

# LP5860 11 × 18 LED Matrix Driver with 8-bit Analog and 8-/16-bit PWM Dimming

## 1 Features

- LED matrix topology:
  - 18 constant current sinks with 11 scan switches for 198 LED dots
  - Configurable for 1 to 11 scan switches
- Operating voltage range:
  - $V_{CC}/V_{LED}$  range: 2.7 V to 5.5 V
  - Logic pins compatible with 1.8 V, 3.3 V, and 5 V
- 18 constant current sinks with high precision:
  - 0.1–50 mA per current sink when  $V_{CC} \geq 3.3$  V
  - Device-to-device error:  $\pm 5\%$
  - Channel-to-channel error:  $\pm 5\%$
  - Phase-shift for balanced transient power
- Ultra-low power consumption:
  - Shutdown mode:  $I_{CC} \leq 2$   $\mu$ A when EN = Low
  - Standby mode:  $I_{CC} \leq 10$   $\mu$ A when EN = High and CHIP\_EN = 0 (data retained)
  - Active Mode:  $I_{CC} = 3$  mA (typ.) when channel current = 5 mA
- Flexible dimming options:
  - Individual ON/OFF control for each LED dot
  - Analog dimming (current gain control)
    - Global 3-bit Maximum Current (MC) setting for all LED dots
    - 3 groups of 7-bit Color Current (CC) setting for red, green, and blue
    - Individual 8-bit Dot Current (DC) setting for each LED dot
  - PWM dimming with audible-noise-free frequency
    - Global 8-bit PWM dimming for all LED dots
    - 3 programmable groups of 8-bit PWM dimming for LED dot arbitrary mapping
    - Individual 8-bit or 16-bit PWM dimming for each LED dot
- Full addressable SRAM to minimize data traffic
- Individual LED dot open/short detection
- Deghosting and low brightness compensation
- Interface options:
  - 1-MHz (max.) I<sup>2</sup>C interface when IFS = Low
  - 12-MHz (max.) SPI interface when IFS = High

## 2 Applications

- LED animation and indication for:
  - Keyboard, mouse, and gaming accessories
  - Major and smart home appliances
  - Smart speaker, wired and wireless speaker
  - Audio mixer, DJ equipment, and broadcast
  - Access equipment, switches, and servers
- Constant current sinks for optical module

## 3 Description

Electronic devices are becoming smarter, requiring to use larger quantity of LEDs for animation and indication purposes and high performance LED matrix driver is required to improve user experience with small solution size.

The **LP586x devices** are a family of high performance LED matrix drivers. It integrates 18 constant current sinks with N (N = 1/2/4/6/8/11) switching MOSFETs to support N×18 LED dots or N × 6 RGB LEDs. The LP5860 integrates 11 MOSFETs for up to 198 LED dots or 66 RGB LEDs.

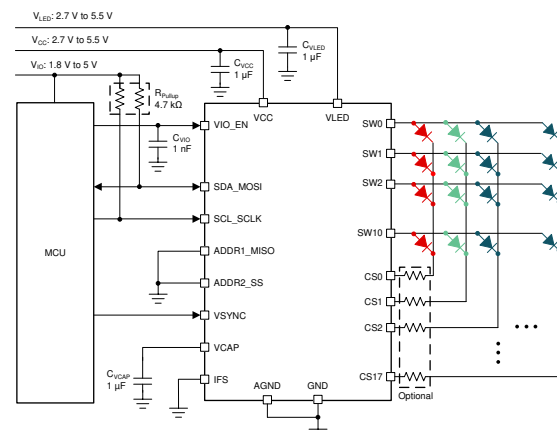
The LP5860 supports both analog dimming and PWM dimming methods. For analog dimming, each LED dot can be adjusted with 256 steps. For PWM dimming, the integrated 8-bit or 16-bit configurable PWM generators enable smooth and audible-noise-free dimming control. Each LED dot can also be arbitrarily mapped into 8-bit Group PWM to achieve dimming control together.

The LP5860 device implements full addressable SRAM to minimize the data traffic. The ghost-cancellation circuitry is integrated to eliminate both upside and downside ghosting. The LP5860 also supports LED open and short detection functions. Both 1-MHz (max.) I<sup>2</sup>C and 12-MHz (max.) SPI are available in LP5860.

### Device Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM) |
|-------------|------------------------|-----------------|
| LP5860      | VQFN (40)              | 5 mm × 5 mm     |

- (1) For all available packages, see the orderable addendum at the end of the data sheet.



**Simplified Schematic**



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## 4 Revision History

| DATE     | REVISION | NOTES           |
|----------|----------|-----------------|
| May 2021 | *        | Initial Release |

## 5 Device Comparison

| PART NUMBER | MATERIAL                   | LED DOT #     | PACKAGE <sup>(2)</sup> | SOFTWARE COMPATIBLE |
|-------------|----------------------------|---------------|------------------------|---------------------|
| LP5861      | LP5861RSMR                 | 18 × 1 = 18   | VQFN-32                | Yes                 |
| LP5862      | LP5862RSMR                 | 18 × 2 = 36   | VQFN-32                |                     |
|             | LP5862DBTR                 |               | TSSOP-38               |                     |
| LP5864      | LP5864RSMR                 | 18 × 4 = 72   | VQFN-32                |                     |
|             | LP5864MRSMR <sup>(1)</sup> |               |                        |                     |
| LP5866      | LP5866RKPR                 | 18 × 6 = 108  | VQFN-40                |                     |
|             | LP5866DBTR                 |               | TSSOP-38               |                     |
|             | LP5866MDBTR <sup>(1)</sup> |               |                        |                     |
| LP5868      | LP5868RKPR                 | 18 × 8 = 144  | VQFN-40                |                     |
| LP5860      | LP5860RKPR                 | 18 × 11 = 198 | VQFN-40                |                     |
|             | LP5860MRKPR <sup>(1)</sup> |               |                        |                     |

- (1) Extended Temperature devices, supporting –55°C ~ 125°C operating ambient temperature.  
(2) The same packages are hardware compatible.

## 6 Pin Configuration and Functions

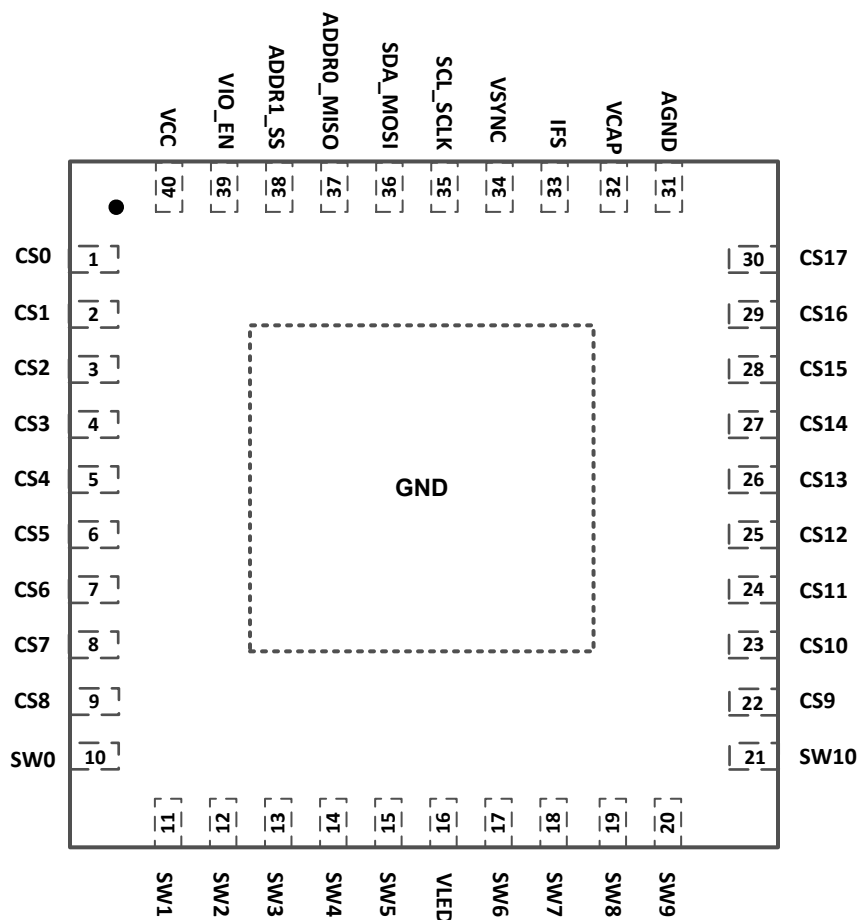


Figure 6-1. LP5860 RKP Package 40-Pin VQFN with Exposed Thermal Pad Top View

Table 6-1. Pin Functions

| PIN |      | I/O   | DESCRIPTION                                                                                |
|-----|------|-------|--------------------------------------------------------------------------------------------|
| NO. | NAME |       |                                                                                            |
| 1   | CS0  | O     | Current sink 0. If not used, this pin must be left floating.                               |
| 2   | CS1  | O     | Current sink 1. If not used, this pin must be left floating.                               |
| 3   | CS2  | O     | Current sink 2. If not used, this pin must be left floating.                               |
| 4   | CS3  | O     | Current sink 3. If not used, this pin must be left floating.                               |
| 5   | CS4  | O     | Current sink 4. If not used, this pin must be left floating.                               |
| 6   | CS5  | O     | Current sink 5. If not used, this pin must be left floating.                               |
| 7   | CS6  | O     | Current sink 6. If not used, this pin must be left floating.                               |
| 8   | CS7  | O     | Current sink 7. If not used, this pin must be left floating.                               |
| 9   | CS8  | O     | Current sink 8. If not used, this pin must be left floating.                               |
| 10  | SW0  | O     | High-side PMOS switch output for scan line 0. If not used, this pin must be left floating. |
| 11  | SW1  | O     | High-side PMOS switch output for scan line 1. If not used, this pin must be left floating. |
| 12  | SW2  | O     | High-side PMOS switch output for scan line 2. If not used, this pin must be left floating. |
| 13  | SW3  | O     | High-side PMOS switch output for scan line 3. If not used, this pin must be left floating. |
| 14  | SW4  | O     | High-side PMOS switch output for scan line 4. If not used, this pin must be left floating. |
| 15  | SW5  | O     | High-side PMOS switch output for scan line 5. If not used, this pin must be left floating. |
| 16  | VLED | Power | Power input for high-side switches.                                                        |

**Table 6-1. Pin Functions (continued)**

| PIN                 |            | I/O     | DESCRIPTION                                                                                                                                                        |
|---------------------|------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NO.                 | NAME       |         |                                                                                                                                                                    |
| 17                  | SW6        | O       | High-side PMOS switch output for scan line 6. If not used, this pin must be left floating.                                                                         |
| 18                  | SW7        | O       | High-side PMOS switch output for scan line 7. If not used, this pin must be left floating.                                                                         |
| 19                  | SW8        | O       | High-side PMOS switch output for scan line 8. If not used, this pin must be left floating.                                                                         |
| 20                  | SW9        | O       | High-side PMOS switch output for scan line 9. If not used, this pin must be left floating.                                                                         |
| 21                  | SW10       | O       | High-side PMOS switch output for scan line 10. If not used, this pin must be left floating.                                                                        |
| 22                  | CS9        | O       | Current sink 9. If not used, this pin must be left floating.                                                                                                       |
| 23                  | CS10       | O       | Current sink 10. If not used, this pin must be left floating.                                                                                                      |
| 24                  | CS11       | O       | Current sink 11. If not used, this pin must be left floating.                                                                                                      |
| 25                  | CS12       | O       | Current sink 12. If not used, this pin must be left floating.                                                                                                      |
| 26                  | CS13       | O       | Current sink 13. If not used, this pin must be left floating.                                                                                                      |
| 27                  | CS14       | O       | Current sink 14. If not used, this pin must be left floating.                                                                                                      |
| 28                  | CS15       | O       | Current sink 15. If not used, this pin must be left floating.                                                                                                      |
| 29                  | CS16       | O       | Current sink 16. If not used, this pin must be left floating.                                                                                                      |
| 30                  | CS17       | O       | Current sink 17. If not used, this pin must be left floating.                                                                                                      |
| 31                  | AGND       | Ground  | Analog ground. Must be connected to exposed thermal pad and common ground plane.                                                                                   |
| 32                  | VCAP       | O       | Internal LDO output. An 1- $\mu$ F capacitor must be connected between this pin with GND. Place the capacitor as close to the device as possible.                  |
| 33                  | IFS        | I       | Interface type select. I <sup>2</sup> C is selected when IFS is low. SPI is selected when IFS is high. A resistor must be connected between VIO and this pin.      |
| 34                  | VSYNC      | I       | External synchronize signal for display mode 2 and mode 3.                                                                                                         |
| 35                  | SCL_SCLK   | I       | I <sup>2</sup> C clock input or SPI clock input. Pull up to VIO when configured as I <sup>2</sup> C.                                                               |
| 36                  | SDA_MOSI   | I/O     | I <sup>2</sup> C data input or SPI leader output follower input. Pull up to VIO when configured as I <sup>2</sup> C.                                               |
| 37                  | ADDR0_MISO | I/O     | I <sup>2</sup> C address select 0 or SPI leader input follower output.                                                                                             |
| 38                  | ADDR1_SS   | I       | I <sup>2</sup> C address select 1 or SPI follower select.                                                                                                          |
| 39                  | VIO_EN     | Power,I | Power supply for digital circuits and chip enable. An 1-nF capacitor must be connected between this pin with GND and be placed as close to the device as possible. |
| 40                  | VCC        | Power   | Power supply for device. A 1- $\mu$ F capacitor must be connected between this pin with GND and be placed as close to the device as possible.                      |
| Exposed Thermal Pad | GND        | Ground  | Must be connected to AGND and common ground plane.                                                                                                                 |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                                                                                                                        |                      | MIN                | MAX | UNIT |
|----------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------|-----|------|
| Voltage on<br>VCC / VLED /<br>VIO / EN / CS /<br>SW / SDA /<br>SCL / SCLK /<br>MOSI / MISO /<br>SS / ADDR0 /<br>ADDR1 /<br>VSYNC / IFS |                      | -0.3               | 6   | V    |
| Voltage on<br>VCAP                                                                                                                     |                      | -0.3               | 2   | V    |
| Continuous<br>power<br>dissipation                                                                                                     |                      | Internally limited |     |      |
| T <sub>J</sub>                                                                                                                         | Junction temperature |                    |     | °C   |
| T <sub>stg</sub>                                                                                                                       | Storage temperature  | -65                | 150 | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Rating* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 7.2 ESD Ratings

|                    |                         |                                                                                          | VALUE | UNIT |
|--------------------|-------------------------|------------------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins <sup>(1)</sup>             | ±2000 | V    |
|                    |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | ±     |      |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. [Following sentence optional; see the wiki.] Manufacturing with less than 500-V HBM is possible with the necessary precautions. [Following sentence optional; see the wiki.] Pins listed as ±WWW V and/or ±XXX V may actually have higher performance.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. [Following sentence optional; see the wiki.] Manufacturing with less than 250-V CDM is possible with the necessary precautions. [Following sentence optional; see the wiki.] Pins listed as ±YYY V and/or ±ZZZ V may actually have higher performance.

### 7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

|                               |                           | MIN  | NOM | MAX | UNIT |
|-------------------------------|---------------------------|------|-----|-----|------|
| Input<br>voltage on<br>VCC    | Supply voltage            | 2.7  |     | 5.5 | V    |
| Input<br>voltage on<br>VLED   | High-level output current | 2.7  |     | 5.5 | V    |
| Input<br>voltage on<br>VIO_EN |                           | 1.65 |     | 5.5 | V    |

### 7.3 Recommended Operating Conditions (continued)

over operating free-air temperature range (unless otherwise noted)

|                                                                                  |                     | MIN | NOM | MAX             | UNIT |
|----------------------------------------------------------------------------------|---------------------|-----|-----|-----------------|------|
| Voltage on SDA / SCL / SCLK / MOSI / MISO / SS / ADDR <sub>x</sub> / VSYNC / IFS |                     |     |     | V <sub>IO</sub> | V    |
| T <sub>A</sub>                                                                   | Ambient temperature | –40 |     | 85              | °C   |

### 7.4 Electrical Characteristics

V<sub>CC</sub> = 3.3V, V<sub>LED</sub> = 3.8V, V<sub>IO</sub> = 1.8V and T<sub>A</sub> = –40°C to +85°C; Typical values are at T<sub>A</sub> = 25°C(unless otherwise specified)

| PARAMETER           |                                                                                                                   | TEST CONDITIONS                                                                                                                          | MIN  | TYP | MAX | UNIT |
|---------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------|-----|-----|------|
| Power supplies      |                                                                                                                   |                                                                                                                                          |      |     |     |      |
| V <sub>CC</sub>     | Device supply voltage                                                                                             |                                                                                                                                          | 2.7  |     | 5.5 | V    |
| V <sub>UVR</sub>    | Undervoltage restart                                                                                              | V <sub>CC</sub> rising, Test mode                                                                                                        |      |     | 2.5 | V    |
| V <sub>UVF</sub>    | Undervoltage shutdown                                                                                             | V <sub>CC</sub> falling, Test mode                                                                                                       | 2    |     |     | V    |
| V <sub>UV_HYS</sub> | Undervoltage shutdown hysteresis                                                                                  |                                                                                                                                          |      | 0.2 |     | V    |
| I <sub>CC</sub>     | Shutdown supply current I <sub>SHUTDOWN</sub>                                                                     | V <sub>EN</sub> = 0V, CHIP_EN = 0 (bit), measure the total current from VCC and VLED                                                     |      |     | 2   | μA   |
|                     | Standby supply current I <sub>STANDBY</sub>                                                                       | V <sub>EN</sub> = 3.3V, CHIP_EN = 0 (bit), measure the total current from VCC and VLED                                                   |      |     | 15  | μA   |
|                     | Active mode supply current I <sub>NORMAL</sub>                                                                    | V <sub>EN</sub> = 3.3V, CHIP_EN = 1 (bit), all channels I <sub>out</sub> = 5mA(MC = 1, CC = 127, DC = 256), measure the current from VCC |      |     | 10  | mA   |
| V <sub>LED</sub>    | LED supply voltage                                                                                                |                                                                                                                                          | 2.7  |     | 5.5 | V    |
| V <sub>VIO</sub>    | VIO supply voltage                                                                                                |                                                                                                                                          | 1.65 |     | 5.5 | V    |
| I <sub>VIO</sub>    | VIO supply current                                                                                                | Interface idle                                                                                                                           |      |     | 5   | μA   |
| Output Stages       |                                                                                                                   |                                                                                                                                          |      |     |     |      |
| I <sub>CS</sub>     | Constant current sink output range (CS0 – CS17)                                                                   | 2.7 <= VCC < 3.3V, PWM = 100%                                                                                                            | 1    |     | 40  | mA   |
|                     |                                                                                                                   | VCC >= 3.3V PWM = 100%                                                                                                                   | 1    |     | 50  | mA   |
| I <sub>LKG</sub>    | Leakage current (OUT0 – OUT17)                                                                                    | channels off, up_degghost = 0, VCS=5V                                                                                                    |      | 0.1 | 1   | μA   |
| I <sub>ERR_DD</sub> | Device to device current error, I <sub>ERR_DD</sub> =(I <sub>AVE</sub> -I <sub>SET</sub> )/I <sub>SET</sub> ×100% | All channels ON. Current set to 1mA. 1) MC=7, CC=2, PWM = 100%, DC=255 2) MC=0, CC=127, PWM = 100%, DC=255                               | –5   |     | 5   | %    |
|                     |                                                                                                                   | All channels ON. Current set to 10mA. MC=2 CC=127 DC=255 PWM=100%                                                                        | –5   |     | 5   | %    |
|                     |                                                                                                                   | All channels ON. Current set to 25mA. MC=7 CC=64 DC=255 PWM=100%                                                                         | –5   |     | 5   | %    |
|                     |                                                                                                                   | All channels ON. Current set to 40mA. MC=6 CC=127 DC=255 PWM=100%                                                                        | –5   |     | 5   | %    |
|                     |                                                                                                                   | All channels ON. Current set to 50mA. MC=7 CC=127 DC=255 PWM=100%                                                                        | –5   |     | 5   | %    |

## 7.4 Electrical Characteristics (continued)

VCC = 3.3V, VLED = 3.8V, VIO = 1.8V and TA = –40°C to +85°C; Typical values are at TA = 25°C(unless otherwise specified)

| PARAMETER             |                                                                                                                         | TEST CONDITIONS                                                                                                  | MIN       | TYP                  | MAX  | UNIT |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------|----------------------|------|------|
| I <sub>ERR_CC</sub>   | Channel to channel current error,<br>I <sub>ERR_CC</sub> =(I <sub>OUTX</sub> -I <sub>AVE</sub> )/I <sub>AVE</sub> ×100% | All channels ON. Current set to 1mA. 1)<br>MC=7, CC=2, PWM = 100%, DC=255 2)<br>MC=0, CC=127, PWM = 100%, DC=255 | −5        |                      | 5    | %    |
|                       |                                                                                                                         | All channels ON. Current set to 10mA.<br>MC=2 CC=127 DC=255 PWM=100%                                             | −5        |                      | 5    | %    |
|                       |                                                                                                                         | All channels ON. Current set to 25mA.<br>MC=7 CC=64 DC=255 PWM=100%                                              | −5        |                      | 5    | %    |
|                       |                                                                                                                         | All channels ON. Current set to 40mA.<br>MC=6 CC=127 DC=255 PWM=100%                                             | −5        |                      | 5    | %    |
|                       |                                                                                                                         | All channels ON. Current set to 50mA.<br>MC=7 CC=127 DC=255 PWM=100%                                             | −5        |                      | 5    | %    |
| f <sub>PWM</sub>      | LED PWM frequency                                                                                                       | PWM_Fre = 1, PWM = 100%                                                                                          |           | 62.5                 |      | KHz  |
|                       |                                                                                                                         | PWM_Fre = 0, PWM = 100%                                                                                          |           | 125                  |      | KHz  |
| V <sub>SAT</sub>      | Output saturation voltage                                                                                               | IOUT = 50mA, decreasing output voltage,<br>when the LED current has dropped 5%                                   |           |                      | 0.5  | V    |
|                       |                                                                                                                         | IOUT = 30mA, decreasing output voltage,<br>when the LED current has dropped 5%                                   |           |                      | 0.4  | V    |
|                       |                                                                                                                         | IOUT = 10mA, decreasing output voltage,<br>when the LED current has dropped 5%                                   |           |                      | 0.35 | V    |
| R <sub>SW</sub>       | High-side PMOS ON resistance                                                                                            | VLED = 2.7V, ISW = 200mA                                                                                         |           | 350                  |      | mΩ   |
|                       |                                                                                                                         | VLED = 3.8V, ISW = 200mA                                                                                         |           |                      |      | mΩ   |
|                       |                                                                                                                         | VLED = 5V, ISW = 200mA                                                                                           |           |                      |      | mΩ   |
| Logic Interfaces      |                                                                                                                         |                                                                                                                  |           |                      |      |      |
| V <sub>LOGIC_IL</sub> | Low-level input voltage, SDA, SCL,<br>SCLK, MOSI, SS, ADDR <sub>x</sub> , VSYNC, IFS                                    |                                                                                                                  |           | 0.3 x VIO            |      | V    |
| V <sub>LOGIC_IH</sub> | High-level input voltage, SDA, SCL,<br>SCLK, MOSI, SS, ADDR <sub>x</sub> , VSYNC, IFS                                   |                                                                                                                  | 0.7 x VIO |                      |      | V    |
| V <sub>EN_IL</sub>    | Low-level input voltage of EN                                                                                           |                                                                                                                  |           |                      | 0.4  | V    |
| V <sub>EN_IH</sub>    | High-level input voltage of EN                                                                                          | When VCAP powered up                                                                                             | 1.4       |                      |      | V    |
| I <sub>LOGIC_I</sub>  | Input current, SDA, SCL, SCLK, MOSI,<br>SS, ADDR <sub>x</sub>                                                           |                                                                                                                  | −1        |                      | 1    | μA   |
| V <sub>LOGIC_OL</sub> | Low-level output voltage, SDA, MISO                                                                                     | IPULLUP = 3 mA                                                                                                   |           |                      | 0.4  | V    |
| V <sub>LOGIC_OH</sub> | High-level output voltage, MISO                                                                                         | IPULLUP = -3 mA                                                                                                  | 0.7 x VIO |                      |      | V    |
| Protection Circuits   |                                                                                                                         |                                                                                                                  |           |                      |      |      |
| V <sub>LOD_TH</sub>   | Threshold for channel open detection                                                                                    |                                                                                                                  |           | 0.25                 |      | V    |
| V <sub>LSD_TH</sub>   | Threshold for channel short detection                                                                                   |                                                                                                                  |           | V <sub>LED</sub> − 1 |      | V    |
| T <sub>TSD</sub>      | Thermal-shutdown junction temperature                                                                                   |                                                                                                                  |           | 150                  |      | °C   |
| T <sub>HYS</sub>      | Thermal shutdown temperature<br>hysteresis                                                                              |                                                                                                                  |           | 15                   |      | °C   |

## 7.5 Thermal Information

| THERMAL METRIC        |                                           | LP5860     | UNIT |
|-----------------------|-------------------------------------------|------------|------|
|                       |                                           | RKP (VQFN) |      |
|                       |                                           | 40 PINS    |      |
| R <sub>θJA</sub>      | Junction-to-ambient thermal resistance    | TBD        | °C/W |
| R <sub>θJC(top)</sub> | Junction-to-case (top) thermal resistance | TBD        | °C/W |
| R <sub>θJB</sub>      | Junction-to-board thermal resistance      | TBD        | °C/W |

## 7.5 Thermal Information (continued)

| THERMAL METRIC       |                                              | LP5860     | UNIT |
|----------------------|----------------------------------------------|------------|------|
|                      |                                              | RKP (VQFN) |      |
|                      |                                              | 40 PINS    |      |
| $\Psi_{JT}$          | Junction-to-top characterization parameter   | TBD        | °C/W |
| $\Psi_{JB}$          | Junction-to-board characterization parameter | TBD        | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | TBD        | °C/W |

