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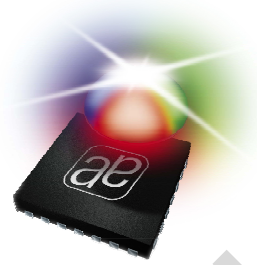
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# AS3685C

## Ultra Small High Efficiency 1000mA Charge Pump for White LED Flash with Two Wire Serial Interface

## 1    General Description

The AS3685 is low noise high efficiency capacitive charge pump with 1:1, 1:1.5 and 1:2 operating modes in a small 3x3mm DFN10 or a tiny 2x1.5mm WL-CSP (Wafer Level Chip Scale Package) package. It can drive one flash led at up to 1000mA current. It supports flash/torch and indicator mode for the flash led.

Additionally the AS3685 limits the flash time automatically to protect the flash LED.

## 2    Key Features

- High Efficiency capactive charge pump with 1:1, 1:1.5 and 1:2 modes
  - 1:2 Mode can be disabled by interface

- Up to 1000mA Led Current

- Automatic Charge Pump Mode switching (Up)

- LED cathode disconnect in Shutdown

- Overtemperature Protection

- Automatic Flash Timeout to protect the LED
  - Adjustable between off, 100ms…1500ms

- Two Wire Interface
  - Accurate Control of Currents and Modes

- Package
  - DFN10 3x3mm (10 pins + exposed pad)
  - WL-CSP (Wafer Level Chip Scale Package) 3x4 balls 0.5mm pitch (2x1.5mm)

## 3    Applications

- Flash / Torch for Mobile Phones, Digital Cameras and PDA

## 4    Application Diagram
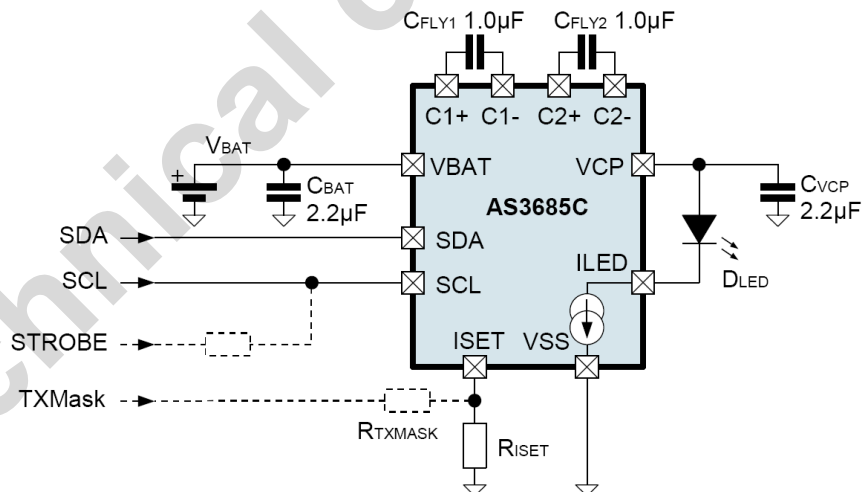
Figure 1 – Application Diagram of AS3685C

# Table of Contents

# 5  Characteristics

## 5.1  Absolute Maximum Ratings

Stresses beyond those listed in Table 1 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in Section 5 Electrical Characteristics is not implied.

Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

*Table* 1 – Absolute Maximum Ratings

| Symbol | Parameter | Min | Max | Unit | Note |
|--------|-----------|-----|-----|------|------|
| $V_{BATMAX}$ | Maximum Supply Voltage | -0.3 | 7.0 | V | |
| $I_{IN}$ | Input Pin Current without causing latchup | -25 | +25 | mA | At 25ºC, Norm: Jedec 17 |
| $T_{STRG}$ | Storage Temperature Range | -55 | 125 | °C | |
| | Humidity | 5 | 85 | % | Non condensing |
| $V_{ESD}$ | Electrostatic Discharge | -1000 | 1000 | V | Norm: MIL 883 E Method 3015 |
| PT | Total Continuous Power Dissipation | | 1.14 | W | DFN10 3x3mm, $T_A$ = 70°C [1] |
| | | | 1.02 | W | WL-CSP 2x1.5mm, $T_A$ = 70°C [1] |
| $P_{DERATE}$ | PT Derating Factor [2] | | 16.3 | mW/°C | DFN10 3x3mm |
| | | | 14.7 | mW/°C | WL-CSP 2x1.5mm |
| $T_{JUNC}$ | Junction Temperature | | 150 | °C | |
| $T_{BODY}$ | Body Temperature during Soldering | | 260 | °C | according to IPC/JEDEC J-STD-020 |

