = 0x03;
SPI_Write(CH5_CFG1_W,CH5_CFG1_reg);
/* LED Channel 5 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH5_CFG2_reg = 0x0b;
SPI_Write(CH5_CFG2_W,CH5_CFG2_reg);
/* LED Channel 5 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH5_CFG3_reg = 0x2c;
SPI_Write(CH5_CFG3_W,CH5_CFG3_reg);
/* LED Channel 5 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH5_CFG4_reg = 0x04;
SPI_Write(CH5_CFG4_W,CH5_CFG4_reg);
/* LED Channel 6 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH6_CFG1_reg = 0x03;
SPI_Write(CH6_CFG1_W,CH6_CFG1_reg);
/* LED Channel 6 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH6_CFG2_reg = 0x0b;
SPI_Write(CH6_CFG2_W,CH6_CFG2_reg);
/* LED Channel 6 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH6_CFG3_reg = 0x2c;
SPI_Write(CH6_CFG3_W,CH6_CFG3_reg);
```

```
/* LED Channel 6 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH6_CFG4_reg = 0x04;
SPI_Write(CH6_CFG4_W,CH6_CFG4_reg);
/* LED Channel 7 Configuration setting 1
LED CH0: enable
LED CH0 group configuration: Group 1 */
CH7_CFG1_reg = 0x03;
SPI_Write(CH7_CFG1_W,CH7_CFG1_reg);
/* LED Channel 7 Configuration setting 2
LED CH0 preset current 1: 0x0b */
CH7_CFG2_reg = 0x0b;
SPI_Write(CH7_CFG2_W,CH7_CFG2_reg);
/* LED Channel 7 Configuration setting 3
LED CH0 preset current 2: 0x2c */
CH7_CFG3_reg = 0x2c;
SPI_Write(CH7_CFG3_W,CH7_CFG3_reg);
/* LED Channel 7 Configuration setting 4
LED CH0 preset current 1: 0x04 */
CH7_CFG4_reg = 0x04;
SPI_Write(CH7_CFG4_W,CH7_CFG4_reg);
/***** Start LED gradation demo *****/
/* GRD_EN: 1 (Gradation starts from Grid0)
GRD_MODE: 1 (Recurrence mode) */
GRD_CTL_reg = 0xc0;
SPI_Write(GRD_CTL_W,GRD_CTL_reg);
while (1)
{
}
return 0;
}
```

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