## 7.6 Timing Requirements

|                                               |                                                              | MIN   | NOM | MAX  | UNIT |
|-----------------------------------------------|--------------------------------------------------------------|-------|-----|------|------|
| <b>MISC. Timing Requirements</b>              |                                                              |       |     |      |      |
| $f_{OSC}$                                     | Internal oscillator frequency                                |       | 32  |      | MHz  |
| $f_{OSC\_ERR}$                                | Device to device oscillator frequency error                  | –0.02 |     | 0.02 |      |
| $t_{POR\_H}$                                  | Wait time from UVLO disactive to device NORMAL               |       |     | 500  | μS   |
| $t_{CHIP\_EN}$                                | Wait time from setting Chip_EN(Register) =1 to device NORMAL |       |     | 100  | μS   |
| $t_{RISE}$                                    | LED output rise time                                         |       | TBD |      | nS   |
| $t_{fall}$                                    | LED output fall time                                         |       |     |      | nS   |
| $t_{VSYNC\_H}$                                | The minimum high-level pulse width of VSYNC                  | 200   |     |      | μS   |
| <b>SPI Timing Requirements</b>                |                                                              |       |     |      |      |
| $f_{SCLK}$                                    | SPI Clock frequency                                          |       |     | 12   | MHz  |
| 1                                             | Cycle time                                                   | 83.3  |     |      | nS   |
| 2                                             | SS active lead-time                                          | 50    |     |      | nS   |
| 3                                             | SS active leg time                                           | 50    |     |      | nS   |
| 4                                             | SS inactive time                                             | 50    |     |      | nS   |
| 5                                             | SCLK low time                                                | 36    |     |      | nS   |
| 6                                             | SCLK high time                                               | 36    |     |      | nS   |
| 7                                             | MOSI set-up time                                             | 20    |     |      | nS   |
| 8                                             | MOSI hold time                                               | 20    |     |      | nS   |
| 9                                             | MISO disable time                                            |       |     | 30   | nS   |
| 10                                            | MISO data valid time                                         |       |     | 35   | nS   |
| $C_b$                                         | Bus capacitance                                              | 5     |     | 40   | pF   |
| <b>I2C Fast Mode Timing Requirements</b>      |                                                              |       |     |      |      |
| $f_{SCL}$                                     | I2C Clock frequency                                          | 0     |     | 400  | kHz  |
| 1                                             | Hold time (repeated) START condition                         | 600   |     |      | nS   |
| 2                                             | Clock low time                                               | 1300  |     |      | nS   |
| 3                                             | Clock high time                                              | 600   |     |      | nS   |
| 4                                             | Setup time for a repeated START condition                    | 600   |     |      | nS   |
| 5                                             | Data hold time                                               | 0     |     |      | nS   |
| 6                                             | Data setup time                                              | 100   |     |      | nS   |
| 7                                             | Rise time of SDA and SCL                                     |       |     | 300  | nS   |
| 8                                             | Fall time of SDA and SCL                                     |       |     | 300  | nS   |
| 9                                             | Setup time for STOP condition                                | 600   |     |      | nS   |
| 10                                            | Bus free time between a STOP and a START condition           | 1.3   |     |      | μS   |
| <b>I2C Fast Mode Plus Timing Requirements</b> |                                                              |       |     |      |      |
| $f_{SCL}$                                     | I2C Clock frequency                                          | 0     |     | 400  | kHz  |
| 1                                             | Hold time (repeated) START condition                         | 600   |     |      | nS   |
| 2                                             | Clock low time                                               | 1300  |     |      | nS   |

## 7.6 Timing Requirements (continued)

|    |                                                    | MIN | NOM | MAX | UNIT |
|----|----------------------------------------------------|-----|-----|-----|------|
| 3  | Clock high time                                    | 600 |     |     | nS   |
| 4  | Setup time for a repeated START condition          | 600 |     |     | nS   |
| 5  | Data hold time                                     | 0   |     |     | nS   |
| 6  | Data setup time                                    | 100 |     |     | nS   |
| 7  | Rise time of SDA and SCL                           |     |     | 300 | nS   |
| 8  | Fall time of SDA and SCL                           |     |     | 300 | nS   |
| 9  | Setup time for STOP condition                      | 600 |     |     | nS   |
| 10 | Bus free time between a STOP and a START condition | 1.3 |     |     | μS   |

## 8 Detailed Description

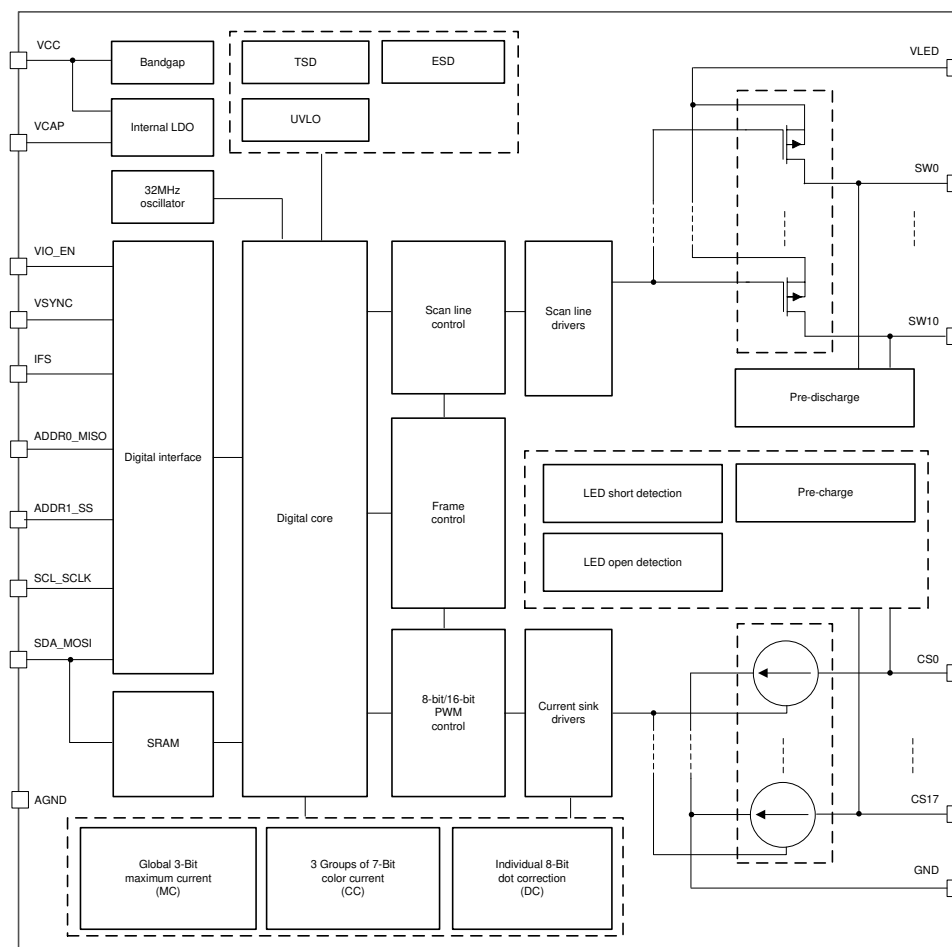
### 8.1 Overview

The LP5860 is an  $11 \times 18$  LED matrix driver. It integrates 11 switching FETs with 18 constant current sinks. One LP5860 device can drive up to 198 LED dots or 66 RGB pixels by using time-multiplexing matrix scheme.

The LP5860 supports both analog dimming and PWM dimming methods. For analog dimming, the current gain of each individual LED dot can be adjusted with 256 steps through 8-bits dot correction. For PWM dimming, the integrated 8-bits or 16-bits configurable, > 20-KHz PWM generators for each LED dot enable smooth, vivid animation effects without audible noise. Each LED can also be mapped into a 8-bits group PWM to achieve the group control with minimum data traffic.

The LP5860 device implements full addressable SRAM. It supports entire SRAM data refresh and partial SRAM data update on demand to minimize the data traffic. The LP5860 implements the ghost cancellation circuit to eliminate both upside and downside ghosting. The LP5860 also utilizes low brightness compensation technology to support high density LED pixels. Both 1-MHz (max.) I<sup>2</sup>C and 12-MHz (max.) SPI interfaces are available in the LP5860.

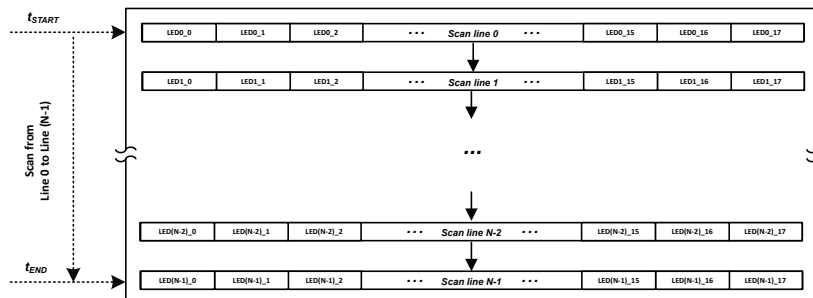
### 8.2 Functional Block Diagram



### 8.3 Feature Description

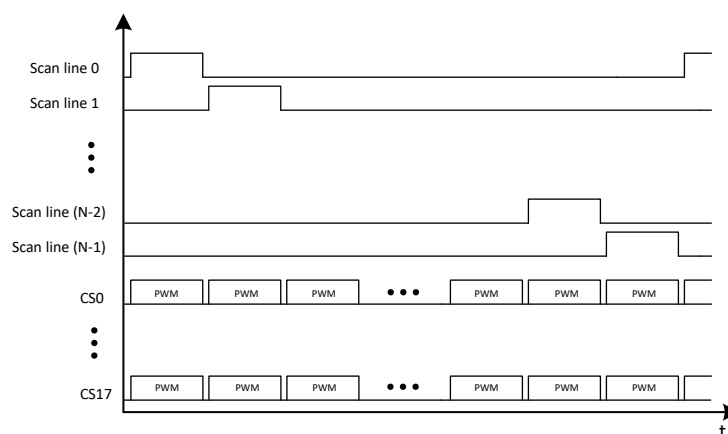
#### 8.3.1 Time-Multiplexing Matrix

The LP5860 device utilizes time-multiplexing matrix scheme to support up to 198 LED dots with a single chip. It integrates 18 current sinks with 11 scan lines to drive  $18 \times 11 = 198$  LED dots or  $6 \times 11 = 66$  RGB pixels. In matrix control scheme, the device scans from Line 0 to Line 10 sequentially as shown in [Figure 8-1](#). Current gain and PWM duty registers are programmable for each LED dot to support individual analog and PWM dimming.



**Figure 8-1. Scan Line Control Scheme**

There are 11 high-side p-channel MOSFETs (PMOS) integrated in LP5860 device. Users can flexibly set the active scan numbers from 1 to 11 by configuring the 'Max\_Line\_Num' in Dev\_initial register. The time-multiplexing matrix timing sequence follows the [Figure 8-2](#).



**Figure 8-2. Time-Multiplexing Matrix Timing Sequence**

One cycle time of the line switching can be calculated as below:

$$t_{\text{line\_switch}} = t_{\text{PWM}} + t_{\text{SW\_BLK}} + 2 \times t_{\text{phase\_shift}} \quad (1)$$

- $t_{\text{PWM}}$  is the current sink active time, which equals to 8 us (PWM frequency set at 125 kHz) or 16 us (PWM frequency set at 62.5 kHz) by configuring 'PWM\_Fre' in Dev\_initial register.
- $t_{\text{SW\_BLK}}$  is the switch blank time, which equals to 1 us or 0.5 us by configuring 'SW\_BLK' in Dev\_config1 register.
- $t_{\text{phase\_shift}}$  is the PWM phase shift time, which equal to 0 or 125 ns by configuring 'PWM\_Phase\_Shift' in Dev\_config1 register.

Total display time for one complete sub-period is  $t_{\text{sub\_period}}$  and it can be calculated by the following equation:

$$t_{\text{sub\_period}} = t_{\text{line\_switch}} \times \text{Scan\_line\#} \quad (2)$$

- Scan\_line# is the scan line number determined by 'Max\_Line\_Num' in Dev\_initial register.

The time-multiplexing matrix scheme time diagram is shown in [Figure 8-3](#). The  $t_{\text{CS\_ON\_Shift}}$  is the current sink turning on shift by configuring 'CS\_ON\_Shift' bit in Dev\_config1 register.

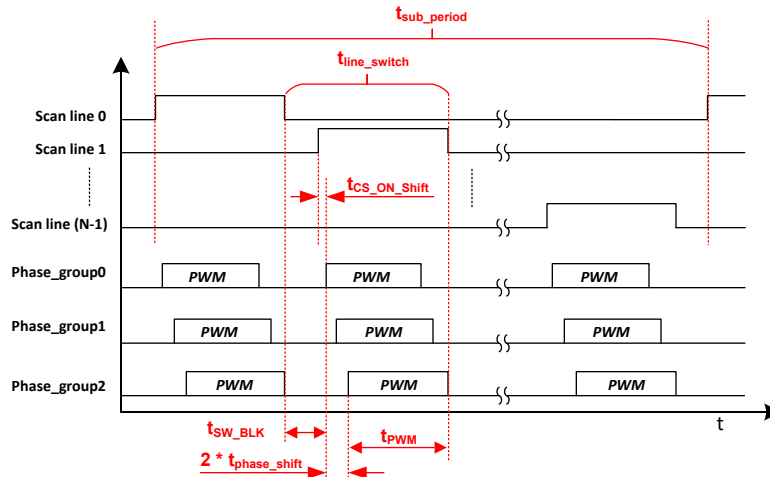


Figure 8-3. Time-Multiplexing Matrix Timing Diagram

The LP5860 device implements deghosting and low brightness compensation to remove the side effects of matrix topology:

- **Deghosting:** Both upside deghosting and downside deghosting are implemented to eliminate the LED's unexpected weak turn-on.
  - Upside\_deghosting: discharge each scan line during its off state. By configuring the 'Up\_Deghost' in Dev\_config3 register, the LP5860 will discharge and clamp the scan line switch to a certain voltage.
  - Downside\_deghosting: pre-charge each current sink voltage during its off state. The deghosting capability can be adjusted through the 'Down\_Deghost' in Dev\_config3 register.
- **Low Brightness Compensation:** 3 groups compensation are implemented to overcome the color-shift and non-uniformity in low brightness conditions. The compensation capability can be through 'Comp\_Group1', 'Comp\_Group2', and 'Comp\_Group3' in Dev\_config2 register.
  - Compensation\_group 1: CS0, CS3, CS6, CS9, CS12, CS15.
  - Compensation\_group 2: CS1, CS4, CS7, CS10, CS13, CS16.
  - Compensation\_group 3: CS2, CS5, CS8, CS11, CS14, CS17.

### 8.3.2 Analog Dimming (Current Gain Control)

Analog dimming of LP5860 is achieved by configuring the current gain control. There are several methods to control the current gain of each LED.

- Global 3-bits Maximum Current (MC) Setting without External Resistor
- 3 Groups of 7-bits Color Current (CC) Setting
- Individual 8-bit Dot Current (DC) Setting

#### Global 3-Bits Maximum Current (MC) Setting

The MC is used to set the maximum current  $I_{OUT\_MAX}$  for each current sink and this current will be the maximum peak current for each LED dot. The MC can be set with 3-bits (8 steps) from 3 mA to 50 mA. When the device is powered on, the MC data is set to default value, which is 15 mA.

For data refresh [Mode 1](#), MC data will be effective immediately once new data updated. For [Mode 2](#) and [Mode 3](#), to avoid unexpected MC data change during high speed data refreshing, MC data should be changed when all channels are off and new MC data will only be updated when the 'Chip\_EN' bit in Chip\_en register is set to 0, and after the 'Chip\_EN' returns to 1, the new MC data will be effective. 'Down\_Deghost' and 'Up\_Deghost' in Dev\_config3 work in the similar way with MC.

Table 8-1. Maximum Current (MC) Register Setting

| 3-BITS MAXIMUM_CURRENT REGISTER |         | $I_{OUT\_MAX}$ |
|---------------------------------|---------|----------------|
| Binary                          | Decimal | mA             |
| 000                             | 0       | 3              |

**Table 8-1. Maximum Current (MC) Register Setting (continued)**

| 3-BITS MAXIMUM_CURRENT REGISTER |             | I <sub>OUT_MAX</sub> |
|---------------------------------|-------------|----------------------|
| Binary                          | Decimal     | mA                   |
| 001                             | 1           | 5                    |
| 010                             | 2           | 10                   |
| 011 (Default)                   | 3 (Default) | 15 (Default)         |
| 100                             | 4           | 20                   |
| 101                             | 5           | 30                   |
| 110                             | 6           | 40                   |
| 111                             | 7           | 50                   |

**3 Groups of 7-Bits Color Current (CC) Setting**

The LP5860 device is able to adjust the output current of three color groups separately. For each color, it has 7-bits data in 'CC\_Group1', 'CC\_Group2', and 'CC\_Group3'. Thus, all color group currents can be adjusted in 128 steps from 0% to 100% of the maximum output current, I<sub>OUT\_MAX</sub>.

The 18 current sinks have fixed mapping to the three color groups:

- CC-Group 1: CS0, CS3, CS6, CS9, CS12, CS15.
- CC-Group 2: CS1, CS4, CS7, CS10, CS13, CS16.
- CC-Group 3: CS2, CS5, CS8, CS11, CS14, CS17.

**Table 8-2. 3 Groups of 7-bits Color Current (CC) Setting**

| 7-BITS CC_GROUP1/CC_GROUP2/CC_GROUP3 REGISTER |              | RATIO OF OUTPUT CURRENT TO I <sub>OUT_MAX</sub> |
|-----------------------------------------------|--------------|-------------------------------------------------|
| Binary                                        | Decimal      | %                                               |
| 000 0000                                      | 0            | 0                                               |
| 000 0001                                      | 1            | 0.79                                            |
| 000 0010                                      | 2            | 1.57                                            |
| ---                                           | ---          | ---                                             |
| 100 0000 (default)                            | 64 (default) | 50.4 (default)                                  |
| ---                                           | ---          | ---                                             |
| 111 1101                                      | 125          | 98.4                                            |
| 111 1110                                      | 126          | 99.2                                            |
| 111 1111                                      | 127          | 100                                             |

**Individual 8-bit Dot Current (DC) Setting**

The LP5860 can individually adjust the output current of each LED by using dot current function through DC setting. It allows the brightness deviations of the LEDs to adjusted be individually. Each output DC is programmed with a 8-bit depth, so the value can be adjusted with 256 steps within the range from 0% to 100% of (I<sub>OUT\_MAX</sub> × CC/127).

**Table 8-3. Individual 8-bit Dot Current (DC) Setting**

| 8-BIT DC REGISTER   |               | RATIO OF OUTPUT CURRENT TO I <sub>OUT_MAX</sub> × CC/127 |
|---------------------|---------------|----------------------------------------------------------|
| Binary              | Decimal       | %                                                        |
| 0000 0000           | 0             | 0                                                        |
| 0000 0001           | 1             | 0.39                                                     |
| 0000 0010           | 2             | 0.78                                                     |
| ---                 | ---           | ---                                                      |
| 1000 0000 (Default) | 128 (Default) | 50.2 (Default)                                           |
| ---                 | ---           | ---                                                      |

**Table 8-3. Individual 8-bit Dot Current (DC) Setting (continued)**

| 8-BIT DC REGISTER |         | RATIO OF OUTPUT CURRENT TO $I_{OUT\_MAX} \times CC/127$ |
|-------------------|---------|---------------------------------------------------------|
| Binary            | Decimal | %                                                       |
| 1111 1101         | 253     | 99.2                                                    |
| 1111 1110         | 254     | 99.6                                                    |
| 1111 1111         | 255     | 100                                                     |

In summary, the current gain of each current sink can be calculated as below:

$$I_{OUT} \text{ (mA)} = I_{OUT\_MAX} \times (CC/127) \times (DC/255) \quad (3)$$

For time-multiplexing scan scheme, if the scan number is N, each LED dot's average current  $I_{AVG}$  is shown as below:

$$I_{AVG} \text{ (mA)} = I_{OUT}/N = I_{OUT\_MAX} \times (CC/127) \times (DC/255)/N \quad (4)$$

### 8.3.3 PWM Dimming

There are several methods to control the PWM duty cycle of each LED dot.

- **Individual 8-bit / 16-bit PWM for Each LED Dot**

Every LED has an individual 8-bit or 16-bit PWM register that is used to change the LED brightness by PWM duty. The LP5860 uses an enhanced spectrum PWM (ES-PWM) algorithm to achieve 16-bit depth with high refresh rate and this can avoid flicker under high speed camera. Comparing with conventional 8-bit PWM, 16-bit PWM can help to achieve ultimate high dimming resolution in LED animation applications.

- **3 Programmable Groups of 8-bit PWM Dimming**

The group PWM Control is used to select LEDs into 1 to 3 groups where each group has a separate register for duty cycle control. Every LED has 2-bit selection in LED\_DOT\_GROUP Registers (x = 0, 1, ... , 54.) to select whether it belongs to one of the three groups or not:

- 00: not a member of any group
- 01: member of group 1
- 10: member of group 2
- 11: member of group 3

- **8-bit PWM for Global Dimming**

The Global PWM Control function affects all LEDs simultaneously.

The final PWM duty cycle can be calculated as below:

$$PWM\_Final(8\text{-bit}) = PWM\_Individual(8\text{-bit}) \times PWM\_Group(8\text{-bit}) \times PWM\_Global(8\text{-bit}) \quad (5)$$

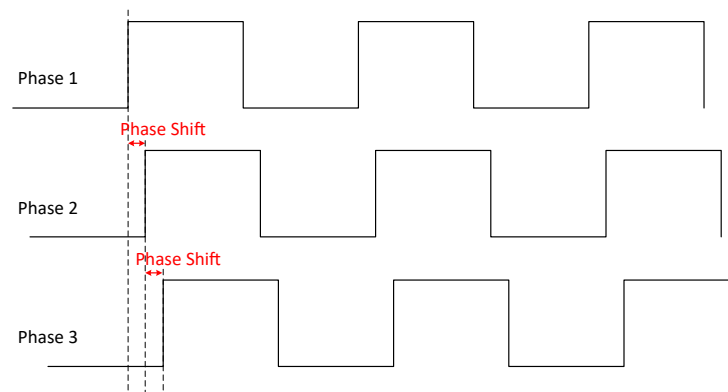
$$PWM\_Final(16\text{-bit}) = PWM\_Individual(8\text{-bit}) \times PWM\_Group(8\text{-bit}) \times PWM\_Global(16\text{-bit}) \quad (6)$$

The LP5860 supports 125-kHz or 62.5-kHz PWM output frequency. The PWM frequency is selected by configuring the 'PWM\_Fre' in Dev\_initial register. An internal 32-MHz oscillator is used for generating PWM outputs. The oscillator's high accuracy design ( $f_{OSC\_ERR} \leq \pm 2\%$ ) enables a better synchronization if multiple LP5860 devices are connected together.

A PWM phase-shifting scheme is implemented in each current sink to avoid the current overshoot when turning on simultaneously. As the LED drivers are not activated simultaneously, the peak load current from the pre-stage power supply is significantly decreased. This scheme also reduces input-current ripple and ceramic-capacitor audible ringing. LED drivers are grouped into three different phases. By configuring the 'PWM\_Phase\_Shift' in Dev\_config1 register, which is default off, the LP5860 supports  $t_{phase\_shift} = 125\text{-ns}$  shifting time shown in [Figure 8-4](#).

- Phase 1: CS0, CS3, CS6, CS9, CS12, CS15.

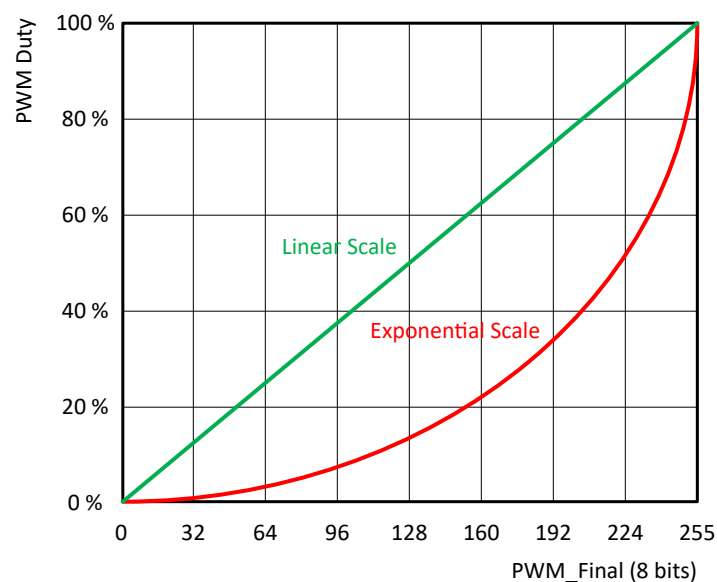
- Phase 2: CS1, CS4, CS7, CS10, CS13, CS16.
- Phase 3: CS2, CS5, CS8, CS11, CS14, CS17.



**Figure 8-4. Phase Shift**

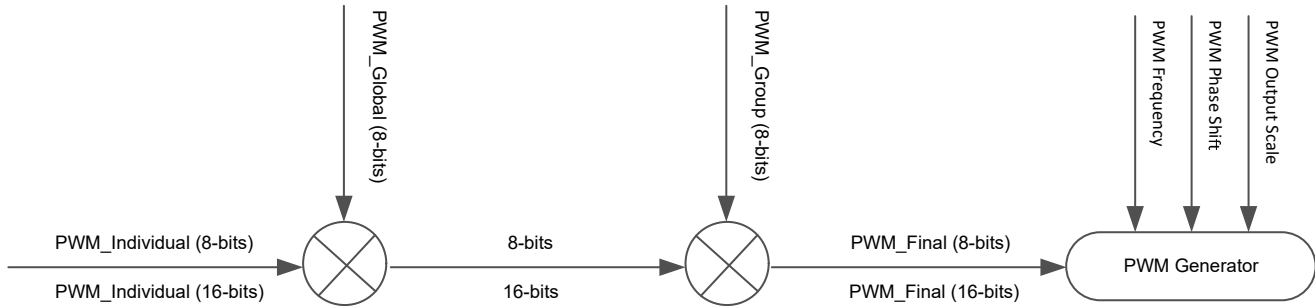
To avoid high current sinks output ripple during line switching, current sinks can be configured to turn on with 1 clock delay (62.5ns or 31.25ns according to the PWM frequency) after lines turn on, as shown in [Figure 8-3](#). This function could be configured by 'CS\_ON\_Shift' in Dev\_config1 register.