**Notes:**

1. Depending on actual PCB layout and PCB used;  for peak power dissipation during flashing see document 'AS3685 Thermal Measurements'
   For 1A flash current see application notes 'AN3685_1Aflash' and 'AN3685_1Aflash_thermal_1v0'.
2. The PT derating factor changes the total continuous power dissipation, if the ambient temperature is different to 70°C.  Therefore for e.g. 85°C calculate $PT_{85°C} = PT – P_{DERATE} * (85°C – 70 °C)$

## 5.2  Operating Conditions

*Table* 2 – Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
| VBAT | Battery Supply Voltage | 3.0 | 3.6 | 5.5 | V | Supply voltage range |
| VBATFUNC | Battery Supply Voltage, Functionally working | 2.6 | | | V | AS3685 functionally working, but not all parameters fulfilled |
| $I_{BAT}$ | Operating Current | | | 0.4 | A | Depending on load current and charge pump mode |
| | | | | 2.0 | A | Limited lifetime, max 20,000s |
| $T_{AMB}$ | Ambient Temperature | -30 | 25 | 85 | °C | |
| $I_{OFF}$ | Off mode current | | 1.0 | 4.0 | μA | Mode setting=off; VBAT<=4.2V |

*Table* 2 – Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
| I$_{OPERATING}$ | Power Consumption without load | | 0.85 | | mA | 1:1 Mode |
| | | | 6.6 | | mA | 1:1.5 Mode |
| | | | 8.1 | | mA | 1:2 Mode |

# 5.3 Electrical Characteristics

*Table* 3 – Charge Pump Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
| V$_{CPOUT}$ | V(VCP) Output voltage without load – do not short to VSS | | | VBAT * CP-mode | V | CP-mode is 1, 1.5 or 2 (automatically selected) |
| | Output limitation | | 5.4 | 5.6 | | internally limited |
| R$_{CP}$ | Charge Pump effective Resistance | | 0.28 | 0.53 | Ω | 1:1 Mode V$_{BAT}$ = 3.6V, I$_{CPOUT}$ = 200mA |
| | | | 1.37 | 2.00 | Ω | 1:1.5 Mode V$_{BAT}$ = 3.3V, I$_{CPOUT}$ = 500mA, T$_{JUNCTION}$<=85°C |
| | | | 1.95 | 2.44 | Ω | 1:2 Mode V$_{BAT}$ = 3.0V, I$_{CPOUT}$=700mA, T$_{JUNCTION}$<=85°C |
| Eta | Efficiency | 75 | | 93 | % | Vin=3.0V-4.5V, Iout=100mA (Charge Pump alone) |
| V$_{RIPPLE}$ | Output ripple voltage | | 100 | | mVpp | Vin=3.0-4.5V, Iout=350mA, |
| fclk | Operating Frequency | -20% | 1.0 | +20% | MHz | |
| t$_{UP\_DEB\_LONG}$ | Initial Mode Switching Debounce Time | | 256 | | µs | Mode switching up-debounce time after enabling of the charge pump or after mode switching between 1:1 to 1:1.5 |
| t$_{UP\_DEB}$ | Mode Switching Debounce Time | | 16 | | µs | Mode switching up-debounce time in normal operation |

*Table* 4 – Current Source (Sink) Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
| I$_{LED}$ | Output Current Range | | 700 | 1000 | mA | 700mA: R$_{ISET}$ = 14.2kΩ 1000mA: R$_{ISET}$ = 10kΩ |
| I$_{ACCURACY}$ | Current Setting Accuracy | -10% | 500 | +10% | mA | Measured with R$_{ISET}$ = 19.9kΩ and maximum flash current |
| I$_{INDICATOR}$ | Indicator Current setting | | 1.0 | | mA | |
| V$_{ISET}$ | Current Generator Set Point Voltage (pin ISET) | | 1.3 | | V | I$_{ISET}$ = V$_{ISET}$ / R$_{ISET}$ if the resulting bias current is higher than 200µA (typ.), the current source is disabled |
| I$_{ISET}$ | Current Generator operating range | 10.0 | | 130 | µA | |
| I$_{FLASH2ISET}$ | Flash Current to Bias Current Ratio | | 7650 | | A/A | At full flash current (700mA with R$_{ISET}$ = 14.2kΩ) |
| V$_{SWITCH}$ | Mode Switching Threshold on V(ILED) between 1:1 -> 1:1.5 and 1:1.5 -> 1:2 | 350 | 400 | 450 | mV | Data1<7:0>(flash LED current) >= 0x80h in flash mode; I$_{LED}$>350mA @ R$_{ISET}$=14.2kΩ |