The LP5860 allows users to configure the dimming scale either exponentially (Gamma Correction) or linearly through the 'PWM\_Scale\_Mode' in Dev\_config1 register. If a human-eye-friendly dimming curve is desired, using the internal fixed exponential scale is an easy approach. If a special dimming curve is desired, using the linear scale with software correction is recommended. The LP5860 supports both linear and exponential dimming curves under 8-bit and 16-bit PWM depth. [Figure 8-5](#) is an example of 8-bit PWM depth.



**Figure 8-5. Linear and Exponential Dimming Curves**

In summary, the PWM control method is illustrated as [Figure 8-6](#):



**Figure 8-6. PWM Control Scheme**

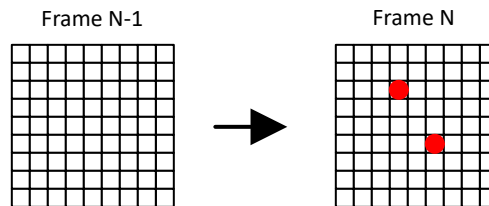
### 8.3.4 ON/OFF Control

The LP5860 device supports the individual ON/OFF control of each LED. For indication purpose, users can turn on and off the LED directly by writing 1-bit ON/OFF data to the corresponding Dot\_onoffx (x = 0, 1, ... , 32) register.

### 8.3.5 Data Refresh Mode

The LP5860 supports three data refresh modes: Mode 1, Mode 2, and Mode 3, by configuring 'Data\_Ref\_Mode' in Dev\_initial register.

**Mode 1:** 8-bit PWM data without VSYNC command. Data is sent out for display instantly once received. With Mode1, users can refresh the corresponding dots' data only instead of updating the whole SRAM. It is called 'on demand data refresh', which can save the total data volume effectively. As shown in Figure 8-7, the red LED dots can be refreshed after sending the corresponding data while the others kept the same with last frame.

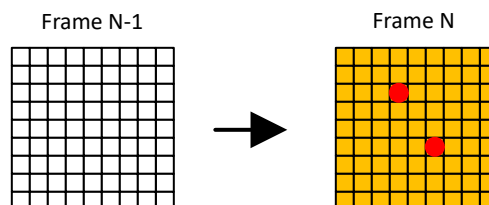


**Figure 8-7. On Demand Data Refresh - Mode 1**

**Mode 2:** 8-bit PWM data with VSYNC command. Data is held and sent out simultaneously by frame after receiving the VSYNC command.

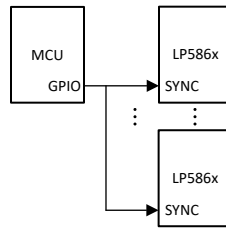
**Mode 3:** 16-bit PWM data with VSYNC command. Data is held and sent out simultaneously by frame after receiving the VSYNC command.

Frame control is implemented in Mode 2 and Mode 3. Instead of refreshing the output instantly once data is received (Mode 1), the device holds the data and refreshes the whole frame data by a fixed frame rate,  $f_{VSYNC}$ . Usually, 24 Hz, 50 Hz, 60 Hz, 120Hz or even higher frame rate is selected to achieve vivid animation effects. Whole SRAM Data Refresh is shown in Figure 8-8, a new frame is updated after receiving the VSYNC command.

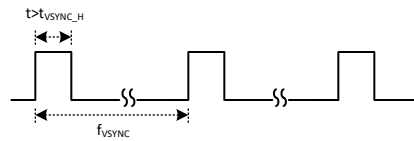


**Figure 8-8. Whole SRAM Data Refresh**

Comparing with Mode 1, Mode 2 and Mode 3 provide a better synchronization when multiple LP5860 devices used together. A high-level pulse width longer than  $t_{\text{SYNC\_H}}$  is required at the beginning of each VSYNC frame. Figure 8-9 shows the VSYNC connections and Figure 8-10 shows the timing requirements.



**Figure 8-9. Multiple Devices Sync**



**Figure 8-10. VSYNC Timing**

Table 8-4 is the summary of the 3 data refresh modes.

**Table 8-4. Data Refresh Mode**

| MODE TYPE | PWM RESOLUTION | PWM OUTPUT            | EXTERNAL VSYNC |
|-----------|----------------|-----------------------|----------------|
| Mode 1    | 8 Bits         | Data update instantly | No             |
| Mode 2    | 8 Bits         | Data update by frame  | Yes            |
| Mode 3    | 16 Bits        |                       |                |

### 8.3.6 Full Addressable SRAM

SRAM is implemented inside the LP5860 device to support data writing and reading at the same time.

Although data refresh mechanisms are not the same for Mode 1 and Mode 2/3, the data writing and reading follow the same method. Users can update partial of the SRAM data only or the whole SRAM page simultaneously. The LP5860 supports auto-increment function to minimize data traffic and increase data transfer efficiency.

Please be noted that 16-bit PWM (Mode 3) and 8-bit PWM (Mode 1 and Mode 2) are assigned with different SRAM addresses.

### 8.3.7 Protections and Diagnostics

#### LED Open Detection

The LP5860 includes LED open detection (LOD) for the fault caused by any opened LED dot. The threshold for LED open is 0.25-V typical. LED open detection is only performed when  $\text{PWM} \geq 25$  (Mode 1 and Mode 2) or  $\text{PWM} \geq 6400$  (Mode 3) and voltage on CSn is detected lower than open threshold for continuously 4 sub-periods.

Figure 8-11 shows the detection circuit of LOD function. When open fault is detected, 'Global\_LOD' bit in Fault\_state register is set to 1 and detailed fault state for each LED would also be monitored in register Dot\_lodx ( $x = 0, 1, \dots, 32$ ). All open fault indicator bits can be cleared by setting  $\text{LOD\_clear} = 0\text{Fh}$  once the open condition is removed.

LOD removal function can be enabled by setting 'LOD\_removal' bit in Dev\_config2 register to 1. This function turns off the current sink of the open channel when scanning to the line where the opened LED is included.

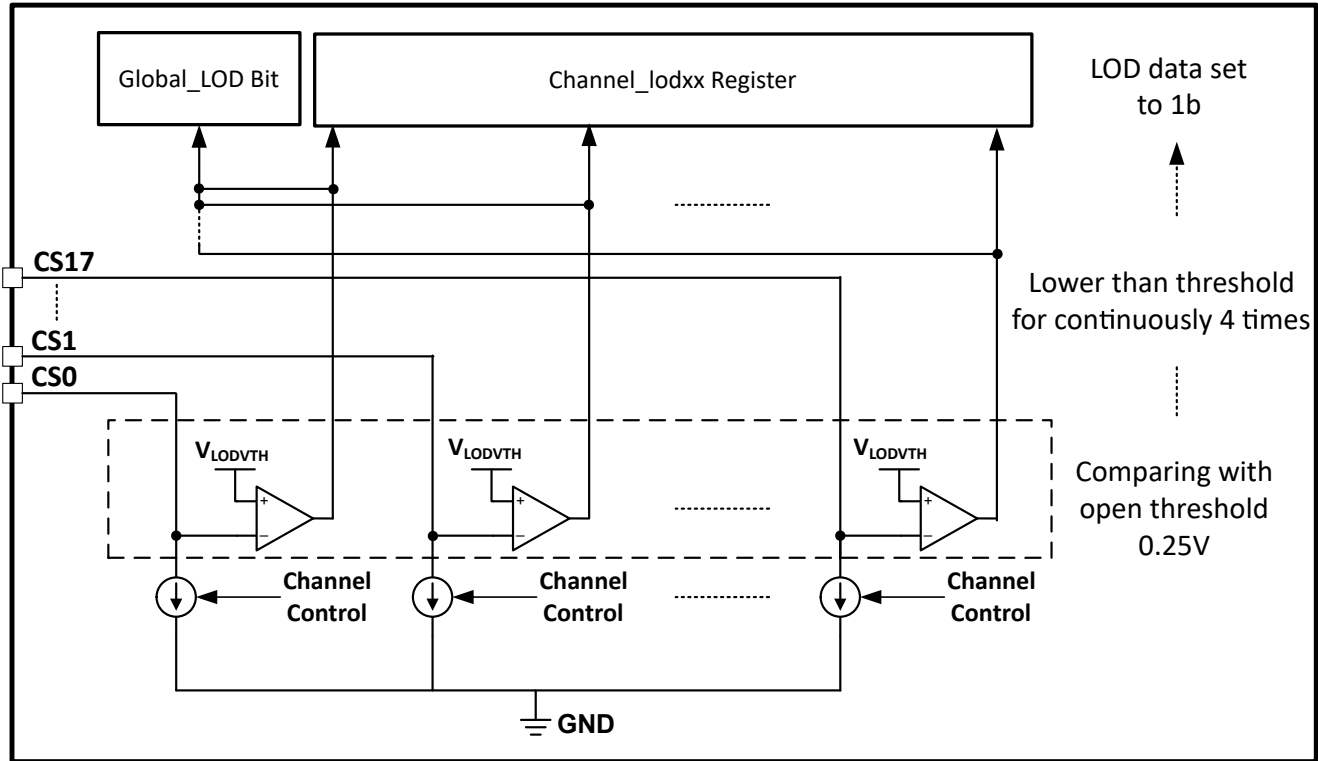


Figure 8-11. LOD Circuits

### LED Short Detection

The LP5860 includes LED short detection (LSD) for the fault caused by any shorted LED. Threshold for channel short is  $(V_{LED} - 1)$  V typical. LED short detection only performed when  $PWM \geq 25$  (Mode 1 and Mode 2) or  $PWM \geq 6400$  (Mode 3) and voltage on CSn is detected higher than short threshold for continuously 4 sub-periods. As there is parasitic capacitance for the current sink, to make sure the LSD result is correct, it is recommended to set the LED current higher than 0.5 mA.

Figure 8-12 shows the detection circuit of LSD function. When short fault is detected, 'Global\_LSD bit' in Fault\_state register is set to 1 and detailed fault state for every channel would also be monitored in register Dot\_Isdx ( $x = 0, 1, \dots, 32$ ). All short fault indicator bits can be cleared by setting LSD\_clear = 0Fh once the short condition is removed.

LSD removal function can be enabled by setting 'LSD\_removal' bit in Dev\_config2 register to 1. This function turns off the upside deghosting function of the scan line where short LED is included.

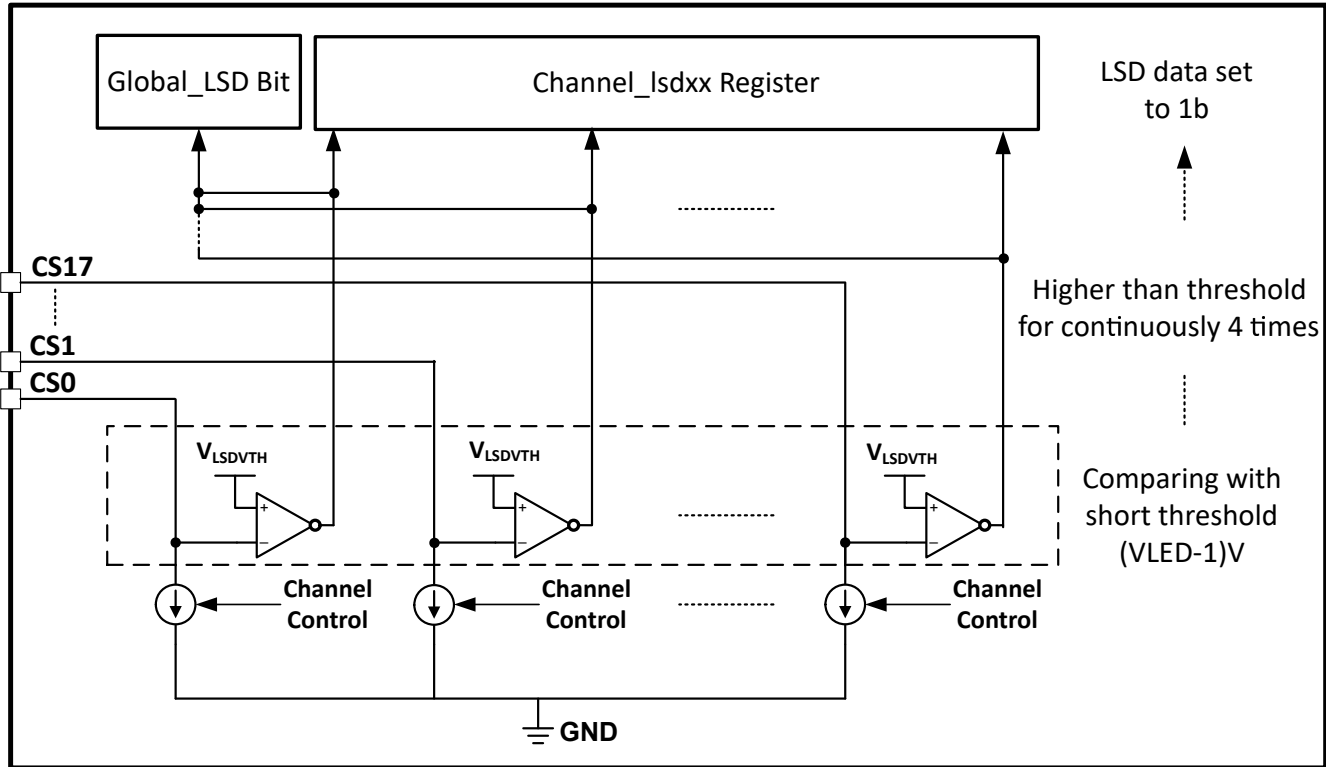


Figure 8-12. LSD Circuit

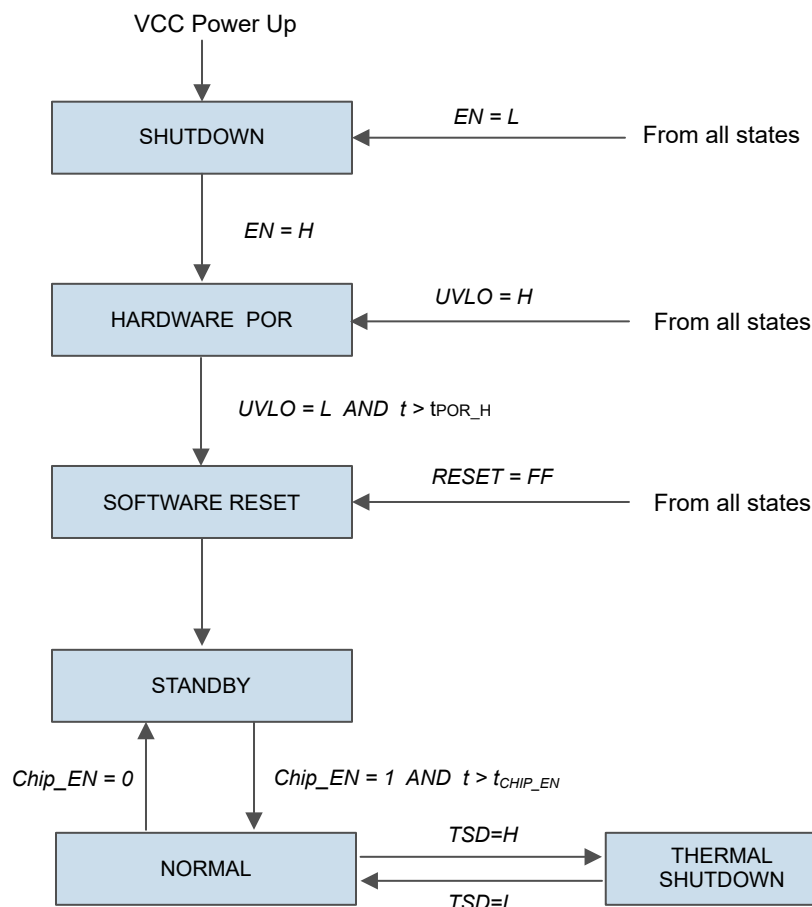
### Thermal Shutdown

The LP5860 device implements thermal shutdown mechanism to protect the device from damage due to overheating. When the junction temperature rises to 160°C (typical) and above, the device switches into shutdown mode. The LP5860 exits thermal shutdown when the junction temperature of the device drops to 145°C (typical) and below.

### UVLO (Under Voltage Lock Out)

The LP5860 has an internal comparator that monitors the voltage at VCC. When VCC is below  $V_{UVF}$ , reset is active and the LP5860 will enter INITIALIZATION state.

## 8.4 Device Functional Modes



**Figure 8-13. Device Functional Modes**

- **SHUTDOWN:** The device enters into SHUTDOWN mode from all states on VCC power up or EN pin is low.
- **HARDWARE POR:** The device enters into HARDWARE POR when Enable pin is high or VCC fall under  $V_{UVF}$  causing  $UVLO=H$  from all states.
- **SOFTWARE RESET:** The device enters into SOFTWARE RESET mode when VCC rise higher than  $V_{UVR}$  with the time  $t > t_{POR\_H}$ . In this mode, all the registers are reset. Entry can also be from any state when the RESET (register) = FFh or UVLO is low.
- **STANDBY:** The device enters the STANDBY mode when Chip\_EN (register) = 0. In this mode, device enters into low power mode, but the I<sup>2</sup>C/SPI are still available for Chip\_EN only and the registers' data are retained.
- **NORMAL:** The device enters the NORMAL mode when 'Chip\_EN' = 1 with the time  $t > t_{CHIP\_EN}$ .
- **THERMAL SHUTDOWN:** The device automatically enters the THERMAL SHUTDOWN mode when the junction temperature exceeds 160°C (typical). If the junction temperature decreases below 145°C (typical), the device returns to the NORMAL mode.

## 8.5 Programming

### Interface Selection

The LP5860 supports two communication interfaces: I<sup>2</sup>C and SPI. If IFS is high, it enters into SPI mode. If IFS is low, it enters into I<sup>2</sup>C mode.

**Table 8-5. Interface Selection**

| INTERFACE TYPE   | ENTRY CONDITION |
|------------------|-----------------|
| I <sup>2</sup> C | IFS = Low       |

**Table 8-5. Interface Selection (continued)**

| INTERFACE TYPE | ENTRY CONDITION |
|----------------|-----------------|
| SPI            | IFS = High      |

## I<sup>2</sup>C Interface

The LP5860 is compatible with I<sup>2</sup>C standard specification. It supports both Fast Mode (400-KHz maximum) and Fast Plus Mode (1-MHz maximum).

### I<sup>2</sup>C Data Transactions

The data on SDA line must be stable during the HIGH period of the clock signal (SCL). In other words, state of the data line can only be changed when clock signal is LOW. START and STOP conditions classify the beginning and the end of the data transfer session. A START condition is defined as the SDA signal transitioning from HIGH to LOW while SCL line is HIGH. A STOP condition is defined as the SDA transitioning from LOW to HIGH while SCL is HIGH. The bus leader always generates START and STOP conditions. The bus is considered to be busy after a START condition and free after a STOP condition. During data transmission, the bus leader can generate repeated START conditions. First START and repeated START conditions are functionally equivalent.

Each byte of data has to be followed by an acknowledge bit. The acknowledge related clock pulse is generated by the leader. The leader releases the SDA line (HIGH) during the acknowledge clock pulse. The device pulls down the SDA line during the 9<sup>th</sup> clock pulse, signifying an acknowledge. The device generates an acknowledge after each byte has been received.

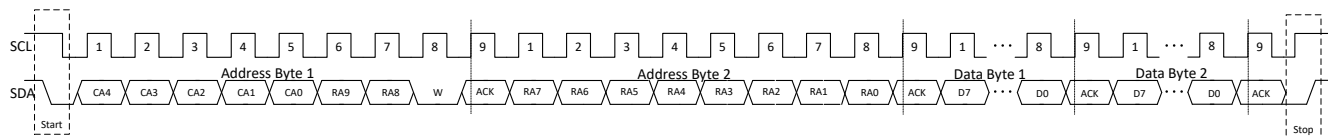
There is one exception to the acknowledge after every byte rule. When the leader is the receiver, it must indicate to the transmitter an end of data by not acknowledging (*negative acknowledge*) the last byte clocked out of the follower. This negative acknowledge still includes the acknowledge clock pulse (generated by the leader), but the SDA line is not pulled down.

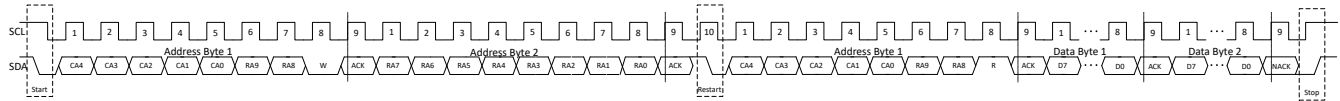
### I<sup>2</sup>C Data Format

The address and data bits are transmitted MSB first with 8-bits length format in each cycle. Each transmission is started with Address Byte 1, which are divided into 5-bits of the chip address, 2 higher bits of the register address, and 1 read/write bit. The other 8 lower bits of register address are put in Address Byte 2. The device supports both independent mode and broadcast mode. The auto-increment feature allows writing / reading several consecutive registers within one transmission. If not consecutive, a new transmission must be started.

**Table 8-6. I<sup>2</sup>C Data Format**

| Address Byte1 | Chip Address        |                     |                     |                     |                     | Register Address    |                     | R/W                 |
|---------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|               | Bit 7               | Bit 6               | Bit 5               | Bit 4               | Bit 3               | Bit 2               | Bit 1               | Bit 0               |
| Independent   | 1                   | 0                   | 0                   | ADDR1               | ADDR0               | 9 <sup>th</sup> bit | 8 <sup>th</sup> bit | R: 1 W: 0           |
| Broadcast     | 1                   | 0                   | 1                   | 0                   | 1                   |                     |                     |                     |
| Address Byte2 | Register Address    |                     |                     |                     |                     |                     |                     |                     |
|               | Bit 7               | Bit 6               | Bit 5               | Bit 4               | Bit 3               | Bit 2               | Bit 1               | Bit 0               |
|               | 7 <sup>th</sup> bit | 6 <sup>th</sup> bit | 5 <sup>th</sup> bit | 4 <sup>th</sup> bit | 3 <sup>th</sup> bit | 2 <sup>th</sup> bit | 1 <sup>th</sup> bit | 0 <sup>th</sup> bit |

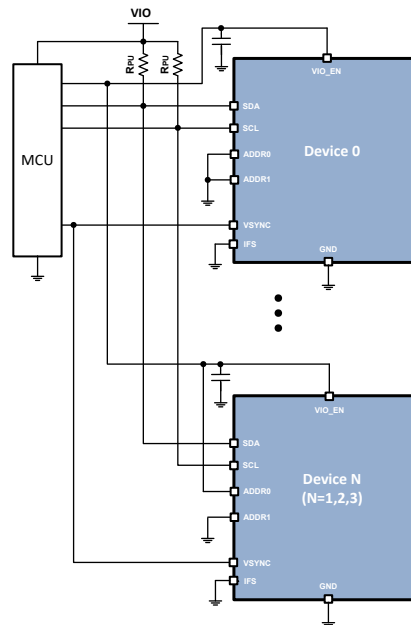
**Figure 8-14. I<sup>2</sup>C Write Timing**



**Figure 8-15. I²C Read Timing**

### Multiple Devices Connection

The LP5860 enters into I²C mode if IFS is connected to GND. The ADDR0/1 pin is used to select the unique I²C follower address for each device. The SCL and SDA lines should each have a pullup resistor (4.7 KΩ for 400 KHz, 2 KΩ for 1 MHz) placed somewhere on the line and remain HIGH even when the bus is idle. VIO\_EN can either be connected with VIO power supply or GPIO. It's suggested to put one 1nF cap as closer to VIO\_EN pin as possible. Up to four LP5860 follower devices may share the same I²C bus by the different ADDR configurations.



**Figure 8-16. I²C Multiple Devices Connection**

### SPI Interface

The LP5860 is compatible with SPI serial-bus specification, and it operates as a follower. The maximum frequency supported by LP5860 is 12 MHz.

### SPI Data Transactions

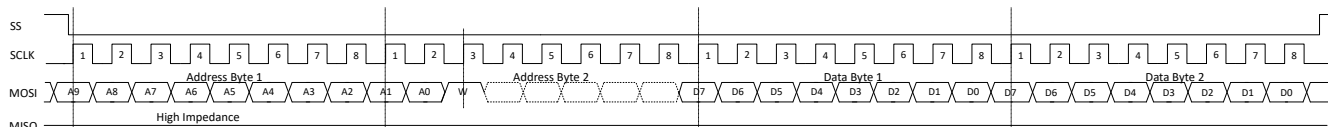
MISO output is normally in a high impedance state. When the follower-select pin SS for the device is active (low) the MISO output is pulled low for read only. During write cycle MISO stays in high-impedance state. The follower-select signal SS must be low during the cycle transmission. SS resets the interface when high. Data is clocked in on the rising edge of the SCLK clock signal, while data is clocked out on the falling edge of SCLK.

### SPI Data Format

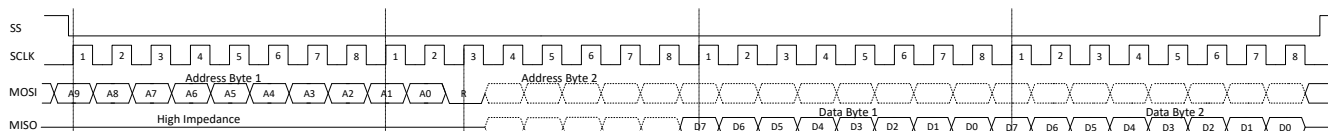
The address and data bits are transmitted MSB first with 8-bits length format in each cycle. Each transmission is started with Address Byte 1, which contains 8 higher bits of the register address. The Address Byte 2 is started with 2 lower bits of the register address and 1 read/write bit. The auto-increment feature allows writing / reading several consecutive registers within one transmission. If not consecutive, a new transmission must be started.