*Table* 4 – Current Source (Sink) Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
|  |  | 150 | 200 | 250 | mV | All lower currents |

*Table* 5 –Digital Interface characteristics

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
| $V_{IH}$ | High Level Input voltage | 1.5 |  | VBAT | V | For Pins SCL and SDA |
| $V_{IL}$ | Low Level Input voltage | 0.0 |  | 0.5 | V |  |
| $I_{LEAKAGE}$ | Input pin leakage current | -10 |  | 10 | μA |  |

*Table* 6 – Protection Functions

| Symbol | Parameter | Min | Typ | Max | Unit | Note |
|--------|-----------|-----|-----|-----|------|------|
| $T_{OVTEMP}$ | Overtemperature protection |  | 140 |  | °C | If the junction temperature exceeds $T_{OVTEMP}$, the current sink will be disabled and the charge pump switched back into 1:1 mode until the temperature drops below $T_{OVTEMP}$ - $T_{OVTEMPHYST}$ |
| $T_{OVTEMPHYST}$ | Overtemperature protection Hysteresis |  | 5 |  | °C |  |
| $t_{FLASHTIMEOUT}$ | Flash Timeout Time | -20% | 100…1500 | +20% | ms | adjustable by register Flash Timeout Timer |

# 6 Typical Operation Characteristics

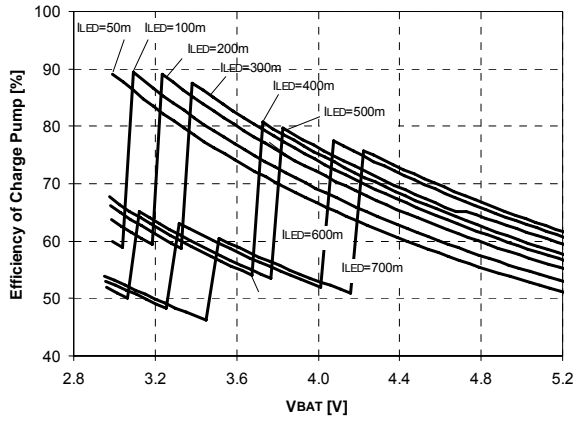*Figure* 2 – Efficiency vs. Battery Voltage (with Lumiled PWF1)



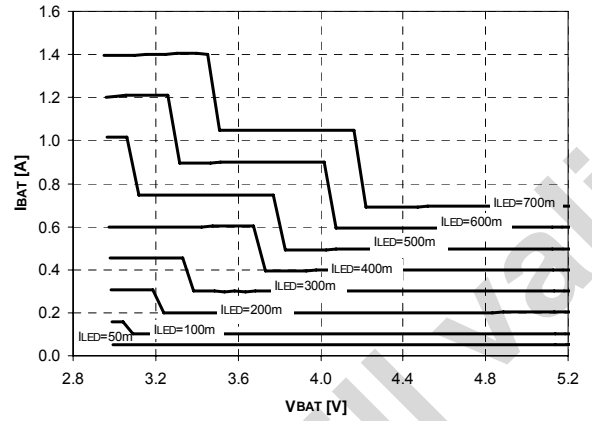*Figure* 3 – Battery Current vs. Battery Voltage (with Lumiled PWF1)