**Table 8-7. SPI Data Format**

| Address Byte1 | Register Address    |                     |                     |                     |                     |                     |                     |                     |
|---------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|               | Bit 7               | Bit 6               | Bit 5               | Bit 4               | Bit 3               | Bit 2               | Bit 1               | Bit 0               |
|               | 9 <sup>th</sup> bit | 8 <sup>th</sup> bit | 7 <sup>th</sup> bit | 6 <sup>th</sup> bit | 5 <sup>th</sup> bit | 4 <sup>th</sup> bit | 3 <sup>th</sup> bit | 2 <sup>th</sup> bit |
| Address Byte2 | Register Address    |                     |                     |                     |                     |                     |                     |                     |
|               | Bit 7               | Bit 6               | Bit 5               | Bit 4               | Bit 3               | Bit 2               | Bit 1               | Bit 0               |
|               | 1 <sup>th</sup> bit | 0 <sup>th</sup> bit | R: 1 W: 0           | Don't Care          |                     |                     |                     |                     |



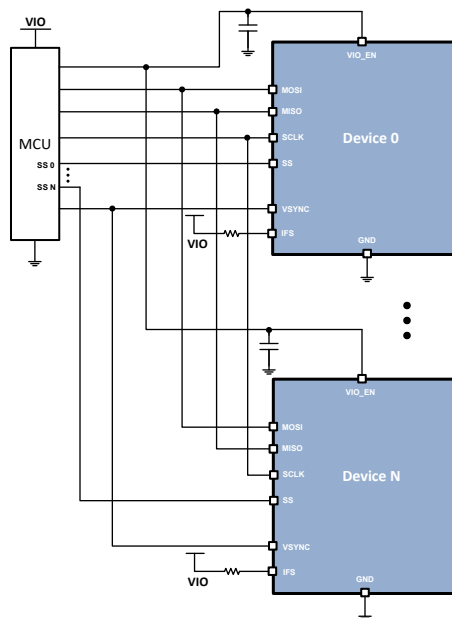
**Figure 8-17. SPI Write Timing**



**Figure 8-18. SPI Read Timing**

### Multiple Devices Connection

The device enters into SPI mode if IFS is pulled high to VIO through a pullup resistor(4.7KΩ recommended). VIO\_EN can either be connected with VIO power supply or GPIO. It's suggested to put one 1nF cap as closer to VIO\_EN pin as possible. In SPI mode host can address as many devices as there are follower select pins on host.



**Figure 8-19. SPI Multiple Devices Connection**

## 8.6 Register Maps

This section provides a summary of the register maps. For detailed register functions and descriptions, please refer to [LP5860 11x18 LED Matrix Driver Register Maps](#).

**Table 8-8. Register Section/Block Access Type Codes**

| Access Type            | Code         | Description                                   |
|------------------------|--------------|-----------------------------------------------|
| <b>Read Type</b>       |              |                                               |
| R                      | R            | Read                                          |
| RC                     | R<br>C       | Read<br>to Clear                              |
| R-0                    | R<br>-0      | Read<br>Returns 0s                            |
| <b>Write Type</b>      |              |                                               |
| W                      | W            | Write                                         |
| W0CP                   | W<br>0C<br>P | W<br>0 to clear<br>Requires privileged access |
| Reset or Default Value |              |                                               |
| -n                     |              | Value after reset or the default value        |

| Register Acronym | Address | Type | D7                | D6           | D5                | D4       | D3                | D2                 | D1                  | D0                        | Default |     |
|------------------|---------|------|-------------------|--------------|-------------------|----------|-------------------|--------------------|---------------------|---------------------------|---------|-----|
| Chip_en          | 000h    | R/W  | Reserved          |              |                   |          |                   |                    |                     |                           | Chip_EN | 00h |
| Dev_initial      | 001h    | R/W  | Reserved          | Max_Line_Num |                   |          |                   | Data_Ref_Mode      |                     | PWM_Fre                   | 5Eh     |     |
| Dev_config1      | 002h    | R/W  | Reserved          | Reserved     | Reserved          | Reserved | SW_BLK            | PWM_Sc<br>ale_Mode | PWM_Ph<br>ase_Shift | CS_ON_<br>Shift           | 00h     |     |
| Dev_config2      | 003h    | R/W  | Comp_Group3       |              | Comp_Group2       |          | Comp_Group1       |                    | LOD_rem<br>oval     | LSD_rem<br>oval           | 00h     |     |
| Dev_config3      | 004h    | R/W  | Down_Deghost      |              | Up_Deghost        |          | Maximum_Current   |                    |                     | Up_Degh<br>ost_enabl<br>e | 47h     |     |
| Global_bri       | 005h    | R/W  | PWM_Global        |              |                   |          |                   |                    |                     |                           |         | FFh |
| Group0_bri       | 006h    | R/W  | PWM_Group1        |              |                   |          |                   |                    |                     |                           |         | FFh |
| Group1_bri       | 007h    | R/W  | PWM_Group2        |              |                   |          |                   |                    |                     |                           |         | FFh |
| Group2_bri       | 008h    | R/W  | PWM_Group3        |              |                   |          |                   |                    |                     |                           |         | FFh |
| R_current_set    | 009h    | R/W  | Reserved          | CC_Group1    |                   |          |                   |                    |                     |                           |         | 40h |
| G_current_set    | 00Ah    | R/W  | Reserved          | CC_Group2    |                   |          |                   |                    |                     |                           |         | 40h |
| B_current_set    | 00Bh    | R/W  | Reserved          | CC_Group3    |                   |          |                   |                    |                     |                           |         | 40h |
| Dot_grp_sel0     | 00Ch    | R/W  | Dot L0-CS3 group  |              | Dot L0-CS2 group  |          | Dot L0-CS1 group  |                    | Dot L0-CS0 group    |                           | 00h     |     |
| Dot_grp_sel1     | 00Dh    | R/W  | Dot L0-CS7 group  |              | Dot L0-CS6 group  |          | Dot L0-CS5 group  |                    | Dot L0-CS4 group    |                           | 00h     |     |
| Dot_grp_sel2     | 00Eh    | R/W  | Dot L0-CS11 group |              | Dot L0-CS10 group |          | Dot L0-CS9 group  |                    | Dot L0-CS8 group    |                           | 00h     |     |
| Dot_grp_sel3     | 00Fh    | R/W  | Dot L0-CS15 group |              | Dot L0-CS14 group |          | Dot L0-CS13 group |                    | Dot L0-CS12 group   |                           | 00h     |     |
| Dot_grp_sel4     | 010h    | R/W  | Reserved          |              |                   |          | Dot L0-CS17 group |                    | Dot L0-CS16 group   |                           | 00h     |     |
| Dot_grp_sel5     | 011h    | R/W  | Dot L1-CS3 group  |              | Dot L1-CS2 group  |          | Dot L1-CS1 group  |                    | Dot L1-CS0 group    |                           | 00h     |     |
| Dot_grp_sel6     | 012h    | R/W  | Dot L1-CS7 group  |              | Dot L1-CS6 group  |          | Dot L1-CS5 group  |                    | Dot L1-CS4 group    |                           | 00h     |     |
| Dot_grp_sel7     | 013h    | R/W  | Dot L1-CS11 group |              | Dot L1-CS10 group |          | Dot L1-CS9 group  |                    | Dot L1-CS8 group    |                           | 00h     |     |
| Dot_grp_sel8     | 014h    | R/W  | Dot L1-CS15 group |              | Dot L1-CS14 group |          | Dot L1-CS13 group |                    | Dot L1-CS12 group   |                           | 00h     |     |
| Dot_grp_sel9     | 015h    | R/W  | Reserved          |              |                   |          | Dot L1-CS17 group |                    | Dot L1-CS16 group   |                           | 00h     |     |
| Dot_grp_sel10    | 016h    | R/W  | Dot L2-CS3 group  |              | Dot L2-CS2 group  |          | Dot L2-CS1 group  |                    | Dot L2-CS0 group    |                           | 00h     |     |
| Dot_grp_sel11    | 017h    | R/W  | Dot L2-CS7 group  |              | Dot L2-CS6 group  |          | Dot L2-CS5 group  |                    | Dot L2-CS4 group    |                           | 00h     |     |
| Dot_grp_sel12    | 018h    | R/W  | Dot L2-CS11 group |              | Dot L2-CS10 group |          | Dot L2-CS9 group  |                    | Dot L2-CS8 group    |                           | 00h     |     |
| Dot_grp_sel13    | 019h    | R/W  | Dot L2-CS15 group |              | Dot L2-CS14 group |          | Dot L2-CS13 group |                    | Dot L2-CS12 group   |                           | 00h     |     |
| Dot_grp_sel14    | 01Ah    | R/W  | Reserved          |              |                   |          | Dot L2-CS17 group |                    | Dot L2-CS16 group   |                           | 00h     |     |

|               |      |     |                    |                   |                    |                   |                    |                    |                    |                    |                   |     |
|---------------|------|-----|--------------------|-------------------|--------------------|-------------------|--------------------|--------------------|--------------------|--------------------|-------------------|-----|
| Dot_grp_sel15 | 01Bh | R/W | Dot L3-CS3 group   |                   | Dot L3-CS2 group   |                   | Dot L3-CS1 group   |                    | Dot L3-CS0 group   |                    | 00h               |     |
| Dot_grp_sel16 | 01Ch | R/W | Dot L3-CS7 group   |                   | Dot L3-CS6 group   |                   | Dot L3-CS5 group   |                    | Dot L3-CS4 group   |                    | 00h               |     |
| Dot_grp_sel17 | 01Dh | R/W | Dot L3-CS11 group  |                   | Dot L3-CS10 group  |                   | Dot L3-CS9 group   |                    | Dot L3-CS8 group   |                    | 00h               |     |
| Dot_grp_sel18 | 01Eh | R/W | Dot L3-CS15 group  |                   | Dot L3-CS14 group  |                   | Dot L3-CS13 group  |                    | Dot L3-CS12 group  |                    | 00h               |     |
| Dot_grp_sel19 | 01Fh | R/W | Reserved           |                   |                    |                   |                    | Dot L3-CS17 group  |                    | Dot L3-CS16 group  |                   | 00h |
| Dot_grp_sel20 | 020h | R/W | Dot L4-CS3 group   |                   | Dot L4-CS2 group   |                   | Dot L4-CS1 group   |                    | Dot L4-CS0 group   |                    | 00h               |     |
| Dot_grp_sel21 | 021h | R/W | Dot L4-CS7 group   |                   | Dot L4-CS6 group   |                   | Dot L4-CS5 group   |                    | Dot L4-CS4 group   |                    | 00h               |     |
| Dot_grp_sel22 | 022h | R/W | Dot L4-CS11 group  |                   | Dot L4-CS10 group  |                   | Dot L4-CS9 group   |                    | Dot L4-CS8 group   |                    | 00h               |     |
| Dot_grp_sel23 | 023h | R/W | Dot L4-CS15 group  |                   | Dot L4-CS14 group  |                   | Dot L4-CS13 group  |                    | Dot L4-CS12 group  |                    | 00h               |     |
| Dot_grp_sel24 | 024h | R/W | Reserved           |                   |                    |                   |                    | Dot L4-CS17 group  |                    | Dot L4-CS16 group  |                   | 00h |
| Dot_grp_sel25 | 025h | R/W | Dot L5-CS3 group   |                   | Dot L5-CS2 group   |                   | Dot L5-CS1 group   |                    | Dot L5-CS0 group   |                    | 00h               |     |
| Dot_grp_sel26 | 026h | R/W | Dot L5-CS7 group   |                   | Dot L5-CS6 group   |                   | Dot L5-CS5 group   |                    | Dot L5-CS4 group   |                    | 00h               |     |
| Dot_grp_sel27 | 027h | R/W | Dot L5-CS11 group  |                   | Dot L5-CS10 group  |                   | Dot L5-CS9 group   |                    | Dot L5-CS8 group   |                    | 00h               |     |
| Dot_grp_sel28 | 028h | R/W | Dot L5-CS15 group  |                   | Dot L5-CS14 group  |                   | Dot L5-CS13 group  |                    | Dot L5-CS12 group  |                    | 00h               |     |
| Dot_grp_sel29 | 029h | R/W | Reserved           |                   |                    |                   |                    | Dot L5-CS17 group  |                    | Dot L5-CS16 group  |                   | 00h |
| Dot_grp_sel30 | 02Ah | R/W | Dot L6-CS3 group   |                   | Dot L6-CS2 group   |                   | Dot L6-CS1 group   |                    | Dot L6-CS0 group   |                    | 00h               |     |
| Dot_grp_sel31 | 02Bh | R/W | Dot L6-CS7 group   |                   | Dot L6-CS6 group   |                   | Dot L6-CS5 group   |                    | Dot L6-CS4 group   |                    | 00h               |     |
| Dot_grp_sel32 | 02Ch | R/W | Dot L6-CS11 group  |                   | Dot L6-CS10 group  |                   | Dot L6-CS9 group   |                    | Dot L6-CS8 group   |                    | 00h               |     |
| Dot_grp_sel33 | 02Dh | R/W | Dot L6-CS15 group  |                   | Dot L6-CS14 group  |                   | Dot L6-CS13 group  |                    | Dot L6-CS12 group  |                    | 00h               |     |
| Dot_grp_sel34 | 02Eh | R/W | Reserved           |                   |                    |                   |                    | Dot L6-CS17 group  |                    | Dot L6-CS16 group  |                   | 00h |
| Dot_grp_sel35 | 02Fh | R/W | Dot L7-CS3 group   |                   | Dot L7-CS2 group   |                   | Dot L7-CS1 group   |                    | Dot L7-CS0 group   |                    | 00h               |     |
| Dot_grp_sel36 | 030h | R/W | Dot L7-CS7 group   |                   | Dot L7-CS6 group   |                   | Dot L7-CS5 group   |                    | Dot L7-CS4 group   |                    | 00h               |     |
| Dot_grp_sel37 | 031h | R/W | Dot L7-CS11 group  |                   | Dot L7-CS10 group  |                   | Dot L7-CS9 group   |                    | Dot L7-CS8 group   |                    | 00h               |     |
| Dot_grp_sel38 | 032h | R/W | Dot L7-CS15 group  |                   | Dot L7-CS14 group  |                   | Dot L7-CS13 group  |                    | Dot L7-CS12 group  |                    | 00h               |     |
| Dot_grp_sel39 | 033h | R/W | Reserved           |                   |                    |                   |                    | Dot L7-CS17 group  |                    | Dot L7-CS16 group  |                   | 00h |
| Dot_grp_sel40 | 034h | R/W | Dot L8-CS3 group   |                   | Dot L8-CS2 group   |                   | Dot L8-CS1 group   |                    | Dot L8-CS0 group   |                    | 00h               |     |
| Dot_grp_sel41 | 035h | R/W | Dot L8-CS7 group   |                   | Dot L8-CS6 group   |                   | Dot L8-CS5 group   |                    | Dot L8-CS4 group   |                    | 00h               |     |
| Dot_grp_sel42 | 036h | R/W | Dot L8-CS11 group  |                   | Dot L8-CS10 group  |                   | Dot L8-CS9 group   |                    | Dot L8-CS8 group   |                    | 00h               |     |
| Dot_grp_sel43 | 037h | R/W | Dot L8-CS15 group  |                   | Dot L8-CS14 group  |                   | Dot L8-CS13 group  |                    | Dot L8-CS12 group  |                    | 00h               |     |
| Dot_grp_sel44 | 038h | R/W | Reserved           |                   |                    |                   |                    | Dot L8-CS17 group  |                    | Dot L8-CS16 group  |                   | 00h |
| Dot_grp_sel45 | 039h | R/W | Dot L9-CS3 group   |                   | Dot L9-CS2 group   |                   | Dot L9-CS1 group   |                    | Dot L9-CS0 group   |                    | 00h               |     |
| Dot_grp_sel46 | 03Ah | R/W | Dot L9-CS7 group   |                   | Dot L9-CS6 group   |                   | Dot L9-CS5 group   |                    | Dot L9-CS4 group   |                    | 00h               |     |
| Dot_grp_sel47 | 03Bh | R/W | Dot L9-CS11 group  |                   | Dot L9-CS10 group  |                   | Dot L9-CS9 group   |                    | Dot L9-CS8 group   |                    | 00h               |     |
| Dot_grp_sel48 | 03Ch | R/W | Dot L9-CS15 group  |                   | Dot L9-CS14 group  |                   | Dot L9-CS13 group  |                    | Dot L9-CS12 group  |                    | 00h               |     |
| Dot_grp_sel49 | 03Dh | R/W | Reserved           |                   |                    |                   |                    | Dot L9-CS17 group  |                    | Dot L9-CS16 group  |                   | 00h |
| Dot_grp_sel50 | 03Eh | R/W | Dot L10-CS3 group  |                   | Dot L10-CS2 group  |                   | Dot L10-CS1 group  |                    | Dot L10-CS0 group  |                    | 00h               |     |
| Dot_grp_sel51 | 03Fh | R/W | Dot L10-CS7 group  |                   | Dot L10-CS6 group  |                   | Dot L10-CS5 group  |                    | Dot L10-CS4 group  |                    | 00h               |     |
| Dot_grp_sel52 | 040h | R/W | Dot L10-CS11 group |                   | Dot L10-CS10 group |                   | Dot L10-CS9 group  |                    | Dot L10-CS8 group  |                    | 00h               |     |
| Dot_grp_sel53 | 041h | R/W | Dot L10-CS15 group |                   | Dot L10-CS14 group |                   | Dot L10-CS13 group |                    | Dot L10-CS12 group |                    | 00h               |     |
| Dot_grp_sel54 | 042h | R/W | Reserved           |                   |                    |                   |                    | Dot L10-CS17 group |                    | Dot L10-CS16 group |                   | 00h |
| Dot_onoff0    | 043h | R/W | Dot L0-CS7 onoff   | Dot L0-CS6 onoff  | Dot L0-CS5 onoff   | Dot L0-CS4 onoff  | Dot L0-CS3 onoff   | Dot L0-CS2 onoff   | Dot L0-CS1 onoff   | Dot L0-CS0 onoff   | FFh               |     |
| Dot_onoff1    | 044h | R/W | Dot L0-CS15onoff   | Dot L0-CS14 onoff | Dot L0-CS13 onoff  | Dot L0-CS12 onoff | Dot L0-CS11 onoff  | Dot L0-CS10 onoff  | Dot L0-CS9 onoff   | Dot L0-CS8 onoff   | FFh               |     |
| Dot_onoff2    | 045h | R/W | Reserved           |                   |                    |                   |                    |                    | Dot L0-CS17 onoff  |                    | Dot L0-CS16 onoff | 03h |

|                    |      |     |                          |                          |                          |                          |                          |                          |                          |                          |     |
|--------------------|------|-----|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----|
| <b>Dot_onoff3</b>  | 046h | R/W | Dot L1-<br>CS7 onoff     | Dot L1-<br>CS6 onoff     | Dot L1-<br>CS5 onoff     | Dot L1-<br>CS4 onoff     | Dot L1-<br>CS3 onoff     | Dot L1-<br>CS2 onoff     | Dot L1-<br>CS1 onoff     | Dot L1-<br>CS0 onoff     | FFh |
| <b>Dot_onoff4</b>  | 047h | R/W | Dot L1-<br>CS15<br>onoff | Dot L1-<br>CS14<br>onoff | Dot L1-<br>CS13<br>onoff | Dot L1-<br>CS12<br>onoff | Dot L1-<br>CS11<br>onoff | Dot L1-<br>CS10<br>onoff | Dot L1-<br>CS9 onoff     | Dot L1-<br>CS8 onoff     | FFh |
| <b>Dot_onoff5</b>  | 048h | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L1-<br>CS17<br>onoff | Dot L1-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff6</b>  | 049h | R/W | Dot L2-<br>CS7 onoff     | Dot L2-<br>CS6 onoff     | Dot L2-<br>CS5 onoff     | Dot L2-<br>CS4 onoff     | Dot L2-<br>CS3 onoff     | Dot L2-<br>CS2 onoff     | Dot L2-<br>CS1 onoff     | Dot L2-<br>CS0 onoff     | FFh |
| <b>Dot_onoff7</b>  | 04Ah | R/W | Dot L2-<br>CS15<br>onoff | Dot L2-<br>CS14<br>onoff | Dot L2-<br>CS13<br>onoff | Dot L2-<br>CS12<br>onoff | Dot L2-<br>CS11<br>onoff | Dot L2-<br>CS10<br>onoff | Dot L2-<br>CS9 onoff     | Dot L2-<br>CS8 onoff     | FFh |
| <b>Dot_onoff8</b>  | 04Bh | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L2-<br>CS17<br>onoff | Dot L2-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff9</b>  | 04Ch | R/W | Dot L3-<br>CS7 onoff     | Dot L3-<br>CS6 onoff     | Dot L3-<br>CS5 onoff     | Dot L3-<br>CS4 onoff     | Dot L3-<br>CS3 onoff     | Dot L3-<br>CS2 onoff     | Dot L3-<br>CS1 onoff     | Dot L3-<br>CS0 onoff     | FFh |
| <b>Dot_onoff10</b> | 04Dh | R/W | Dot L3-<br>CS15<br>onoff | Dot L3-<br>CS14<br>onoff | Dot L3-<br>CS13<br>onoff | Dot L3-<br>CS12<br>onoff | Dot L3-<br>CS11<br>onoff | Dot L3-<br>CS10<br>onoff | Dot L3-<br>CS9 onoff     | Dot L3-<br>CS8 onoff     | FFh |
| <b>Dot_onoff11</b> | 04Eh | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L3-<br>CS17<br>onoff | Dot L3-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff12</b> | 04Fh | R/W | Dot L4-<br>CS7 onoff     | Dot L4-<br>CS6 onoff     | Dot L4-<br>CS5 onoff     | Dot L4-<br>CS4 onoff     | Dot L4-<br>CS3 onoff     | Dot L4-<br>CS2 onoff     | Dot L4-<br>CS1 onoff     | Dot L4-<br>CS0 onoff     | FFh |
| <b>Dot_onoff13</b> | 050h | R/W | Dot L4-<br>CS15<br>onoff | Dot L4-<br>CS14<br>onoff | Dot L4-<br>CS13<br>onoff | Dot L4-<br>CS12<br>onoff | Dot L4-<br>CS11<br>onoff | Dot L4-<br>CS10<br>onoff | Dot L4-<br>CS9 onoff     | Dot L4-<br>CS8 onoff     | FFh |
| <b>Dot_onoff14</b> | 051h | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L4-<br>CS17<br>onoff | Dot L4-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff15</b> | 052h | R/W | Dot L5-<br>CS7 onoff     | Dot L5-<br>CS6 onoff     | Dot L5-<br>CS5 onoff     | Dot L5-<br>CS4 onoff     | Dot L5-<br>CS3 onoff     | Dot L5-<br>CS2 onoff     | Dot L5-<br>CS1 onoff     | Dot L5-<br>CS0 onoff     | FFh |
| <b>Dot_onoff16</b> | 053h | R/W | Dot L5-<br>CS15<br>onoff | Dot L5-<br>CS14<br>onoff | Dot L5-<br>CS13<br>onoff | Dot L5-<br>CS12<br>onoff | Dot L5-<br>CS11<br>onoff | Dot L5-<br>CS10<br>onoff | Dot L5-<br>CS9 onoff     | Dot L5-<br>CS8 onoff     | FFh |
| <b>Dot_onoff17</b> | 054h | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L5-<br>CS17<br>onoff | Dot L5-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff18</b> | 055h | R/W | Dot L6-<br>CS7 onoff     | Dot L6-<br>CS6 onoff     | Dot L6-<br>CS5 onoff     | Dot L6-<br>CS4 onoff     | Dot L6-<br>CS3 onoff     | Dot L6-<br>CS2 onoff     | Dot L6-<br>CS1 onoff     | Dot L6-<br>CS0 onoff     | FFh |
| <b>Dot_onoff19</b> | 056h | R/W | Dot L6-<br>CS15<br>onoff | Dot L6-<br>CS14<br>onoff | Dot L6-<br>CS13<br>onoff | Dot L6-<br>CS12<br>onoff | Dot L6-<br>CS11<br>onoff | Dot L6-<br>CS10<br>onoff | Dot L6-<br>CS9 onoff     | Dot L6-<br>CS8 onoff     | FFh |
| <b>Dot_onoff20</b> | 057h | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L6-<br>CS17<br>onoff | Dot L6-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff21</b> | 058h | R/W | Dot L7-<br>CS7 onoff     | Dot L7-<br>CS6 onoff     | Dot L7-<br>CS5 onoff     | Dot L7-<br>CS4 onoff     | Dot L7-<br>CS3 onoff     | Dot L7-<br>CS2 onoff     | Dot L7-<br>CS1 onoff     | Dot L7-<br>CS0 onoff     | FFh |
| <b>Dot_onoff22</b> | 059h | R/W | Dot L7-<br>CS15<br>onoff | Dot L7-<br>CS14<br>onoff | Dot L7-<br>CS13<br>onoff | Dot L7-<br>CS12<br>onoff | Dot L7-<br>CS11<br>onoff | Dot L7-<br>CS10<br>onoff | Dot L7-<br>CS9 onoff     | Dot L7-<br>CS8 onoff     | FFh |
| <b>Dot_onoff23</b> | 05Ah | R/W | Reserved                 |                          |                          |                          |                          |                          | Dot L7-<br>CS17<br>onoff | Dot L7-<br>CS16<br>onoff | 03h |
| <b>Dot_onoff24</b> | 05Bh | R/W | Dot L8-<br>CS7 onoff     | Dot L8-<br>CS6 onoff     | Dot L8-<br>CS5 onoff     | Dot L8-<br>CS4 onoff     | Dot L8-<br>CS3 onoff     | Dot L8-<br>CS2 onoff     | Dot L8-<br>CS1 onoff     | Dot L8-<br>CS0 onoff     | FFh |