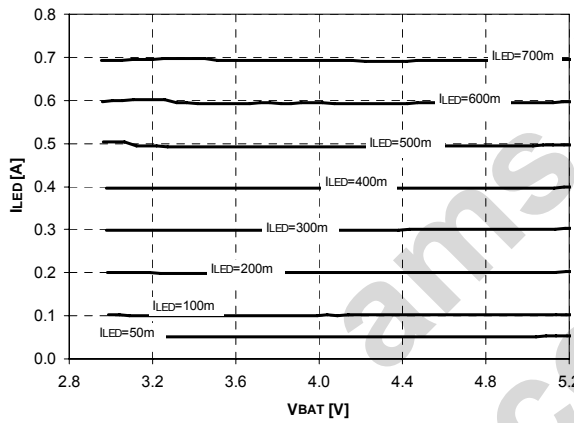*Figure* 4 – LED current I(ILED) vs. Battery Voltage (with Lumiled PWF1)
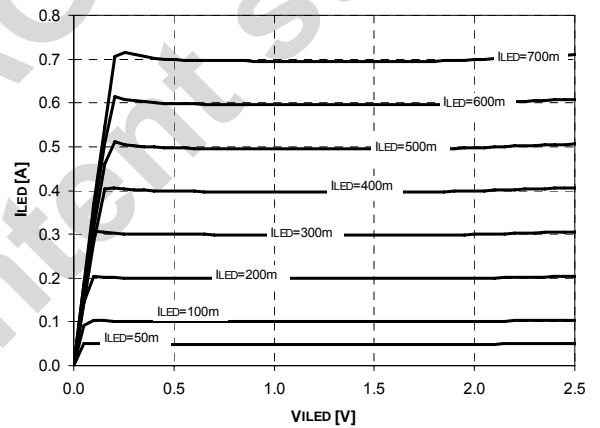


*Figure* 5 – Linearty of Current Sink



*Figure* 6 –I(ILED) vs. R(ISET)
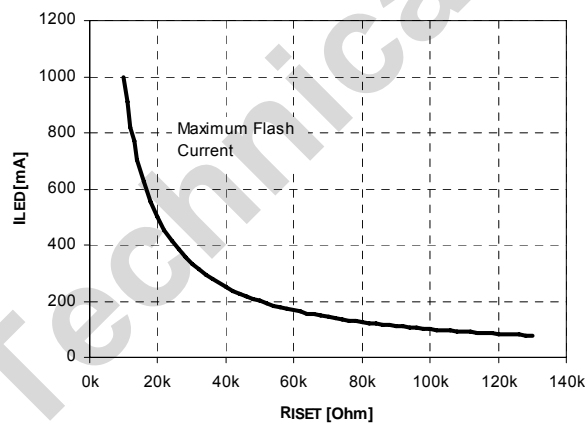


*Figure* 7 – Typical Operating Waveforms 1:1.5 Mode



VCP ac-coupled, 100mV/div  1µs/div
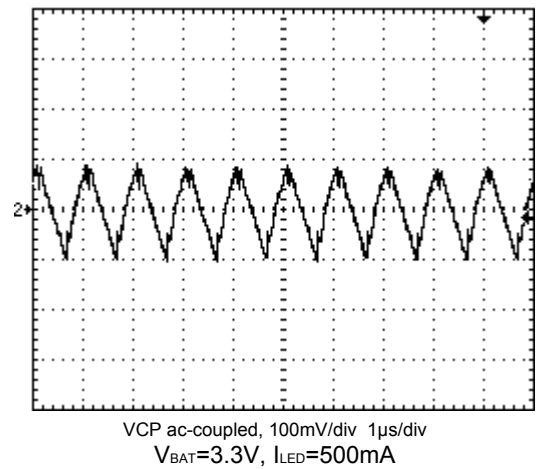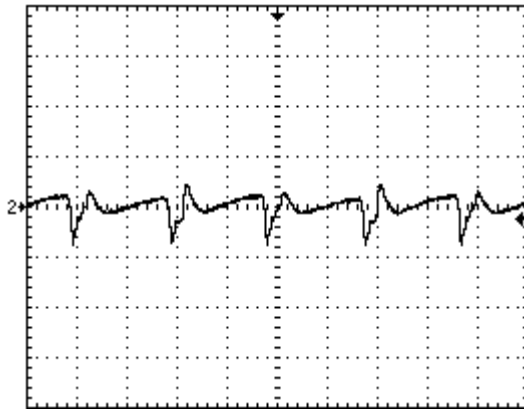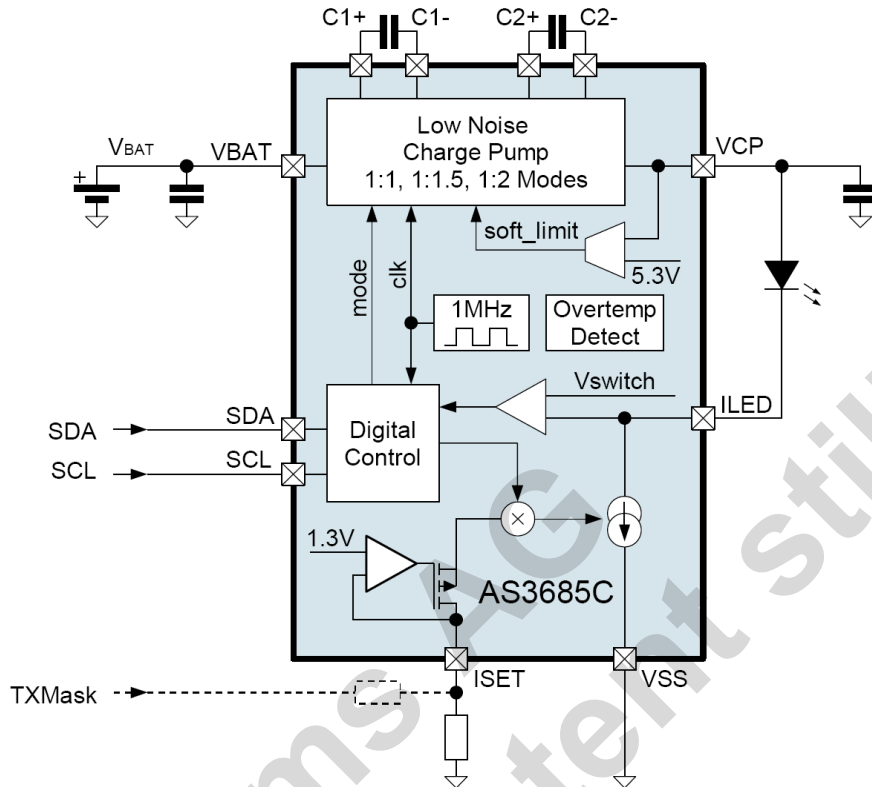$V_{BAT}$=3.3V, $I_{LED}$=500mA