|                    |      |     |                           |                           |                           |                           |                           |                           |                           |                           |     |
|--------------------|------|-----|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----|
| <b>Dot_onoff25</b> | 05Ch | R/W | Dot L8-<br>CS15<br>onoff  | Dot L8-<br>CS14<br>onoff  | Dot L8-<br>CS13<br>onoff  | Dot L8-<br>CS12<br>onoff  | Dot L8-<br>CS11<br>onoff  | Dot L8-<br>CS10<br>onoff  | Dot L8-<br>CS9 onoff      | Dot L8-<br>CS8 onoff      | FFh |
| <b>Dot_onoff26</b> | 05Dh | R/W | Reserved                  |                           |                           |                           |                           |                           | Dot L8-<br>CS17<br>onoff  | Dot L8-<br>CS16<br>onoff  | 03h |
| <b>Dot_onoff27</b> | 05Eh | R/W | Dot L9-<br>CS7 onoff      | Dot L9-<br>CS6 onoff      | Dot L9-<br>CS5 onoff      | Dot L9-<br>CS4 onoff      | Dot L9-<br>CS3 onoff      | Dot L9-<br>CS2 onoff      | Dot L9-<br>CS1 onoff      | Dot L9-<br>CS0 onoff      | FFh |
| <b>Dot_onoff28</b> | 05Fh | R/W | Dot L9-<br>CS15<br>onoff  | Dot L9-<br>CS14<br>onoff  | Dot L9-<br>CS13<br>onoff  | Dot L9-<br>CS12<br>onoff  | Dot L9-<br>CS11<br>onoff  | Dot L9-<br>CS10<br>onoff  | Dot L9-<br>CS9 onoff      | Dot L9-<br>CS8 onoff      | FFh |
| <b>Dot_onoff29</b> | 060h | R/W | Reserved                  |                           |                           |                           |                           |                           | Dot L9-<br>CS17<br>onoff  | Dot L9-<br>CS16<br>onoff  | 03h |
| <b>Dot_onoff30</b> | 061h | R/W | Dot L10-<br>CS7 onoff     | Dot L10-<br>CS6 onoff     | Dot L10-<br>CS5 onoff     | Dot L10-<br>CS4 onoff     | Dot L10-<br>CS3 onoff     | Dot L10-<br>CS2 onoff     | Dot L10-<br>CS1 onoff     | Dot L10-<br>CS0 onoff     | FFh |
| <b>Dot_onoff31</b> | 062h | R/W | Dot L10-<br>CS15<br>onoff | Dot L10-<br>CS14<br>onoff | Dot L10-<br>CS13<br>onoff | Dot L10-<br>CS12<br>onoff | Dot L10-<br>CS11<br>onoff | Dot L10-<br>CS10<br>onoff | Dot L10-<br>CS9 onoff     | Dot L10-<br>CS8 onoff     | FFh |
| <b>Dot_onoff32</b> | 063h | R/W | Reserved                  |                           |                           |                           |                           |                           | Dot L10-<br>CS17<br>onoff | Dot L10-<br>CS16<br>onoff | 03h |
| <b>Fault_state</b> | 064h | R   | Reserved                  |                           |                           |                           |                           |                           | Global_L<br>OD            | Global_L<br>SD            | 00h |
| <b>Dot_lod0</b>    | 065h | R   | Dot L0-<br>CS7 LOD        | Dot L0-<br>CS6 LOD        | Dot L0-<br>CS5 LOD        | Dot L0-<br>CS4 LOD        | Dot L0-<br>CS3 LOD        | Dot L0-<br>CS2 LOD        | Dot L0-<br>CS1 LOD        | Dot L0-<br>CS0 LOD        | 00h |
| <b>Dot_lod1</b>    | 066h | R   | Dot L0-<br>CS15<br>LOD    | Dot L0-<br>CS14<br>LOD    | Dot L0-<br>CS13<br>LOD    | Dot L0-<br>CS12<br>LOD    | Dot L0-<br>CS11<br>LOD    | Dot L0-<br>CS10<br>LOD    | Dot L0-<br>CS9 LOD        | Dot L0-<br>CS8 LOD        | 00h |
| <b>Dot_lod2</b>    | 067h | R   | Reserved                  |                           |                           |                           |                           |                           | Dot L0-<br>CS17<br>LOD    | Dot L0-<br>CS16<br>LOD    | 00h |
| <b>Dot_lod3</b>    | 068h | R   | Dot L1-<br>CS7 LOD        | Dot L1-<br>CS6 LOD        | Dot L1-<br>CS5 LOD        | Dot L1-<br>CS4 LOD        | Dot L1-<br>CS3 LOD        | Dot L1-<br>CS2 LOD        | Dot L1-<br>CS1 LOD        | Dot L1-<br>CS0 LOD        | 00h |
| <b>Dot_lod4</b>    | 069h | R   | Dot L1-<br>CS15<br>LOD    | Dot L1-<br>CS14<br>LOD    | Dot L1-<br>CS13<br>LOD    | Dot L1-<br>CS12<br>LOD    | Dot L1-<br>CS11<br>LOD    | Dot L1-<br>CS10<br>LOD    | Dot L1-<br>CS9 LOD        | Dot L1-<br>CS8 LOD        | 00h |
| <b>Dot_lod5</b>    | 06Ah | R   | Reserved                  |                           |                           |                           |                           |                           | Dot L1-<br>CS17<br>LOD    | Dot L1-<br>CS16<br>LOD    | 00h |
| <b>Dot_lod6</b>    | 06Bh | R   | Dot L2-<br>CS7 LOD        | Dot L2-<br>CS6 LOD        | Dot L2-<br>CS5 LOD        | Dot L2-<br>CS4 LOD        | Dot L2-<br>CS3 LOD        | Dot L2-<br>CS2 LOD        | Dot L2-<br>CS1 LOD        | Dot L2-<br>CS0 LOD        | 00h |
| <b>Dot_lod7</b>    | 06Ch | R   | Dot L2-<br>CS15<br>LOD    | Dot L2-<br>CS14<br>LOD    | Dot L2-<br>CS13<br>LOD    | Dot L2-<br>CS12<br>LOD    | Dot L2-<br>CS11<br>LOD    | Dot L2-<br>CS10<br>LOD    | Dot L2-<br>CS9 LOD        | Dot L2-<br>CS8 LOD        | 00h |
| <b>Dot_lod8</b>    | 06Dh | R   | Reserved                  |                           |                           |                           |                           |                           | Dot L2-<br>CS17<br>LOD    | Dot L2-<br>CS16<br>LOD    | 00h |
| <b>Dot_lod9</b>    | 06Eh | R   | Dot L3-<br>CS7 LOD        | Dot L3-<br>CS6 LOD        | Dot L3-<br>CS5 LOD        | Dot L3-<br>CS4 LOD        | Dot L3-<br>CS3 LOD        | Dot L3-<br>CS2 LOD        | Dot L3-<br>CS1 LOD        | Dot L3-<br>CS0 LOD        | 00h |
| <b>Dot_lod10</b>   | 06Fh | R   | Dot L3-<br>CS15<br>LOD    | Dot L3-<br>CS14<br>LOD    | Dot L3-<br>CS13<br>LOD    | Dot L3-<br>CS12<br>LOD    | Dot L3-<br>CS11<br>LOD    | Dot L3-<br>CS10<br>LOD    | Dot L3-<br>CS9 LOD        | Dot L3-<br>CS8 LOD        | 00h |
| <b>Dot_lod11</b>   | 070h | R   | Reserved                  |                           |                           |                           |                           |                           | Dot L3-<br>CS17<br>LOD    | Dot L3-<br>CS16<br>LOD    | 00h |
| <b>Dot_lod12</b>   | 071h | R   | Dot L4-<br>CS7 LOD        | Dot L4-<br>CS6 LOD        | Dot L4-<br>CS5 LOD        | Dot L4-<br>CS4 LOD        | Dot L4-<br>CS3 LOD        | Dot L4-<br>CS2 LOD        | Dot L4-<br>CS1 LOD        | Dot L4-<br>CS0 LOD        | 00h |

|                  |      |   |                         |                         |                         |                         |                         |                         |                         |                         |     |
|------------------|------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-----|
| <b>Dot_lod13</b> | 072h | R | Dot L4-<br>CS15<br>LOD  | Dot L4-<br>CS14<br>LOD  | Dot L4-<br>CS13<br>LOD  | Dot L4-<br>CS12<br>LOD  | Dot L4-<br>CS11<br>LOD  | Dot L4-<br>CS10<br>LOD  | Dot L4-<br>CS9<br>LOD   | Dot L4-<br>CS8<br>LOD   | 00h |
| <b>Dot_lod14</b> | 073h | R | Reserved                |                         |                         |                         |                         |                         | Dot L4-<br>CS17<br>LOD  | Dot L4-<br>CS16<br>LOD  | 00h |
| <b>Dot_lod15</b> | 074h | R | Dot L5-<br>CS7<br>LOD   | Dot L5-<br>CS6<br>LOD   | Dot L5-<br>CS5<br>LOD   | Dot L5-<br>CS4<br>LOD   | Dot L5-<br>CS3<br>LOD   | Dot L5-<br>CS2<br>LOD   | Dot L5-<br>CS1<br>LOD   | Dot L5-<br>CS0<br>LOD   | 00h |
| <b>Dot_lod16</b> | 075h | R | Dot L5-<br>CS15<br>LOD  | Dot L5-<br>CS14<br>LOD  | Dot L5-<br>CS13<br>LOD  | Dot L5-<br>CS12<br>LOD  | Dot L5-<br>CS11<br>LOD  | Dot L5-<br>CS10<br>LOD  | Dot L5-<br>CS9<br>LOD   | Dot L5-<br>CS8<br>LOD   | 00h |
| <b>Dot_lod17</b> | 076h | R | Reserved                |                         |                         |                         |                         |                         | Dot L5-<br>CS17<br>LOD  | Dot L5-<br>CS16<br>LOD  | 00h |
| <b>Dot_lod18</b> | 077h | R | Dot L6-<br>CS7<br>LOD   | Dot L6-<br>CS6<br>LOD   | Dot L6-<br>CS5<br>LOD   | Dot L6-<br>CS4<br>LOD   | Dot L6-<br>CS3<br>LOD   | Dot L6-<br>CS2<br>LOD   | Dot L6-<br>CS1<br>LOD   | Dot L6-<br>CS0<br>LOD   | 00h |
| <b>Dot_lod19</b> | 078h | R | Dot L6-<br>CS15<br>LOD  | Dot L6-<br>CS14<br>LOD  | Dot L6-<br>CS13<br>LOD  | Dot L6-<br>CS12<br>LOD  | Dot L6-<br>CS11<br>LOD  | Dot L6-<br>CS10<br>LOD  | Dot L6-<br>CS9<br>LOD   | Dot L6-<br>CS8<br>LOD   | 00h |
| <b>Dot_lod20</b> | 079h | R | Reserved                |                         |                         |                         |                         |                         | Dot L6-<br>CS17<br>LOD  | Dot L6-<br>CS16<br>LOD  | 00h |
| <b>Dot_lod21</b> | 07Ah | R | Dot L7-<br>CS7<br>LOD   | Dot L7-<br>CS6<br>LOD   | Dot L7-<br>CS5<br>LOD   | Dot L7-<br>CS4<br>LOD   | Dot L7-<br>CS3<br>LOD   | Dot L7-<br>CS2<br>LOD   | Dot L7-<br>CS1<br>LOD   | Dot L7-<br>CS0<br>LOD   | 00h |
| <b>Dot_lod22</b> | 07Bh | R | Dot L7-<br>CS15<br>LOD  | Dot L7-<br>CS14<br>LOD  | Dot L7-<br>CS13<br>LOD  | Dot L7-<br>CS12<br>LOD  | Dot L7-<br>CS11<br>LOD  | Dot L7-<br>CS10<br>LOD  | Dot L7-<br>CS9<br>LOD   | Dot L7-<br>CS8<br>LOD   | 00h |
| <b>Dot_lod23</b> | 07Ch | R | Reserved                |                         |                         |                         |                         |                         | Dot L7-<br>CS17<br>LOD  | Dot L7-<br>CS16<br>LOD  | 00h |
| <b>Dot_lod24</b> | 07Dh | R | Dot L8-<br>CS7<br>LOD   | Dot L8-<br>CS6<br>LOD   | Dot L8-<br>CS5<br>LOD   | Dot L8-<br>CS4<br>LOD   | Dot L8-<br>CS3<br>LOD   | Dot L8-<br>CS2<br>LOD   | Dot L8-<br>CS1<br>LOD   | Dot L8-<br>CS0<br>LOD   | 00h |
| <b>Dot_lod25</b> | 07Eh | R | Dot L8-<br>CS15<br>LOD  | Dot L8-<br>CS14<br>LOD  | Dot L8-<br>CS13<br>LOD  | Dot L8-<br>CS12<br>LOD  | Dot L8-<br>CS11<br>LOD  | Dot L8-<br>CS10<br>LOD  | Dot L8-<br>CS9<br>LOD   | Dot L8-<br>CS8<br>LOD   | 00h |
| <b>Dot_lod26</b> | 07Fh | R | Reserved                |                         |                         |                         |                         |                         | Dot L8-<br>CS17<br>LOD  | Dot L8-<br>CS16<br>LOD  |     |
| <b>Dot_lod27</b> | 080h | R | Dot L9-<br>CS7<br>LOD   | Dot L9-<br>CS6<br>LOD   | Dot L9-<br>CS5<br>LOD   | Dot L9-<br>CS4<br>LOD   | Dot L9-<br>CS3<br>LOD   | Dot L9-<br>CS2<br>LOD   | Dot L9-<br>CS1<br>LOD   | Dot L9-<br>CS0<br>LOD   | 00h |
| <b>Dot_lod28</b> | 081h | R | Dot L9-<br>CS15<br>LOD  | Dot L9-<br>CS14<br>LOD  | Dot L9-<br>CS13<br>LOD  | Dot L9-<br>CS12<br>LOD  | Dot L9-<br>CS11<br>LOD  | Dot L9-<br>CS10<br>LOD  | Dot L9-<br>CS9<br>LOD   | Dot L9-<br>CS8<br>LOD   | 00h |
| <b>Dot_lod29</b> | 082h | R | Reserved                |                         |                         |                         |                         |                         | Dot L9-<br>CS17<br>LOD  | Dot L9-<br>CS16<br>LOD  | 00h |
| <b>Dot_lod30</b> | 083h | R | Dot L10-<br>CS7<br>LOD  | Dot L10-<br>CS6<br>LOD  | Dot L10-<br>CS5<br>LOD  | Dot L10-<br>CS4<br>LOD  | Dot L10-<br>CS3<br>LOD  | Dot L10-<br>CS2<br>LOD  | Dot L10-<br>CS1<br>LOD  | Dot L10-<br>CS0<br>LOD  | 00h |
| <b>Dot_lod31</b> | 084h | R | Dot L10-<br>CS15<br>LOD | Dot L10-<br>CS14<br>LOD | Dot L10-<br>CS13<br>LOD | Dot L10-<br>CS12<br>LOD | Dot L10-<br>CS11<br>LOD | Dot L10-<br>CS10<br>LOD | Dot L10-<br>CS9<br>LOD  | Dot L10-<br>CS8<br>LOD  | 00h |
| <b>Dot_lod32</b> | 085h | R | Reserved                |                         |                         |                         |                         |                         | Dot L10-<br>CS17<br>LOD | Dot L10-<br>CS16<br>LOD | 00h |
| <b>Dot_lsd0</b>  | 086h | R | Dot L0-<br>CS7<br>LSD   | Dot L0-<br>CS6<br>LSD   | Dot L0-<br>CS5<br>LSD   | Dot L0-<br>CS4<br>LSD   | Dot L0-<br>CS3<br>LSD   | Dot L0-<br>CS2<br>LSD   | Dot L0-<br>CS1<br>LSD   | Dot L0-<br>CS0<br>LSD   | 00h |
| <b>Dot_lsd1</b>  | 087h | R | Dot L0-<br>CS15<br>LSD  | Dot L0-<br>CS14<br>LSD  | Dot L0-<br>CS13<br>LSD  | Dot L0-<br>CS12<br>LSD  | Dot L0-<br>CS11<br>LSD  | Dot L0-<br>CS10<br>LSD  | Dot L0-<br>CS9<br>LSD   | Dot L0-<br>CS8<br>LSD   | 00h |

|                  |      |   |                        |                        |                        |                        |                        |                        |                        |                        |     |
|------------------|------|---|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-----|
| <b>Dot_Isd2</b>  | 088h | R | Reserved               |                        |                        |                        |                        |                        | Dot L0-<br>CS17<br>LSD | Dot L0-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd3</b>  | 089h | R | Dot L1-<br>CS7 LSD     | Dot L1-<br>CS6 LSD     | Dot L1-<br>CS5 LSD     | Dot L1-<br>CS4 LSD     | Dot L1-<br>CS3 LSD     | Dot L1-<br>CS2 LSD     | Dot L1-<br>CS1 LSD     | Dot L1-<br>CS0 LSD     | 00h |
| <b>Dot_Isd4</b>  | 08Ah | R | Dot L1-<br>CS15<br>LSD | Dot L1-<br>CS14<br>LSD | Dot L1-<br>CS13<br>LSD | Dot L1-<br>CS12<br>LSD | Dot L1-<br>CS11<br>LSD | Dot L1-<br>CS10<br>LSD | Dot L1-<br>CS9 LSD     | Dot L1-<br>CS8 LSD     | 00h |
| <b>Dot_Isd5</b>  | 08Bh | R | Reserved               |                        |                        |                        |                        |                        | Dot L1-<br>CS17<br>LSD | Dot L1-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd6</b>  | 08Ch | R | Dot L2-<br>CS7 LSD     | Dot L2-<br>CS6 LSD     | Dot L2-<br>CS5 LSD     | Dot L2-<br>CS4 LSD     | Dot L2-<br>CS3 LSD     | Dot L2-<br>CS2 LSD     | Dot L2-<br>CS1 LSD     | Dot L2-<br>CS0 LSD     | 00h |
| <b>Dot_Isd7</b>  | 08Dh | R | Dot L2-<br>CS15<br>LSD | Dot L2-<br>CS14<br>LSD | Dot L2-<br>CS13<br>LSD | Dot L2-<br>CS12<br>LSD | Dot L2-<br>CS11<br>LSD | Dot L2-<br>CS10<br>LSD | Dot L2-<br>CS9 LSD     | Dot L2-<br>CS8 LSD     | 00h |
| <b>Dot_Isd8</b>  | 08Eh | R | Reserved               |                        |                        |                        |                        |                        | Dot L2-<br>CS17<br>LSD | Dot L2-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd9</b>  | 08Fh | R | Dot L3-<br>CS7 LSD     | Dot L3-<br>CS6 LSD     | Dot L3-<br>CS5 LSD     | Dot L3-<br>CS4 LSD     | Dot L3-<br>CS3 LSD     | Dot L3-<br>CS2 LSD     | Dot L3-<br>CS1 LSD     | Dot L3-<br>CS0 LSD     | 00h |
| <b>Dot_Isd10</b> | 090h | R | Dot L3-<br>CS15<br>LSD | Dot L3-<br>CS14<br>LSD | Dot L3-<br>CS13<br>LSD | Dot L3-<br>CS12<br>LSD | Dot L3-<br>CS11<br>LSD | Dot L3-<br>CS10<br>LSD | Dot L3-<br>CS9 LSD     | Dot L3-<br>CS8 LSD     | 00h |
| <b>Dot_Isd11</b> | 091h | R | Reserved               |                        |                        |                        |                        |                        | Dot L3-<br>CS17<br>LSD | Dot L3-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd12</b> | 092h | R | Dot L4-<br>CS7 LSD     | Dot L4-<br>CS6 LSD     | Dot L4-<br>CS5 LSD     | Dot L4-<br>CS4 LSD     | Dot L4-<br>CS3 LSD     | Dot L4-<br>CS2 LSD     | Dot L4-<br>CS1 LSD     | Dot L4-<br>CS0 LSD     | 00h |
| <b>Dot_Isd13</b> | 093h | R | Dot L4-<br>CS15<br>LSD | Dot L4-<br>CS14<br>LSD | Dot L4-<br>CS13<br>LSD | Dot L4-<br>CS12<br>LSD | Dot L4-<br>CS11<br>LSD | Dot L4-<br>CS10<br>LSD | Dot L4-<br>CS9 LSD     | Dot L4-<br>CS8 LSD     | 00h |
| <b>Dot_Isd14</b> | 094h | R | Reserved               |                        |                        |                        |                        |                        | Dot L4-<br>CS17<br>LSD | Dot L4-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd15</b> | 095h | R | Dot L5-<br>CS7 LSD     | Dot L5-<br>CS6 LSD     | Dot L5-<br>CS5 LSD     | Dot L5-<br>CS4 LSD     | Dot L5-<br>CS3 LSD     | Dot L5-<br>CS2 LSD     | Dot L5-<br>CS1 LSD     | Dot L5-<br>CS0 LSD     | 00h |
| <b>Dot_Isd16</b> | 096h | R | Dot L5-<br>CS15<br>LSD | Dot L5-<br>CS14<br>LSD | Dot L5-<br>CS13<br>LSD | Dot L5-<br>CS12<br>LSD | Dot L5-<br>CS11<br>LSD | Dot L5-<br>CS10<br>LSD | Dot L5-<br>CS9 LSD     | Dot L5-<br>CS8 LSD     | 00h |
| <b>Dot_Isd17</b> | 097h | R | Reserved               |                        |                        |                        |                        |                        | Dot L5-<br>CS17<br>LSD | Dot L5-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd18</b> | 098h | R | Dot L6-<br>CS7 LSD     | Dot L6-<br>CS6 LSD     | Dot L6-<br>CS5 LSD     | Dot L6-<br>CS4 LSD     | Dot L6-<br>CS3 LSD     | Dot L6-<br>CS2 LSD     | Dot L6-<br>CS1 LSD     | Dot L6-<br>CS0 LSD     | 00h |
| <b>Dot_Isd19</b> | 099h | R | Dot L6-<br>CS15<br>LSD | Dot L6-<br>CS14<br>LSD | Dot L6-<br>CS13<br>LSD | Dot L6-<br>CS12<br>LSD | Dot L6-<br>CS11<br>LSD | Dot L6-<br>CS10<br>LSD | Dot L6-<br>CS9 LSD     | Dot L6-<br>CS8 LSD     | 00h |
| <b>Dot_Isd20</b> | 09Ah | R | Reserved               |                        |                        |                        |                        |                        | Dot L6-<br>CS17<br>LSD | Dot L6-<br>CS16<br>LSD | 00h |
| <b>Dot_Isd21</b> | 09Bh | R | Dot L7-<br>CS7 LSD     | Dot L7-<br>CS6 LSD     | Dot L7-<br>CS5 LSD     | Dot L7-<br>CS4 LSD     | Dot L7-<br>CS3 LSD     | Dot L7-<br>CS2 LSD     | Dot L7-<br>CS1 LSD     | Dot L7-<br>CS0 LSD     | 00h |
| <b>Dot_Isd22</b> | 09Ch | R | Dot L7-<br>CS15<br>LSD | Dot L7-<br>CS14<br>LSD | Dot L7-<br>CS13<br>LSD | Dot L7-<br>CS12<br>LSD | Dot L7-<br>CS11<br>LSD | Dot L7-<br>CS10<br>LSD | Dot L7-<br>CS9 LSD     | Dot L7-<br>CS8 LSD     | 00h |
| <b>Dot_Isd23</b> | 09Dh | R | Reserved               |                        |                        |                        |                        |                        | Dot L7-<br>CS17<br>LSD | Dot L7-<br>CS16<br>LSD | 00h |

|           |      |     |                                         |                  |                  |                  |                  |                  |                  |                  |     |
|-----------|------|-----|-----------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----|
| Dot_Isd24 | 09Eh | R   | Dot L8-CS7 LSD                          | Dot L8-CS6 LSD   | Dot L8-CS5 LSD   | Dot L8-CS4 LSD   | Dot L8-CS3 LSD   | Dot L8-CS2 LSD   | Dot L8-CS1 LSD   | Dot L8-CS0 LSD   | 00h |
| Dot_Isd25 | 09Fh | R   | Dot L8-CS15 LSD                         | Dot L8-CS14 LSD  | Dot L8-CS13 LSD  | Dot L8-CS12 LSD  | Dot L8-CS11 LSD  | Dot L8-CS10 LSD  | Dot L8-CS9 LSD   | Dot L8-CS8 LSD   | 00h |
| Dot_Isd26 | 0A0h | R   | Reserved                                |                  |                  |                  |                  |                  | Dot L8-CS17 LSD  | Dot L8-CS16 LSD  | 00h |
| Dot_Isd27 | 0A1h | R   | Dot L9-CS7 LSD                          | Dot L9-CS6 LSD   | Dot L9-CS5 LSD   | Dot L9-CS4 LSD   | Dot L9-CS3 LSD   | Dot L9-CS2 LSD   | Dot L9-CS1 LSD   | Dot L9-CS0 LSD   | 00h |
| Dot_Isd28 | 0A2h | R   | Dot L9-CS15 LSD                         | Dot L9-CS14 LSD  | Dot L9-CS13 LSD  | Dot L9-CS12 LSD  | Dot L9-CS11 LSD  | Dot L9-CS10 LSD  | Dot L9-CS9 LSD   | Dot L9-CS8 LSD   | 00h |
| Dot_Isd29 | 0A3h | R   | Reserved                                |                  |                  |                  |                  |                  | Dot L9-CS17 LSD  | Dot L9-CS16 LSD  | 00h |
| Dot_Isd30 | 0A4h | R   | Dot L10-CS7 LSD                         | Dot L10-CS6 LSD  | Dot L10-CS5 LSD  | Dot L10-CS4 LSD  | Dot L10-CS3 LSD  | Dot L10-CS2 LSD  | Dot L10-CS1 LSD  | Dot L10-CS0 LSD  | 00h |
| Dot_Isd31 | 0A5h | R   | Dot L10-CS15 LSD                        | Dot L10-CS14 LSD | Dot L10-CS13 LSD | Dot L10-CS12 LSD | Dot L10-CS11 LSD | Dot L10-CS10 LSD | Dot L10-CS9 LSD  | Dot L10-CS8 LSD  | 00h |
| Dot_Isd32 | 0A6h | R   | Reserved                                |                  |                  |                  |                  |                  | Dot L10-CS17 LSD | Dot L10-CS16 LSD | 00h |
| LOD_clear | 0A7h | W   | Reserved                                |                  |                  |                  | LOD_Clear        |                  |                  |                  | 00h |
| LSD_clear | 0A8h | W   | Reserved                                |                  |                  |                  | LSD_Clear        |                  |                  |                  | 00h |
| Reset     | 0A9h | W   | Reset                                   |                  |                  |                  |                  |                  |                  |                  | 00h |
| DC0       | 100h | R/W | LED dot current setting for Dot L0-CS0  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC1       | 101h | R/W | LED dot current setting for Dot L0-CS1  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC2       | 102h | R/W | LED dot current setting for Dot L0-CS2  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC3       | 103h | R/W | LED dot current setting for Dot L0-CS3  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC4       | 104h | R/W | LED dot current setting for Dot L0-CS4  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC5       | 105h | R/W | LED dot current setting for Dot L0-CS5  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC6       | 106h | R/W | LED dot current setting for Dot L0-CS6  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC7       | 107h | R/W | LED dot current setting for Dot L0-CS7  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC8       | 108h | R/W | LED dot current setting for Dot L0-CS8  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC9       | 109h | R/W | LED dot current setting for Dot L0-CS9  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC10      | 10Ah | R/W | LED dot current setting for Dot L0-CS10 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC11      | 10Bh | R/W | LED dot current setting for Dot L0-CS11 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC12      | 10Ch | R/W | LED dot current setting for Dot L0-CS12 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC13      | 10Dh | R/W | LED dot current setting for Dot L0-CS13 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC14      | 10Eh | R/W | LED dot current setting for Dot L0-CS14 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC15      | 10Fh | R/W | LED dot current setting for Dot L0-CS15 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC16      | 110h | R/W | LED dot current setting for Dot L0-CS16 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC17      | 111h | R/W | LED dot current setting for Dot L0-CS17 |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC18      | 112h | R/W | LED dot current setting for Dot L1-CS0  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC19      | 113h | R/W | LED dot current setting for Dot L1-CS1  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC20      | 114h | R/W | LED dot current setting for Dot L1-CS2  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC21      | 115h | R/W | LED dot current setting for Dot L1-CS3  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC22      | 116h | R/W | LED dot current setting for Dot L1-CS4  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC23      | 117h | R/W | LED dot current setting for Dot L1-CS5  |                  |                  |                  |                  |                  |                  |                  | 80h |
| DC24      | 118h | R/W | LED dot current setting for Dot L1-CS6  |                  |                  |                  |                  |                  |                  |                  | 80h |

|             |      |     |                                         |     |
|-------------|------|-----|-----------------------------------------|-----|
| <b>DC25</b> | 119h | R/W | LED dot current setting for Dot L1-CS7  | 80h |
| <b>DC26</b> | 11Ah | R/W | LED dot current setting for Dot L1-CS8  | 80h |
| <b>DC27</b> | 11Bh | R/W | LED dot current setting for Dot L1-CS9  | 80h |
| <b>DC28</b> | 11Ch | R/W | LED dot current setting for Dot L1-CS10 | 80h |
| <b>DC29</b> | 11Dh | R/W | LED dot current setting for Dot L1-CS11 | 80h |
| <b>DC30</b> | 11Eh | R/W | LED dot current setting for Dot L1-CS12 | 80h |
| <b>DC31</b> | 11Fh | R/W | LED dot current setting for Dot L1-CS13 | 80h |
| <b>DC32</b> | 120h | R/W | LED dot current setting for Dot L1-CS14 | 80h |
| <b>DC33</b> | 121h | R/W | LED dot current setting for Dot L1-CS15 | 80h |
| <b>DC34</b> | 122h | R/W | LED dot current setting for Dot L1-CS16 | 80h |
| <b>DC35</b> | 123h | R/W | LED dot current setting for Dot L1-CS17 | 80h |
| <b>DC36</b> | 124h | R/W | LED dot current setting for Dot L2-CS0  | 80h |
| <b>DC37</b> | 125h | R/W | LED dot current setting for Dot L2-CS1  | 80h |
| <b>DC38</b> | 126h | R/W | LED dot current setting for Dot L2-CS2  | 80h |
| <b>DC39</b> | 127h | R/W | LED dot current setting for Dot L2-CS3  | 80h |
| <b>DC40</b> | 128h | R/W | LED dot current setting for Dot L2-CS4  | 80h |
| <b>DC41</b> | 129h | R/W | LED dot current setting for Dot L2-CS5  | 80h |
| <b>DC42</b> | 12Ah | R/W | LED dot current setting for Dot L2-CS6  | 80h |
| <b>DC43</b> | 12Bh | R/W | LED dot current setting for Dot L2-CS7  | 80h |
| <b>DC44</b> | 12Ch | R/W | LED dot current setting for Dot L2-CS8  | 80h |
| <b>DC45</b> | 12Dh | R/W | LED dot current setting for Dot L2-CS9  | 80h |
| <b>DC46</b> | 12Eh | R/W | LED dot current setting for Dot L2-CS10 | 80h |
| <b>DC47</b> | 12Fh | R/W | LED dot current setting for Dot L2-CS11 | 80h |
| <b>DC48</b> | 130h | R/W | LED dot current setting for Dot L2-CS12 | 80h |
| <b>DC49</b> | 131h | R/W | LED dot current setting for Dot L2-CS13 | 80h |
| <b>DC50</b> | 132h | R/W | LED dot current setting for Dot L2-CS14 | 80h |
| <b>DC51</b> | 133h | R/W | LED dot current setting for Dot L2-CS15 | 80h |
| <b>DC52</b> | 134h | R/W | LED dot current setting for Dot L2-CS16 | 80h |
| <b>DC53</b> | 135h | R/W | LED dot current setting for Dot L2-CS17 | 80h |
| <b>DC54</b> | 136h | R/W | LED dot current setting for Dot L3-CS0  | 80h |
| <b>DC55</b> | 137h | R/W | LED dot current setting for Dot L3-CS1  | 80h |
| <b>DC56</b> | 138h | R/W | LED dot current setting for Dot L3-CS2  | 80h |
| <b>DC57</b> | 139h | R/W | LED dot current setting for Dot L3-CS3  | 80h |
| <b>DC58</b> | 13Ah | R/W | LED dot current setting for Dot L3-CS4  | 80h |
| <b>DC59</b> | 13Bh | R/W | LED dot current setting for Dot L3-CS5  | 80h |
| <b>DC60</b> | 13Ch | R/W | LED dot current setting for Dot L3-CS6  | 80h |
| <b>DC61</b> | 13Dh | R/W | LED dot current setting for Dot L3-CS7  | 80h |
| <b>DC62</b> | 13Eh | R/W | LED dot current setting for Dot L3-CS8  | 80h |
| <b>DC63</b> | 13Fh | R/W | LED dot current setting for Dot L3-CS9  | 80h |
| <b>DC64</b> | 140h | R/W | LED dot current setting for Dot L3-CS10 | 80h |
| <b>DC65</b> | 141h | R/W | LED dot current setting for Dot L3-CS11 | 80h |
| <b>DC66</b> | 142h | R/W | LED dot current setting for Dot L3-CS12 | 80h |
| <b>DC67</b> | 143h | R/W | LED dot current setting for Dot L3-CS13 | 80h |
| <b>DC68</b> | 144h | R/W | LED dot current setting for Dot L3-CS14 | 80h |
| <b>DC69</b> | 145h | R/W | LED dot current setting for Dot L3-CS15 | 80h |
| <b>DC70</b> | 146h | R/W | LED dot current setting for Dot L3-CS16 | 80h |
| <b>DC71</b> | 147h | R/W | LED dot current setting for Dot L3-CS17 | 80h |

|       |      |     |                                         |     |
|-------|------|-----|-----------------------------------------|-----|
| DC72  | 148h | R/W | LED dot current setting for Dot L4-CS0  | 80h |
| DC73  | 149h | R/W | LED dot current setting for Dot L4-CS1  | 80h |
| DC74  | 14Ah | R/W | LED dot current setting for Dot L4-CS2  | 80h |
| DC75  | 14Bh | R/W | LED dot current setting for Dot L4-CS3  | 80h |
| DC76  | 14Ch | R/W | LED dot current setting for Dot L4-CS4  | 80h |
| DC77  | 14Dh | R/W | LED dot current setting for Dot L4-CS5  | 80h |
| DC78  | 14Eh | R/W | LED dot current setting for Dot L4-CS6  | 80h |
| DC79  | 14Fh | R/W | LED dot current setting for Dot L4-CS7  | 80h |
| DC80  | 150h | R/W | LED dot current setting for Dot L4-CS8  | 80h |
| DC81  | 151h | R/W | LED dot current setting for Dot L4-CS9  | 80h |
| DC82  | 152h | R/W | LED dot current setting for Dot L4-CS10 | 80h |
| DC83  | 153h | R/W | LED dot current setting for Dot L4-CS11 | 80h |
| DC84  | 154h | R/W | LED dot current setting for Dot L4-CS12 | 80h |
| DC85  | 155h | R/W | LED dot current setting for Dot L4-CS13 | 80h |
| DC86  | 156h | R/W | LED dot current setting for Dot L4-CS14 | 80h |
| DC87  | 157h | R/W | LED dot current setting for Dot L4-CS15 | 80h |
| DC88  | 158h | R/W | LED dot current setting for Dot L4-CS16 | 80h |
| DC89  | 159h | R/W | LED dot current setting for Dot L4-CS17 | 80h |
| DC90  | 15Ah | R/W | LED dot current setting for Dot L5-CS0  | 80h |
| DC91  | 15Bh | R/W | LED dot current setting for Dot L5-CS1  | 80h |
| DC92  | 15Ch | R/W | LED dot current setting for Dot L5-CS2  | 80h |
| DC93  | 15Dh | R/W | LED dot current setting for Dot L5-CS3  | 80h |
| DC94  | 15Eh | R/W | LED dot current setting for Dot L5-CS4  | 80h |
| DC95  | 15Fh | R/W | LED dot current setting for Dot L5-CS5  | 80h |
| DC96  | 160h | R/W | LED dot current setting for Dot L5-CS6  | 80h |
| DC97  | 161h | R/W | LED dot current setting for Dot L5-CS7  | 80h |
| DC98  | 162h | R/W | LED dot current setting for Dot L5-CS8  | 80h |
| DC99  | 163h | R/W | LED dot current setting for Dot L5-CS9  | 80h |
| DC100 | 164h | R/W | LED dot current setting for Dot L5-CS10 | 80h |
| DC101 | 165h | R/W | LED dot current setting for Dot L5-CS11 | 80h |
| DC102 | 166h | R/W | LED dot current setting for Dot L5-CS12 | 80h |
| DC103 | 167h | R/W | LED dot current setting for Dot L5-CS13 | 80h |
| DC104 | 168h | R/W | LED dot current setting for Dot L5-CS14 | 80h |
| DC105 | 169h | R/W | LED dot current setting for Dot L5-CS15 | 80h |
| DC106 | 16Ah | R/W | LED dot current setting for Dot L5-CS16 | 80h |
| DC107 | 16Bh | R/W | LED dot current setting for Dot L5-CS17 | 80h |
| DC108 | 16Ch | R/W | LED dot current setting for Dot L6-CS0  | 80h |
| DC109 | 16Dh | R/W | LED dot current setting for Dot L6-CS1  | 80h |
| DC110 | 16Eh | R/W | LED dot current setting for Dot L6-CS2  | 80h |
| DC111 | 16Fh | R/W | LED dot current setting for Dot L6-CS3  | 80h |
| DC112 | 170h | R/W | LED dot current setting for Dot L6-CS4  | 80h |
| DC113 | 171h | R/W | LED dot current setting for Dot L6-CS5  | 80h |
| DC114 | 172h | R/W | LED dot current setting for Dot L6-CS6  | 80h |
| DC115 | 173h | R/W | LED dot current setting for Dot L6-CS7  | 80h |
| DC116 | 174h | R/W | LED dot current setting for Dot L6-CS8  | 80h |
| DC117 | 175h | R/W | LED dot current setting for Dot L6-CS9  | 80h |
| DC118 | 176h | R/W | LED dot current setting for Dot L6-CS10 | 80h |

|              |      |     |                                         |     |
|--------------|------|-----|-----------------------------------------|-----|
| <b>DC119</b> | 177h | R/W | LED dot current setting for Dot L6-CS11 | 80h |
| <b>DC120</b> | 178h | R/W | LED dot current setting for Dot L6-CS12 | 80h |
| <b>DC121</b> | 179h | R/W | LED dot current setting for Dot L6-CS13 | 80h |
| <b>DC122</b> | 17Ah | R/W | LED dot current setting for Dot L6-CS14 | 80h |
| <b>DC123</b> | 17Bh | R/W | LED dot current setting for Dot L6-CS15 | 80h |
| <b>DC124</b> | 17Ch | R/W | LED dot current setting for Dot L6-CS16 | 80h |
| <b>DC125</b> | 17Dh | R/W | LED dot current setting for Dot L6-CS17 | 80h |
| <b>DC126</b> | 17Eh | R/W | LED dot current setting for Dot L7-CS0  | 80h |
| <b>DC127</b> | 17Fh | R/W | LED dot current setting for Dot L7-CS1  | 80h |
| <b>DC128</b> | 180h | R/W | LED dot current setting for Dot L7-CS2  | 80h |
| <b>DC129</b> | 181h | R/W | LED dot current setting for Dot L7-CS3  | 80h |
| <b>DC130</b> | 182h | R/W | LED dot current setting for Dot L7-CS4  | 80h |
| <b>DC131</b> | 183h | R/W | LED dot current setting for Dot L7-CS5  | 80h |
| <b>DC132</b> | 184h | R/W | LED dot current setting for Dot L7-CS6  | 80h |
| <b>DC133</b> | 185h | R/W | LED dot current setting for Dot L7-CS7  | 80h |
| <b>DC134</b> | 186h | R/W | LED dot current setting for Dot L7-CS8  | 80h |
| <b>DC135</b> | 187h | R/W | LED dot current setting for Dot L7-CS9  | 80h |
| <b>DC136</b> | 188h | R/W | LED dot current setting for Dot L7-CS10 | 80h |
| <b>DC137</b> | 189h | R/W | LED dot current setting for Dot L7-CS11 | 80h |
| <b>DC138</b> | 18Ah | R/W | LED dot current setting for Dot L7-CS12 | 80h |
| <b>DC139</b> | 18Bh | R/W | LED dot current setting for Dot L7-CS13 | 80h |
| <b>DC140</b> | 18Ch | R/W | LED dot current setting for Dot L7-CS14 | 80h |
| <b>DC141</b> | 18Dh | R/W | LED dot current setting for Dot L7-CS15 | 80h |
| <b>DC142</b> | 18Eh | R/W | LED dot current setting for Dot L7-CS16 | 80h |
| <b>DC143</b> | 18Fh | R/W | LED dot current setting for Dot L7-CS17 | 80h |
| <b>DC144</b> | 190h | R/W | LED dot current setting for Dot L8-CS0  | 80h |
| <b>DC145</b> | 191h | R/W | LED dot current setting for Dot L8-CS1  | 80h |
| <b>DC146</b> | 192h | R/W | LED dot current setting for Dot L8-CS2  | 80h |
| <b>DC147</b> | 193h | R/W | LED dot current setting for Dot L8-CS3  | 80h |
| <b>DC148</b> | 194h | R/W | LED dot current setting for Dot L8-CS4  | 80h |
| <b>DC149</b> | 195h | R/W | LED dot current setting for Dot L8-CS5  | 80h |
| <b>DC150</b> | 196h | R/W | LED dot current setting for Dot L8-CS6  | 80h |
| <b>DC151</b> | 197h | R/W | LED dot current setting for Dot L8-CS7  | 80h |
| <b>DC152</b> | 198h | R/W | LED dot current setting for Dot L8-CS8  | 80h |
| <b>DC153</b> | 199h | R/W | LED dot current setting for Dot L8-CS9  | 80h |
| <b>DC154</b> | 19Ah | R/W | LED dot current setting for Dot L8-CS10 | 80h |
| <b>DC155</b> | 19Bh | R/W | LED dot current setting for Dot L8-CS11 | 80h |
| <b>DC156</b> | 19Ch | R/W | LED dot current setting for Dot L8-CS12 | 80h |
| <b>DC157</b> | 19Dh | R/W | LED dot current setting for Dot L8-CS13 | 80h |
| <b>DC158</b> | 19Eh | R/W | LED dot current setting for Dot L8-CS14 | 80h |
| <b>DC159</b> | 19Fh | R/W | LED dot current setting for Dot L8-CS15 | 80h |
| <b>DC160</b> | 1A0h | R/W | LED dot current setting for Dot L8-CS16 | 80h |
| <b>DC161</b> | 1A1h | R/W | LED dot current setting for Dot L8-CS17 | 80h |
| <b>DC162</b> | 1A2h | R/W | LED dot current setting for Dot L9-CS0  | 80h |
| <b>DC163</b> | 1A3h | R/W | LED dot current setting for Dot L9-CS1  | 80h |
| <b>DC164</b> | 1A4h | R/W | LED dot current setting for Dot L9-CS2  | 80h |
| <b>DC165</b> | 1A5h | R/W | LED dot current setting for Dot L9-CS3  | 80h |

|           |      |     |                                                                               |     |
|-----------|------|-----|-------------------------------------------------------------------------------|-----|
| DC166     | 1A6h | R/W | LED dot current setting for Dot L9-CS4                                        | 80h |
| DC167     | 1A7h | R/W | LED dot current setting for Dot L9-CS5                                        | 80h |
| DC168     | 1A8h | R/W | LED dot current setting for Dot L9-CS6                                        | 80h |
| DC169     | 1A9h | R/W | LED dot current setting for Dot L9-CS7                                        | 80h |
| DC170     | 1AAh | R/W | LED dot current setting for Dot L9-CS8                                        | 80h |
| DC171     | 1ABh | R/W | LED dot current setting for Dot L9-CS9                                        | 80h |
| DC172     | 1ACh | R/W | LED dot current setting for Dot L9-CS10                                       | 80h |
| DC173     | 1ADh | R/W | LED dot current setting for Dot L9-CS11                                       | 80h |
| DC174     | 1AEh | R/W | LED dot current setting for Dot L9-CS12                                       | 80h |
| DC175     | 1AFh | R/W | LED dot current setting for Dot L9-CS13                                       | 80h |
| DC176     | 1B0h | R/W | LED dot current setting for Dot L9-CS14                                       | 80h |
| DC177     | 1B1h | R/W | LED dot current setting for Dot L9-CS15                                       | 80h |
| DC178     | 1B2h | R/W | LED dot current setting for Dot L9-CS16                                       | 80h |
| DC179     | 1B3h | R/W | LED dot current setting for Dot L9-CS17                                       | 80h |
| DC180     | 1B4h | R/W | LED dot current setting for Dot L10-CS0                                       | 80h |
| DC181     | 1B5h | R/W | LED dot current setting for Dot L10-CS1                                       | 80h |
| DC182     | 1B6h | R/W | LED dot current setting for Dot L10-CS2                                       | 80h |
| DC183     | 1B7h | R/W | LED dot current setting for Dot L10-CS3                                       | 80h |
| DC184     | 1B8h | R/W | LED dot current setting for Dot L10-CS4                                       | 80h |
| DC185     | 1B9h | R/W | LED dot current setting for Dot L10-CS5                                       | 80h |
| DC186     | 1BAh | R/W | LED dot current setting for Dot L10-CS6                                       | 80h |
| DC187     | 1BBh | R/W | LED dot current setting for Dot L10-CS7                                       | 80h |
| DC188     | 1BCh | R/W | LED dot current setting for Dot L10-CS8                                       | 80h |
| DC189     | 1BDh | R/W | LED dot current setting for Dot L10-CS9                                       | 80h |
| DC190     | 1BEh | R/W | LED dot current setting for Dot L10-CS10                                      | 80h |
| DC191     | 1BFh | R/W | LED dot current setting for Dot L10-CS11                                      | 80h |
| DC192     | 1C0h | R/W | LED dot current setting for Dot L10-CS12                                      | 80h |
| DC193     | 1C1h | R/W | LED dot current setting for Dot L10-CS13                                      | 80h |
| DC194     | 1C2h | R/W | LED dot current setting for Dot L10-CS14                                      | 80h |
| DC195     | 1C3h | R/W | LED dot current setting for Dot L10-CS15                                      | 80h |
| DC196     | 1C4h | R/W | LED dot current setting for Dot L10-CS16                                      | 80h |
| DC197     | 1C5h | R/W | LED dot current setting for Dot L10-CS17                                      | 80h |
| pwm_bri0  | 200h | R/W | 8-bits PWM for Dot L0-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS0    | 00h |
| pwm_bri1  | 201h | R/W | 8-bits PWM for Dot L0-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS0  | 00h |
| pwm_bri2  | 202h | R/W | 8-bits PWM for Dot L0-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS1    | 00h |
| pwm_bri3  | 203h | R/W | 8-bits PWM for Dot L0-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS1  | 00h |
| pwm_bri4  | 204h | R/W | 8-bits PWM for Dot L0-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS2    | 00h |
| pwm_bri5  | 205h | R/W | 8-bits PWM for Dot L0-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS2  | 00h |
| pwm_bri6  | 206h | R/W | 8-bits PWM for Dot L0-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS3    | 00h |
| pwm_bri7  | 207h | R/W | 8-bits PWM for Dot L0-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS3  | 00h |
| pwm_bri8  | 208h | R/W | 8-bits PWM for Dot L0-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS4    | 00h |
| pwm_bri9  | 209h | R/W | 8-bits PWM for Dot L0-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS4  | 00h |
| pwm_bri10 | 20Ah | R/W | 8-bits PWM for Dot L0-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS5   | 00h |
| pwm_bri11 | 20Bh | R/W | 8-bits PWM for Dot L0-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS5 | 00h |
| pwm_bri12 | 20Ch | R/W | 8-bits PWM for Dot L0-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS6   | 00h |
| pwm_bri13 | 20Dh | R/W | 8-bits PWM for Dot L0-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS6 | 00h |
| pwm_bri14 | 20Eh | R/W | 8-bits PWM for Dot L0-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS7   | 00h |

|           |      |     |                                                                                |     |
|-----------|------|-----|--------------------------------------------------------------------------------|-----|
| pwm_bri15 | 20Fh | R/W | 8-bits PWM for Dot L0-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS7  | 00h |
| pwm_bri16 | 210h | R/W | 8-bits PWM for Dot L0-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS8    | 00h |
| pwm_bri17 | 211h | R/W | 8-bits PWM for Dot L0-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS8  | 00h |
| pwm_bri18 | 212h | R/W | 8-bits PWM for Dot L1-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS9     | 00h |
| pwm_bri19 | 213h | R/W | 8-bits PWM for Dot L1-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS9   | 00h |
| pwm_bri20 | 214h | R/W | 8-bits PWM for Dot L1-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS10    | 00h |
| pwm_bri21 | 215h | R/W | 8-bits PWM for Dot L1-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS10  | 00h |
| pwm_bri22 | 216h | R/W | 8-bits PWM for Dot L1-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS11    | 00h |
| pwm_bri23 | 217h | R/W | 8-bits PWM for Dot L1-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS11  | 00h |
| pwm_bri24 | 218h | R/W | 8-bits PWM for Dot L1-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS12    | 00h |
| pwm_bri25 | 219h | R/W | 8-bits PWM for Dot L1-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS12  | 00h |
| pwm_bri26 | 21Ah | R/W | 8-bits PWM for Dot L1-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS13    | 00h |
| pwm_bri27 | 21Bh | R/W | 8-bits PWM for Dot L1-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS13  | 00h |
| pwm_bri28 | 21Ch | R/W | 8-bits PWM for Dot L1-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS14   | 00h |
| pwm_bri29 | 21Dh | R/W | 8-bits PWM for Dot L1-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS14 | 00h |
| pwm_bri30 | 21Eh | R/W | 8-bits PWM for Dot L1-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS15   | 00h |
| pwm_bri31 | 21Fh | R/W | 8-bits PWM for Dot L1-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS15 | 00h |
| pwm_bri32 | 220h | R/W | 8-bits PWM for Dot L1-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS16   | 00h |
| pwm_bri33 | 221h | R/W | 8-bits PWM for Dot L1-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS16 | 00h |
| pwm_bri34 | 222h | R/W | 8-bits PWM for Dot L1-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L0-CS17   | 00h |
| pwm_bri35 | 223h | R/W | 8-bits PWM for Dot L1-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L0-CS17 | 00h |
| pwm_bri36 | 224h | R/W | 8-bits PWM for Dot L2-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS0     | 00h |
| pwm_bri37 | 225h | R/W | 8-bits PWM for Dot L2-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS0   | 00h |
| pwm_bri38 | 226h | R/W | 8-bits PWM for Dot L2-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS1     | 00h |
| pwm_bri39 | 227h | R/W | 8-bits PWM for Dot L2-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS1   | 00h |
| pwm_bri40 | 228h | R/W | 8-bits PWM for Dot L2-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS2     | 00h |
| pwm_bri41 | 229h | R/W | 8-bits PWM for Dot L2-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS2   | 00h |
| pwm_bri42 | 22Ah | R/W | 8-bits PWM for Dot L2-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS3     | 00h |
| pwm_bri43 | 22Bh | R/W | 8-bits PWM for Dot L2-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS3   | 00h |
| pwm_bri44 | 22Ch | R/W | 8-bits PWM for Dot L2-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS4     | 00h |
| pwm_bri45 | 22Dh | R/W | 8-bits PWM for Dot L2-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS4   | 00h |
| pwm_bri46 | 22Eh | R/W | 8-bits PWM for Dot L2-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS5    | 00h |
| pwm_bri47 | 22Fh | R/W | 8-bits PWM for Dot L2-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS5  | 00h |
| pwm_bri48 | 230h | R/W | 8-bits PWM for Dot L2-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS6    | 00h |
| pwm_bri49 | 231h | R/W | 8-bits PWM for Dot L2-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS6  | 00h |
| pwm_bri50 | 232h | R/W | 8-bits PWM for Dot L2-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS7    | 00h |
| pwm_bri51 | 233h | R/W | 8-bits PWM for Dot L2-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS7  | 00h |
| pwm_bri52 | 234h | R/W | 8-bits PWM for Dot L2-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS8    | 00h |
| pwm_bri53 | 235h | R/W | 8-bits PWM for Dot L2-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS8  | 00h |
| pwm_bri54 | 236h | R/W | 8-bits PWM for Dot L3-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS9     | 00h |
| pwm_bri55 | 237h | R/W | 8-bits PWM for Dot L3-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS9   | 00h |
| pwm_bri56 | 238h | R/W | 8-bits PWM for Dot L3-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS10    | 00h |
| pwm_bri57 | 239h | R/W | 8-bits PWM for Dot L3-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS10  | 00h |
| pwm_bri58 | 23Ah | R/W | 8-bits PWM for Dot L3-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS11    | 00h |
| pwm_bri59 | 23Bh | R/W | 8-bits PWM for Dot L3-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS11  | 00h |
| pwm_bri60 | 23Ch | R/W | 8-bits PWM for Dot L3-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS12    | 00h |
| pwm_bri61 | 23Dh | R/W | 8-bits PWM for Dot L3-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS12  | 00h |

|            |      |     |                                                                                |     |
|------------|------|-----|--------------------------------------------------------------------------------|-----|
| pwm_bri62  | 23Eh | R/W | 8-bits PWM for Dot L3-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS13    | 00h |
| pwm_bri63  | 23Fh | R/W | 8-bits PWM for Dot L3-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS13  | 00h |
| pwm_bri64  | 240h | R/W | 8-bits PWM for Dot L3-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS14   | 00h |
| pwm_bri65  | 241h | R/W | 8-bits PWM for Dot L3-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS14 | 00h |
| pwm_bri66  | 242h | R/W | 8-bits PWM for Dot L3-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS15   | 00h |
| pwm_bri67  | 243h | R/W | 8-bits PWM for Dot L3-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS15 | 00h |
| pwm_bri68  | 244h | R/W | 8-bits PWM for Dot L3-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS16   | 00h |
| pwm_bri69  | 245h | R/W | 8-bits PWM for Dot L3-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS16 | 00h |
| pwm_bri70  | 246h | R/W | 8-bits PWM for Dot L3-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L1-CS17   | 00h |
| pwm_bri71  | 247h | R/W | 8-bits PWM for Dot L3-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L1-CS17 | 00h |
| pwm_bri72  | 248h | R/W | 8-bits PWM for Dot L4-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS0     | 00h |
| pwm_bri73  | 249h | R/W | 8-bits PWM for Dot L4-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS0   | 00h |
| pwm_bri74  | 24Ah | R/W | 8-bits PWM for Dot L4-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS1     | 00h |
| pwm_bri75  | 24Bh | R/W | 8-bits PWM for Dot L4-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS1   | 00h |
| pwm_bri76  | 24Ch | R/W | 8-bits PWM for Dot L4-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS2     | 00h |
| pwm_bri77  | 24Dh | R/W | 8-bits PWM for Dot L4-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS2   | 00h |
| pwm_bri78  | 24Eh | R/W | 8-bits PWM for Dot L4-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS3     | 00h |
| pwm_bri79  | 24Fh | R/W | 8-bits PWM for Dot L4-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS3   | 00h |
| pwm_bri80  | 250h | R/W | 8-bits PWM for Dot L4-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS4     | 00h |
| pwm_bri81  | 251h | R/W | 8-bits PWM for Dot L4-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS4   | 00h |
| pwm_bri82  | 252h | R/W | 8-bits PWM for Dot L4-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS5    | 00h |
| pwm_bri83  | 253h | R/W | 8-bits PWM for Dot L4-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS5  | 00h |
| pwm_bri84  | 254h | R/W | 8-bits PWM for Dot L4-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS6    | 00h |
| pwm_bri85  | 255h | R/W | 8-bits PWM for Dot L4-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS6  | 00h |
| pwm_bri86  | 256h | R/W | 8-bits PWM for Dot L4-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS7    | 00h |
| pwm_bri87  | 257h | R/W | 8-bits PWM for Dot L4-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS7  | 00h |
| pwm_bri88  | 258h | R/W | 8-bits PWM for Dot L4-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS8    | 00h |
| pwm_bri89  | 259h | R/W | 8-bits PWM for Dot L4-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS8  | 00h |
| pwm_bri90  | 25Ah | R/W | 8-bits PWM for Dot L5-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS9     | 00h |
| pwm_bri91  | 25Bh | R/W | 8-bits PWM for Dot L5-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS9   | 00h |
| pwm_bri92  | 25Ch | R/W | 8-bits PWM for Dot L5-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS10    | 00h |
| pwm_bri93  | 25Dh | R/W | 8-bits PWM for Dot L5-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS10  | 00h |
| pwm_bri94  | 25Eh | R/W | 8-bits PWM for Dot L5-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS11    | 00h |
| pwm_bri95  | 25Fh | R/W | 8-bits PWM for Dot L5-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS11  | 00h |
| pwm_bri96  | 260h | R/W | 8-bits PWM for Dot L5-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS12    | 00h |
| pwm_bri97  | 261h | R/W | 8-bits PWM for Dot L5-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS12  | 00h |
| pwm_bri98  | 262h | R/W | 8-bits PWM for Dot L5-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS13    | 00h |
| pwm_bri99  | 263h | R/W | 8-bits PWM for Dot L5-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS13  | 00h |
| pwm_bri100 | 264h | R/W | 8-bits PWM for Dot L5-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS14   | 00h |
| pwm_bri101 | 265h | R/W | 8-bits PWM for Dot L5-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS14 | 00h |
| pwm_bri102 | 266h | R/W | 8-bits PWM for Dot L5-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS15   | 00h |
| pwm_bri103 | 267h | R/W | 8-bits PWM for Dot L5-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS15 | 00h |
| pwm_bri104 | 268h | R/W | 8-bits PWM for Dot L5-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS16   | 00h |
| pwm_bri105 | 269h | R/W | 8-bits PWM for Dot L5-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS16 | 00h |
| pwm_bri106 | 26Ah | R/W | 8-bits PWM for Dot L5-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L2-CS17   | 00h |
| pwm_bri107 | 26Bh | R/W | 8-bits PWM for Dot L5-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L2-CS17 | 00h |
| pwm_bri108 | 26Ch | R/W | 8-bits PWM for Dot L6-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS0     | 00h |

|            |      |     |                                                                                |     |
|------------|------|-----|--------------------------------------------------------------------------------|-----|
| pwm_bri109 | 26Dh | R/W | 8-bits PWM for Dot L6-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS0   | 00h |
| pwm_bri110 | 26Eh | R/W | 8-bits PWM for Dot L6-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS1     | 00h |
| pwm_bri111 | 26Fh | R/W | 8-bits PWM for Dot L6-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS1   | 00h |
| pwm_bri112 | 270h | R/W | 8-bits PWM for Dot L6-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS2     | 00h |
| pwm_bri113 | 271h | R/W | 8-bits PWM for Dot L6-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS2   | 00h |
| pwm_bri114 | 272h | R/W | 8-bits PWM for Dot L6-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS3     | 00h |
| pwm_bri115 | 273h | R/W | 8-bits PWM for Dot L6-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS3   | 00h |
| pwm_bri116 | 274h | R/W | 8-bits PWM for Dot L6-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS4     | 00h |
| pwm_bri117 | 275h | R/W | 8-bits PWM for Dot L6-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS4   | 00h |
| pwm_bri118 | 276h | R/W | 8-bits PWM for Dot L6-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS5    | 00h |
| pwm_bri119 | 277h | R/W | 8-bits PWM for Dot L6-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS5  | 00h |
| pwm_bri120 | 278h | R/W | 8-bits PWM for Dot L6-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS6    | 00h |
| pwm_bri121 | 279h | R/W | 8-bits PWM for Dot L6-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS6  | 00h |
| pwm_bri122 | 27Ah | R/W | 8-bits PWM for Dot L6-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS7    | 00h |
| pwm_bri123 | 27Bh | R/W | 8-bits PWM for Dot L6-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS7  | 00h |
| pwm_bri124 | 27Ch | R/W | 8-bits PWM for Dot L6-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS8    | 00h |
| pwm_bri125 | 27Dh | R/W | 8-bits PWM for Dot L6-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS8  | 00h |
| pwm_bri126 | 27Eh | R/W | 8-bits PWM for Dot L7-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS9     | 00h |
| pwm_bri127 | 27Fh | R/W | 8-bits PWM for Dot L7-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS9   | 00h |
| pwm_bri128 | 280h | R/W | 8-bits PWM for Dot L7-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS10    | 00h |
| pwm_bri129 | 281h | R/W | 8-bits PWM for Dot L7-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS10  | 00h |
| pwm_bri130 | 282h | R/W | 8-bits PWM for Dot L7-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS11    | 00h |
| pwm_bri131 | 283h | R/W | 8-bits PWM for Dot L7-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS11  | 00h |
| pwm_bri132 | 284h | R/W | 8-bits PWM for Dot L7-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS12    | 00h |
| pwm_bri133 | 285h | R/W | 8-bits PWM for Dot L7-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS12  | 00h |
| pwm_bri134 | 286h | R/W | 8-bits PWM for Dot L7-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS13    | 00h |
| pwm_bri135 | 287h | R/W | 8-bits PWM for Dot L7-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS13  | 00h |
| pwm_bri136 | 288h | R/W | 8-bits PWM for Dot L7-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS14   | 00h |
| pwm_bri137 | 289h | R/W | 8-bits PWM for Dot L7-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS14 | 00h |
| pwm_bri138 | 28Ah | R/W | 8-bits PWM for Dot L7-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS15   | 00h |
| pwm_bri139 | 28Bh | R/W | 8-bits PWM for Dot L7-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS15 | 00h |
| pwm_bri140 | 28Ch | R/W | 8-bits PWM for Dot L7-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS16   | 00h |
| pwm_bri141 | 28Dh | R/W | 8-bits PWM for Dot L7-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS16 | 00h |
| pwm_bri142 | 28Eh | R/W | 8-bits PWM for Dot L7-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L3-CS17   | 00h |
| pwm_bri143 | 28Fh | R/W | 8-bits PWM for Dot L7-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L3-CS17 | 00h |
| pwm_bri144 | 290h | R/W | 8-bits PWM for Dot L8-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS0     | 00h |
| pwm_bri145 | 291h | R/W | 8-bits PWM for Dot L8-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS0   | 00h |
| pwm_bri146 | 292h | R/W | 8-bits PWM for Dot L8-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS1     | 00h |
| pwm_bri147 | 293h | R/W | 8-bits PWM for Dot L8-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS1   | 00h |
| pwm_bri148 | 294h | R/W | 8-bits PWM for Dot L8-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS2     | 00h |
| pwm_bri149 | 295h | R/W | 8-bits PWM for Dot L8-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS2   | 00h |
| pwm_bri150 | 296h | R/W | 8-bits PWM for Dot L8-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS3     | 00h |
| pwm_bri151 | 297h | R/W | 8-bits PWM for Dot L8-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS3   | 00h |
| pwm_bri152 | 298h | R/W | 8-bits PWM for Dot L8-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS4     | 00h |
| pwm_bri153 | 299h | R/W | 8-bits PWM for Dot L8-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS4   | 00h |
| pwm_bri154 | 29Ah | R/W | 8-bits PWM for Dot L8-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS5    | 00h |
| pwm_bri155 | 29Bh | R/W | 8-bits PWM for Dot L8-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS5  | 00h |

|            |      |     |                                                                                |     |
|------------|------|-----|--------------------------------------------------------------------------------|-----|
| pwm_bri156 | 29Ch | R/W | 8-bits PWM for Dot L8-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS6    | 00h |
| pwm_bri157 | 29Dh | R/W | 8-bits PWM for Dot L8-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS6  | 00h |
| pwm_bri158 | 29Eh | R/W | 8-bits PWM for Dot L8-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS7    | 00h |
| pwm_bri159 | 29Fh | R/W | 8-bits PWM for Dot L8-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS7  | 00h |
| pwm_bri160 | 2A0h | R/W | 8-bits PWM for Dot L8-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS8    | 00h |
| pwm_bri161 | 2A1h | R/W | 8-bits PWM for Dot L8-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS8  | 00h |
| pwm_bri162 | 2A2h | R/W | 8-bits PWM for Dot L9-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS9     | 00h |
| pwm_bri163 | 2A3h | R/W | 8-bits PWM for Dot L9-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS9   | 00h |
| pwm_bri164 | 2A4h | R/W | 8-bits PWM for Dot L9-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS10    | 00h |
| pwm_bri165 | 2A5h | R/W | 8-bits PWM for Dot L9-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS10  | 00h |
| pwm_bri166 | 2A6h | R/W | 8-bits PWM for Dot L9-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS11    | 00h |
| pwm_bri167 | 2A7h | R/W | 8-bits PWM for Dot L9-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS11  | 00h |
| pwm_bri168 | 2A8h | R/W | 8-bits PWM for Dot L9-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS12    | 00h |
| pwm_bri169 | 2A9h | R/W | 8-bits PWM for Dot L9-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS12  | 00h |
| pwm_bri170 | 2AAh | R/W | 8-bits PWM for Dot L9-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS13    | 00h |
| pwm_bri171 | 2ABh | R/W | 8-bits PWM for Dot L9-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS13  | 00h |
| pwm_bri172 | 2ACh | R/W | 8-bits PWM for Dot L9-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS14   | 00h |
| pwm_bri173 | 2ADh | R/W | 8-bits PWM for Dot L9-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS14 | 00h |
| pwm_bri174 | 2AEh | R/W | 8-bits PWM for Dot L9-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS15   | 00h |
| pwm_bri175 | 2AFh | R/W | 8-bits PWM for Dot L9-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS15 | 00h |
| pwm_bri176 | 2B0h | R/W | 8-bits PWM for Dot L9-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS16   | 00h |
| pwm_bri177 | 2B1h | R/W | 8-bits PWM for Dot L9-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS16 | 00h |
| pwm_bri178 | 2B2h | R/W | 8-bits PWM for Dot L9-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L4-CS17   | 00h |
| pwm_bri179 | 2B3h | R/W | 8-bits PWM for Dot L9-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L4-CS17 | 00h |
| pwm_bri180 | 2B4h | R/W | 8-bits PWM for Dot L10-CS0 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS0    | 00h |
| pwm_bri181 | 2B5h | R/W | 8-bits PWM for Dot L10-CS1 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS0  | 00h |
| pwm_bri182 | 2B6h | R/W | 8-bits PWM for Dot L10-CS2 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS1    | 00h |
| pwm_bri183 | 2B7h | R/W | 8-bits PWM for Dot L10-CS3 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS1  | 00h |
| pwm_bri184 | 2B8h | R/W | 8-bits PWM for Dot L10-CS4 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS2    | 00h |
| pwm_bri185 | 2B9h | R/W | 8-bits PWM for Dot L10-CS5 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS2  | 00h |
| pwm_bri186 | 2BAh | R/W | 8-bits PWM for Dot L10-CS6 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS3    | 00h |
| pwm_bri187 | 2BBh | R/W | 8-bits PWM for Dot L10-CS7 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS3  | 00h |
| pwm_bri188 | 2BCh | R/W | 8-bits PWM for Dot L10-CS8 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS4    | 00h |
| pwm_bri189 | 2BDh | R/W | 8-bits PWM for Dot L10-CS9 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS4  | 00h |
| pwm_bri190 | 2BEh | R/W | 8-bits PWM for Dot L10-CS10 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS5   | 00h |
| pwm_bri191 | 2BFh | R/W | 8-bits PWM for Dot L10-CS11 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS5 | 00h |
| pwm_bri192 | 2C0h | R/W | 8-bits PWM for Dot L10-CS12 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS6   | 00h |
| pwm_bri193 | 2C1h | R/W | 8-bits PWM for Dot L10-CS13 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS6 | 00h |
| pwm_bri194 | 2C2h | R/W | 8-bits PWM for Dot L10-CS14 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS7   | 00h |
| pwm_bri195 | 2C3h | R/W | 8-bits PWM for Dot L10-CS15 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS7 | 00h |
| pwm_bri196 | 2C4h | R/W | 8-bits PWM for Dot L10-CS16 OR 16-bits PWM lower 8 bits [7:0] for Dot L5-CS8   | 00h |
| pwm_bri197 | 2C5h | R/W | 8-bits PWM for Dot L10-CS17 OR 16-bits PWM higher 8 bits [15:8] for Dot L5-CS8 | 00h |
| pwm_bri198 | 2C6h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS9                                  | 00h |
| pwm_bri199 | 2C7h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS9                                | 00h |
| pwm_bri200 | 2C8h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS10                                 | 00h |
| pwm_bri201 | 2C9h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS10                               | 00h |
| pwm_bri202 | 2CAh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS11                                 | 00h |

|            |      |     |                                                  |     |
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| pwm_bri203 | 2CBh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS11 | 00h |
| pwm_bri204 | 2CCh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS12   | 00h |
| pwm_bri205 | 2CDh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS12 | 00h |
| pwm_bri206 | 2CEh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS13   | 00h |
| pwm_bri207 | 2CFh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS13 | 00h |
| pwm_bri208 | 2D0h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS14   | 00h |
| pwm_bri209 | 2D1h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS14 | 00h |
| pwm_bri210 | 2D2h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS15   | 00h |
| pwm_bri211 | 2D3h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS15 | 00h |
| pwm_bri212 | 2D4h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS16   | 00h |
| pwm_bri213 | 2D5h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS16 | 00h |
| pwm_bri214 | 2D6h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L5-CS17   | 00h |
| pwm_bri215 | 2D7h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L5-CS17 | 00h |
| pwm_bri216 | 2D8h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS0    | 00h |
| pwm_bri217 | 2D9h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS0  | 00h |
| pwm_bri218 | 2DAh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS1    | 00h |
| pwm_bri219 | 2DBh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS1  | 00h |
| pwm_bri220 | 2DCh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS2    | 00h |
| pwm_bri221 | 2DDh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS2  | 00h |
| pwm_bri222 | 2DEh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS3    | 00h |
| pwm_bri223 | 2DFh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS3  | 00h |
| pwm_bri224 | 2E0h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS4    | 00h |
| pwm_bri225 | 2E1h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS4  | 00h |
| pwm_bri226 | 2E2h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS5    | 00h |
| pwm_bri227 | 2E3h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS5  | 00h |
| pwm_bri228 | 2E4h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS6    | 00h |
| pwm_bri229 | 2E5h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS6  | 00h |
| pwm_bri230 | 2E6h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS7    | 00h |
| pwm_bri231 | 2E7h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS7  | 00h |
| pwm_bri232 | 2E8h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS8    | 00h |
| pwm_bri233 | 2E9h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS8  | 00h |
| pwm_bri234 | 2EAh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS9    | 00h |
| pwm_bri235 | 2EBh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS9  | 00h |
| pwm_bri236 | 2ECh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS10   | 00h |
| pwm_bri237 | 2EDh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS10 | 00h |
| pwm_bri238 | 2EEh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS11   | 00h |
| pwm_bri239 | 2EFh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS11 | 00h |
| pwm_bri240 | 2F0h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS12   | 00h |
| pwm_bri241 | 2F1h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS12 | 00h |
| pwm_bri242 | 2F2h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS13   | 00h |
| pwm_bri243 | 2F3h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS13 | 00h |
| pwm_bri244 | 2F4h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS14   | 00h |
| pwm_bri245 | 2F5h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS14 | 00h |
| pwm_bri246 | 2F6h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS15   | 00h |
| pwm_bri247 | 2F7h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS15 | 00h |
| pwm_bri248 | 2F8h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS16   | 00h |
| pwm_bri249 | 2F9h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS16 | 00h |

|            |      |     |                                                  |     |
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| pwm_bri250 | 2FAh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L6-CS17   | 00h |
| pwm_bri251 | 2FBh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L6-CS17 | 00h |
| pwm_bri252 | 2FCh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS0    | 00h |
| pwm_bri253 | 2FDh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS0  | 00h |
| pwm_bri254 | 2FEh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS1    | 00h |
| pwm_bri255 | 2FFh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS1  | 00h |
| pwm_bri256 | 300h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS2    | 00h |
| pwm_bri257 | 301h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS2  | 00h |
| pwm_bri258 | 302h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS3    | 00h |
| pwm_bri259 | 303h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS3  | 00h |
| pwm_bri260 | 304h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS4    | 00h |
| pwm_bri261 | 305h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS4  | 00h |
| pwm_bri262 | 306h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS5    | 00h |
| pwm_bri263 | 307h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS5  | 00h |
| pwm_bri264 | 308h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS6    | 00h |
| pwm_bri265 | 309h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS6  | 00h |
| pwm_bri266 | 30Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS7    | 00h |
| pwm_bri267 | 30Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS7  | 00h |
| pwm_bri268 | 30Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS8    | 00h |
| pwm_bri269 | 30Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS8  | 00h |
| pwm_bri270 | 30Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS9    | 00h |
| pwm_bri271 | 30Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS9  | 00h |
| pwm_bri272 | 310h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS10   | 00h |
| pwm_bri273 | 311h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS10 | 00h |
| pwm_bri274 | 312h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS11   | 00h |
| pwm_bri275 | 313h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS11 | 00h |
| pwm_bri276 | 314h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS12   | 00h |
| pwm_bri277 | 315h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS12 | 00h |
| pwm_bri278 | 316h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS13   | 00h |
| pwm_bri279 | 317h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS13 | 00h |
| pwm_bri280 | 318h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS14   | 00h |
| pwm_bri281 | 319h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS14 | 00h |
| pwm_bri282 | 31Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS15   | 00h |
| pwm_bri283 | 31Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS15 | 00h |
| pwm_bri284 | 31Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS16   | 00h |
| pwm_bri285 | 31Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS16 | 00h |
| pwm_bri286 | 31Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L7-CS17   | 00h |
| pwm_bri287 | 31Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L7-CS17 | 00h |
| pwm_bri288 | 320h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS0    | 00h |
| pwm_bri289 | 321h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS0  | 00h |
| pwm_bri290 | 322h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS1    | 00h |
| pwm_bri291 | 323h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS1  | 00h |
| pwm_bri292 | 324h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS2    | 00h |
| pwm_bri293 | 325h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS2  | 00h |
| pwm_bri294 | 326h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS3    | 00h |
| pwm_bri295 | 327h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS3  | 00h |
| pwm_bri296 | 328h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS4    | 00h |

|            |      |     |                                                  |     |
|------------|------|-----|--------------------------------------------------|-----|
| pwm_bri297 | 329h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS4  | 00h |
| pwm_bri298 | 32Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS5    | 00h |
| pwm_bri299 | 32Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS5  | 00h |
| pwm_bri300 | 32Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS6    | 00h |
| pwm_bri301 | 32Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS6  | 00h |
| pwm_bri302 | 32Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS7    | 00h |
| pwm_bri303 | 32Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS7  | 00h |
| pwm_bri304 | 330h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS8    | 00h |
| pwm_bri305 | 331h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS8  | 00h |
| pwm_bri306 | 332h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS9    | 00h |
| pwm_bri307 | 333h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS9  | 00h |
| pwm_bri308 | 334h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS10   | 00h |
| pwm_bri309 | 335h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS10 | 00h |
| pwm_bri310 | 336h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS11   | 00h |
| pwm_bri311 | 337h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS11 | 00h |
| pwm_bri312 | 338h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS12   | 00h |
| pwm_bri313 | 339h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS12 | 00h |
| pwm_bri314 | 33Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS13   | 00h |
| pwm_bri315 | 33Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS13 | 00h |
| pwm_bri316 | 33Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS14   | 00h |
| pwm_bri317 | 33Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS14 | 00h |
| pwm_bri318 | 33Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS15   | 00h |
| pwm_bri319 | 33Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS15 | 00h |
| pwm_bri320 | 340h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS16   | 00h |
| pwm_bri321 | 341h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS16 | 00h |
| pwm_bri322 | 342h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L8-CS17   | 00h |
| pwm_bri323 | 343h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L8-CS17 | 00h |
| pwm_bri324 | 344h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS0    | 00h |
| pwm_bri325 | 345h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS0  | 00h |
| pwm_bri326 | 346h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS1    | 00h |
| pwm_bri327 | 347h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS1  | 00h |
| pwm_bri328 | 348h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS2    | 00h |
| pwm_bri329 | 349h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS2  | 00h |
| pwm_bri330 | 34Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS3    | 00h |
| pwm_bri331 | 34Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS3  | 00h |
| pwm_bri332 | 34Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS4    | 00h |
| pwm_bri333 | 34Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS4  | 00h |
| pwm_bri334 | 34Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS5    | 00h |
| pwm_bri335 | 34Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS5  | 00h |
| pwm_bri336 | 350h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS6    | 00h |
| pwm_bri337 | 351h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS6  | 00h |
| pwm_bri338 | 352h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS7    | 00h |
| pwm_bri339 | 353h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS7  | 00h |
| pwm_bri340 | 354h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS8    | 00h |
| pwm_bri341 | 355h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS8  | 00h |
| pwm_bri342 | 356h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS9    | 00h |
| pwm_bri343 | 357h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS9  | 00h |

|            |      |     |                                                   |     |
|------------|------|-----|---------------------------------------------------|-----|
| pwm_bri344 | 358h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS10    | 00h |
| pwm_bri345 | 359h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS10  | 00h |
| pwm_bri346 | 35Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS11    | 00h |
| pwm_bri347 | 35Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS11  | 00h |
| pwm_bri348 | 35Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS12    | 00h |
| pwm_bri349 | 35Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS12  | 00h |
| pwm_bri350 | 35Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS13    | 00h |
| pwm_bri351 | 35Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS13  | 00h |
| pwm_bri352 | 360h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS14    | 00h |
| pwm_bri353 | 361h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS14  | 00h |
| pwm_bri354 | 362h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS15    | 00h |
| pwm_bri355 | 363h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS15  | 00h |
| pwm_bri356 | 364h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS16    | 00h |
| pwm_bri357 | 365h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS16  | 00h |
| pwm_bri358 | 366h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L9-CS17    | 00h |
| pwm_bri359 | 367h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L9-CS17  | 00h |
| pwm_bri360 | 368h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS0    | 00h |
| pwm_bri361 | 369h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS0  | 00h |
| pwm_bri362 | 36Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS1    | 00h |
| pwm_bri363 | 36Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS1  | 00h |
| pwm_bri364 | 36Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS2    | 00h |
| pwm_bri365 | 36Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS2  | 00h |
| pwm_bri366 | 36Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS3    | 00h |
| pwm_bri367 | 36Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS3  | 00h |
| pwm_bri368 | 370h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS4    | 00h |
| pwm_bri369 | 371h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS4  | 00h |
| pwm_bri370 | 372h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS5    | 00h |
| pwm_bri371 | 373h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS5  | 00h |
| pwm_bri372 | 374h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS6    | 00h |
| pwm_bri373 | 375h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS6  | 00h |
| pwm_bri374 | 376h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS7    | 00h |
| pwm_bri375 | 377h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS7  | 00h |
| pwm_bri376 | 378h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS8    | 00h |
| pwm_bri377 | 379h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS8  | 00h |
| pwm_bri378 | 37Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS9    | 00h |
| pwm_bri379 | 37Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS9  | 00h |
| pwm_bri380 | 37Ch | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS10   | 00h |
| pwm_bri381 | 37Dh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS10 | 00h |
| pwm_bri382 | 37Eh | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS11   | 00h |
| pwm_bri383 | 37Fh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS11 | 00h |
| pwm_bri384 | 380h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS12   | 00h |
| pwm_bri385 | 381h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS12 | 00h |
| pwm_bri386 | 382h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS13   | 00h |
| pwm_bri387 | 383h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS13 | 00h |
| pwm_bri388 | 384h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS14   | 00h |
| pwm_bri389 | 385h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS14 | 00h |
| pwm_bri390 | 386h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS15   | 00h |

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|                   |      |     |                                                   |     |
|-------------------|------|-----|---------------------------------------------------|-----|
| <b>pwm_bri391</b> | 387h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS15 | 00h |
| <b>pwm_bri392</b> | 388h | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS16   | 00h |
| <b>pwm_bri393</b> | 389h | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS16 | 00h |
| <b>pwm_bri394</b> | 38Ah | R/W | 16-bits PWM lower 8 bits [7:0] for Dot L10-CS17   | 00h |
| <b>pwm_bri395</b> | 38Bh | R/W | 16-bits PWM higher 8 bits [15:8] for Dot L10-CS17 | 00h |

ADVANCE INFORMATION



**Table 9-1. Design Parameters (continued)**

| PARAMETER                                   | VALUE               |
|---------------------------------------------|---------------------|
| LED maximum peak current (red, green, blue) | 44 mA, 33 mA, 22 mA |

### 9.2.3 Detailed Design Procedure

LP5860 requires an external capacitor  $C_{V_{CAP}}$ , whose value is 1  $\mu$ F connected from  $V_{CAP}$  to GND for proper operation of internal LDO. It should be placed as close to the device as possible.

1- $\mu$ F capacitors are recommended to be placed between  $V_{CC}$  /  $V_{LED}$  with GND, and 1 nF capacitor placed between  $V_{IO}$  with GND. Place the capacitors as close to the device as possible.

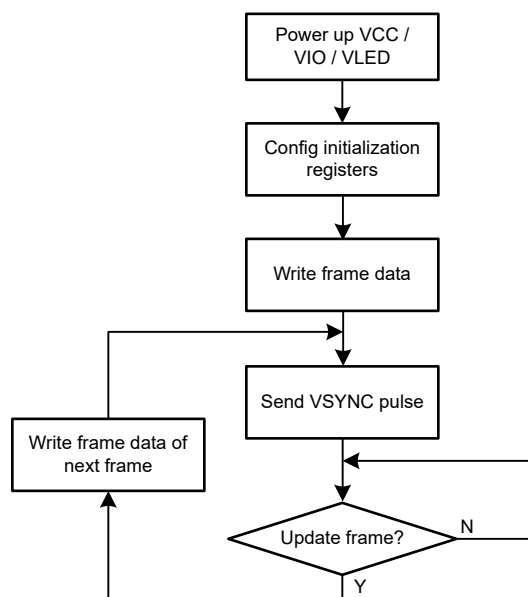
Pull-up resistors  $R_{pull-up}$  are requirement for SCL and SDA when using I<sup>2</sup>C as communication method. In typical applications, 1.8-k $\Omega$  to 4.7-k $\Omega$  resistors are recommended.

To decrease thermal dissipation from device to ambient, resistors  $R_{CS}$  could optionally be placed in serial with the LED. Voltage drop on these resistors should left enough margins for  $V_{SAT}$  to ensure the device work normally.

### 9.2.4 Program Procedure

When selecting data refresh Mode 1, outputs are refreshed instantly once data is received.

When selecting data refresh Mode 2/3, VSYNC signal is required for synchronized display. Programming flow is showed as Figure 9-2. To display full pixel of last frame, VSYNC pulse should be sent to the device after the end of last PWM. Time between two pulses  $t_{VSYNC}$  should be larger than the whole PWM time of all Dots  $t_{frame}$ . Common selection like 60 Hz, 90 Hz, 120 Hz or even higher refresh frequency could be supported. High pulse width longer than  $t_{VSYNC\_H}$  is required at the beginning of each VSYNC frame, and data should not be write to PWM registers during high pulse width.



**Figure 9-2. Program Procedure**

## 10 Power Supply Recommendations

### VDD Input Supply Recommendations

LP5860 is designed to operate from a 2.7-V to 5.5-V VDD voltage supply. This input supply must be well regulated and be able to provide the peak current required by the LED matrix. The resistance of the VDD supply rail must be low enough such that the input current transient does not cause the LP5860 VDD supply voltage to drop below the maximum POR voltage.

### VLED Input Supply Recommendations

LP5860 is designed to operate with a 2.7-V to 5.5-V VLED voltage supply. The VLED supply must be well regulated and able to provide the peak current required by the LED configuration without voltage drop, under load transients like start-up or rapid brightness change. The resistance of the input supply rail must be low enough so that the input current transient does not cause the VLED supply voltage to drop below LED  $V_f + V_{SAT}$  voltage.

### VIO Input Supply Recommendations

LP5860 is designed to operate with a 1.65-V to 5.5-V VIO\_EN voltage supply. The VIO\_EN supply must be well regulated and able to provide the peak current required by the LED configuration without voltage drop under load transients like start-up or rapid brightness change.

## 11 Layout

### 11.1 Layout Guidelines

Below guidelines for layout design could help to get a better onboard performance.

- The decoupling capacitors  $C_{VCC}$  and  $C_{VLED}$  for power supply need to be close to the chip to have minimized the impact of high-frequency noise and ripple from power.  $C_{VCAP}$  for internal LDO need to be put as close to chip as possible. GND plane connections to  $C_{VLED}$  and GND pins must be on TOP layer copper with multiple vias connecting to system ground plane.  $C_{VIO}$  for internal enable block also needs to be put as close to chip as possible.
- The exposed thermal pad should be well soldered to the board, which could have better mechanical reliability. It can optimize heat transfer so that increasing thermal performance. AGND pin should be connected to thermal pad and system ground.
- The major heat flow path from the package to the ambient is through copper on the PCB. Several methods could help thermal performance. Below exposed thermal pad of IC, putting much vias through the PCB to other ground layer can dissipate more heat. Maximizing the copper coverage on the PCB can increase the thermal conductivity of the board.
- Low inductive and resistive path of switch load loop could help to provide a high slew rate. Therefore, path of VLED – SWx must be short and wide and avoid parallel wiring and narrow trace. Transient current in SWx pins is much larger than CSy pins, so that trace for SWx should be wider than CSy.

### 11.2 Layout Example

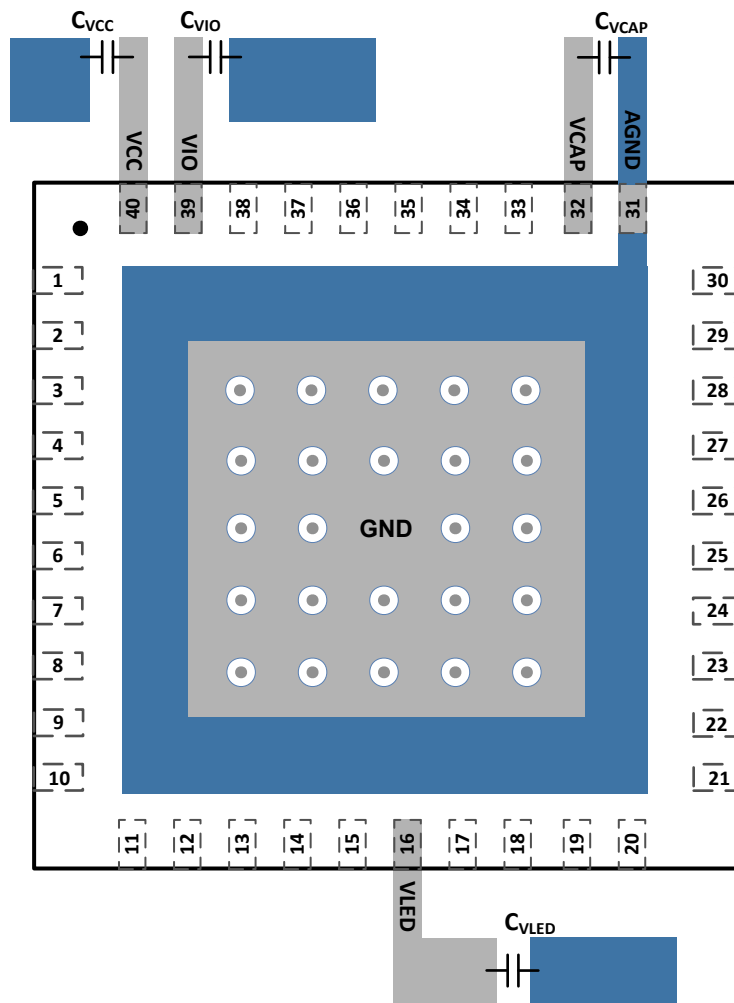


Figure 11-1. LP5860 Layout Example

## 12 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 12.1 Documentation Support

### 12.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 12.3 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 12.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 12.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

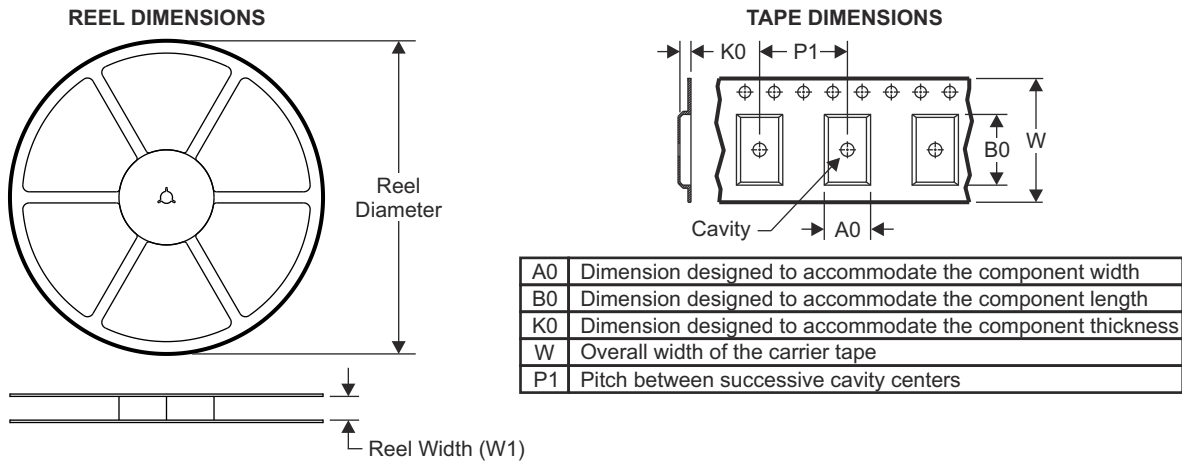
### 12.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

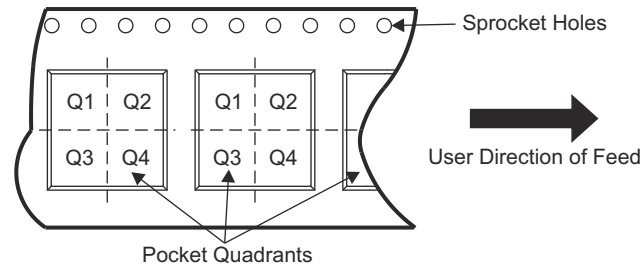
## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## 13.1 Tape and Reel Information

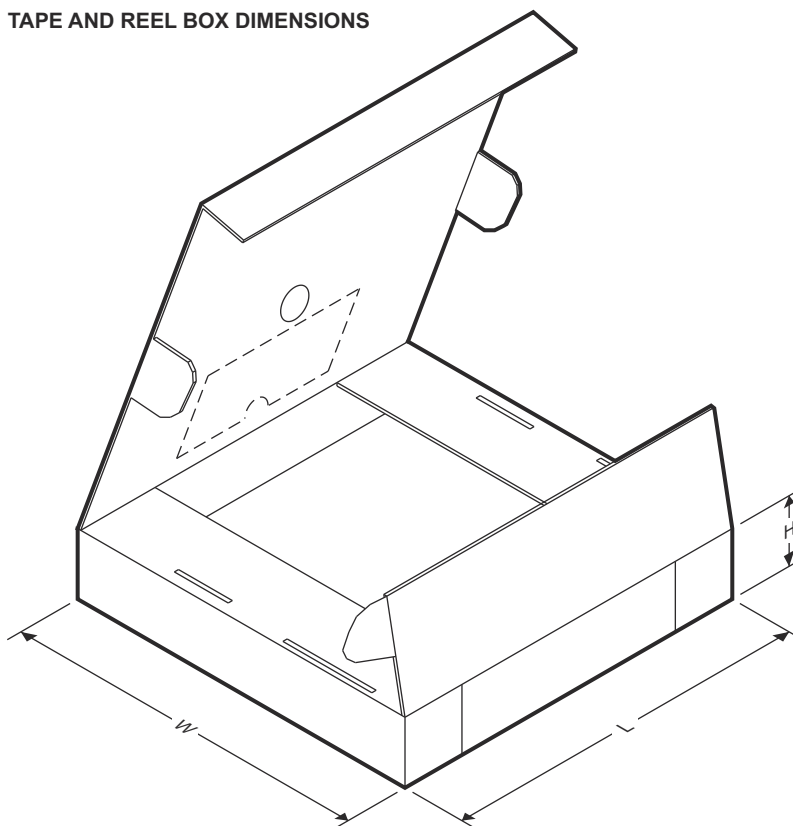


### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



| Device     | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LP5860RKPR | VQFN-40      | RKP             | 40   | 3000 | 330.0              | 12.4               | 5.3     | 5.3     | 1.5     | 8.0     | 12.0   | Q2            |

## TAPE AND REEL BOX DIMENSIONS



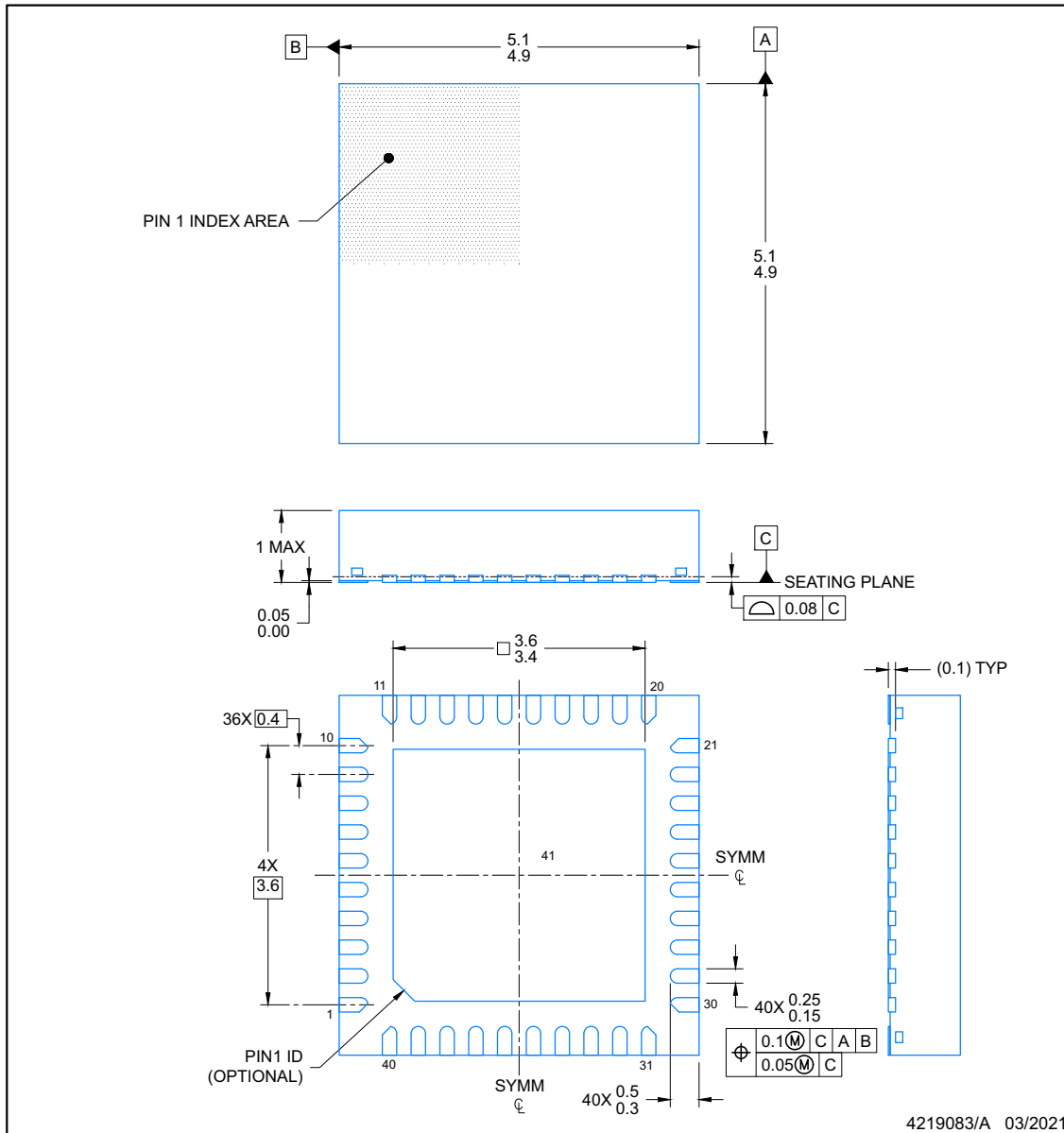
| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LP5860RKPR | VQFN         | RKP             | 40   | 3000 | 367.0       | 367.0      | 35.0        |

## RKP0040B

## PACKAGE OUTLINE

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK- NO LEAD



### NOTES:

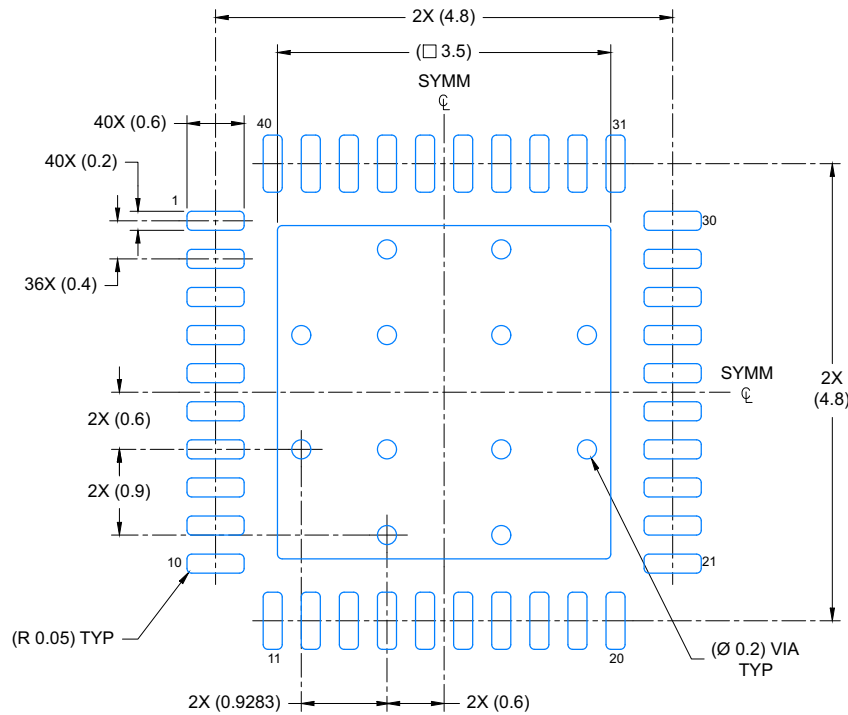
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.

## EXAMPLE BOARD LAYOUT

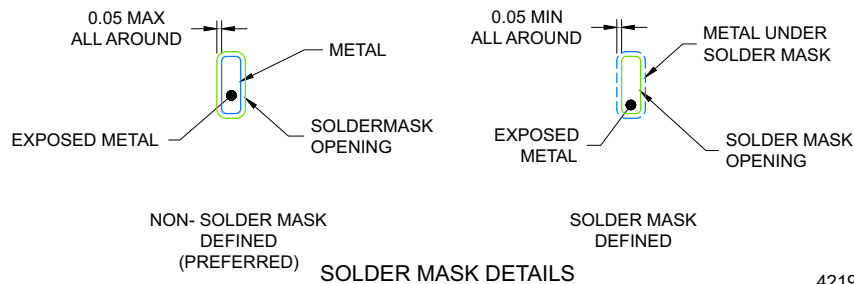
**RKP0040B**

**VQFN - 1 mm max height**

PLASTIC QUAD FLATPACK- NO LEAD



**LAND PATTERN EXAMPLE**  
EXPOSED METAL SHOWN  
SCALE: 15X



4219083/A 03/2021

NOTES: (continued)

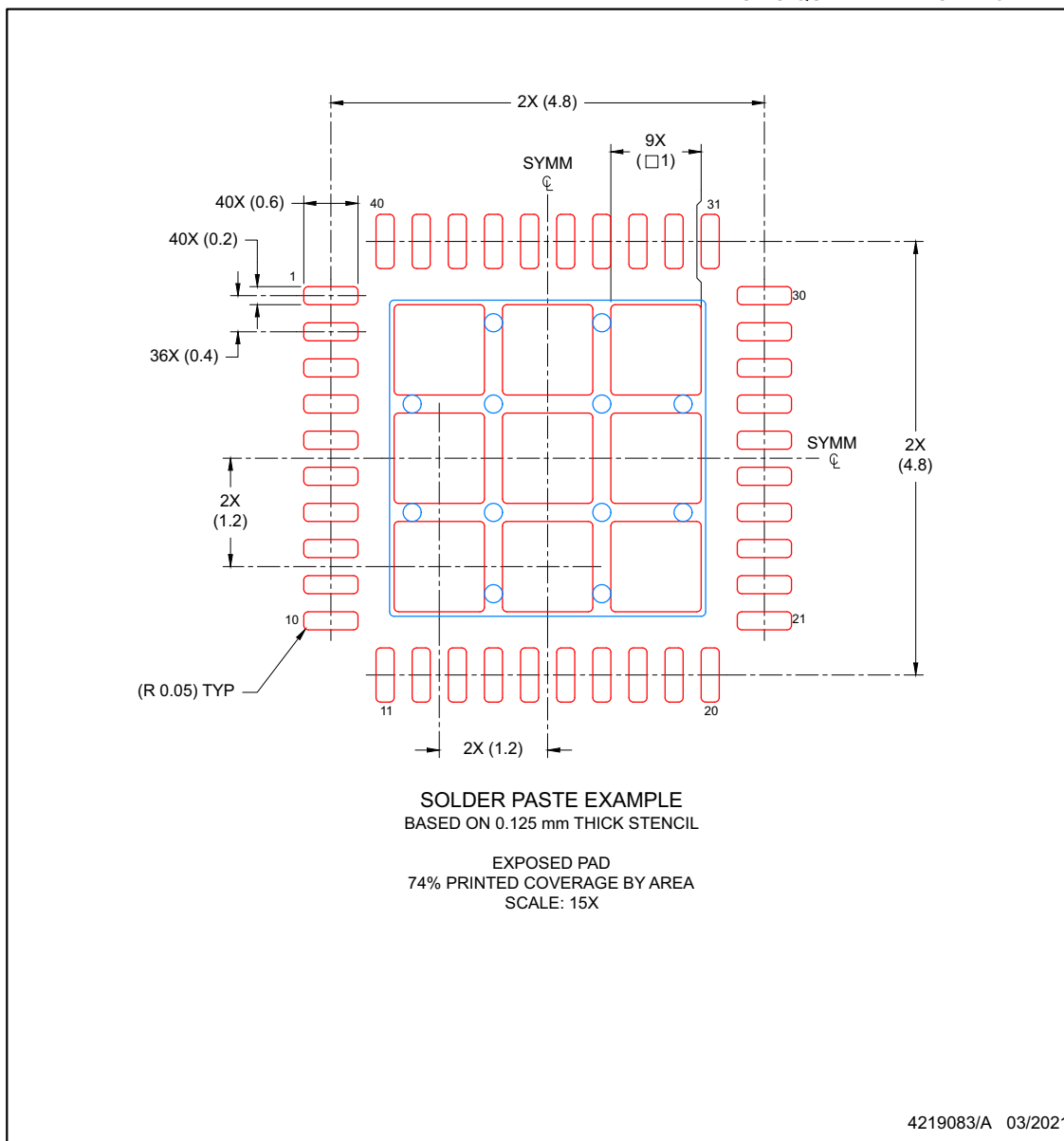
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
- Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

## EXAMPLE STENCIL DESIGN

**RKP0040B**

**VQFN - 1 mm max height**

PLASTIC QUAD FLATPACK- NO LEAD



NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)         | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-------------------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| PLP5860RKPR      | ACTIVE        | VQFN         | RKP                | 40   | 3000           | Non-RoHS &<br>Non-Green | Call TI                              | Call TI              | -40 to 85    |                         | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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