Figure 8 – Typical Operating Waveforms 1:2 Mode



VCP ac-coupled, 50mV/div  250ns/div
$V_{BAT}$=3.3V, $I_{LED}$=500mA

# 7   Detailed Functional Description

Figure 9 – Internal Circuit Diagram of AS3685C



## 7.1  Low Noise Charge Pump

The AS3685 charge pump uses two external flying capacitors to generate output voltages higher than the battery voltage. The charge pump can operate in three different modes:

- 1:1 Bypass Mode or Off Mode
    - Battery input and output are connected by a low-impedance switch
    - Battery current = output current
- 1:1.5 Mode
    - The output voltage is 1.5 times the battery voltage (without load)
    - Battery current = 1.5 times output current
- 1:2 Mode
    - The output voltage is 2 times the battery voltage (without load)
    - Battery current = 2 times output current

The flying capacitors are switched at the fixed frequency fclk.

### 7.1.1  Mode Switching

The AS3685 monitors the voltage at the current sink V(ILED) and if this voltage falls below $V_{SWITCH}$, for a time longer than the debounce time, the charge pump automatically switches into a higher mode.  The debounce time is set to $t_{UP\_DEB\_LONG}$ at enabling of the charge pump or immediately after a 1:1 to 1:1.5 mode change. Afterwards the debounce time is reduced to $t_{UP\_DEB}$.  (This allows the LED current to settle properly on startup or after a mode change)
The charge pump enters always 1:1 mode in off mode or in case of overtemperature.
It is possible to avoid the 1:2 mode (register programmable) to limit the battery current to 1.5 times the output (=LED) current.

### 7.1.2 Soft Start

The soft start mechanism reduces the inrush current. Battery current is smoothed when switching the charge pump on and also at each switching condition. This precaution reduces electromagnetic radiation significantly.

## 7.2 Current Source (Sink)

The AS3685 operates in three different modes:
- Indicator Mode: A small (average) current is used to obtain an indication function with the flash LED (e.g. indication for camera operation)
- Torch Mode: A moderate current of e.g. 150mA allows the use of the flash LED as a torch or video light
- Flash Mode: A high current of e.g. 700mA (up to 1000mA) is set for a high brightness flash. Only in this mode, the flash timeout timer limits the total flash time.

The current through the LED and the operating mode is controlled by the two digital interface connected to SCL and SDA.

The current is controlled with a two wire bus interface commands similar to I2C communication (device address 82h, only commands writing to the AS3685 are possible, no readback) as shown in following figure:

*Figure* 10 – Two wire interface waveform
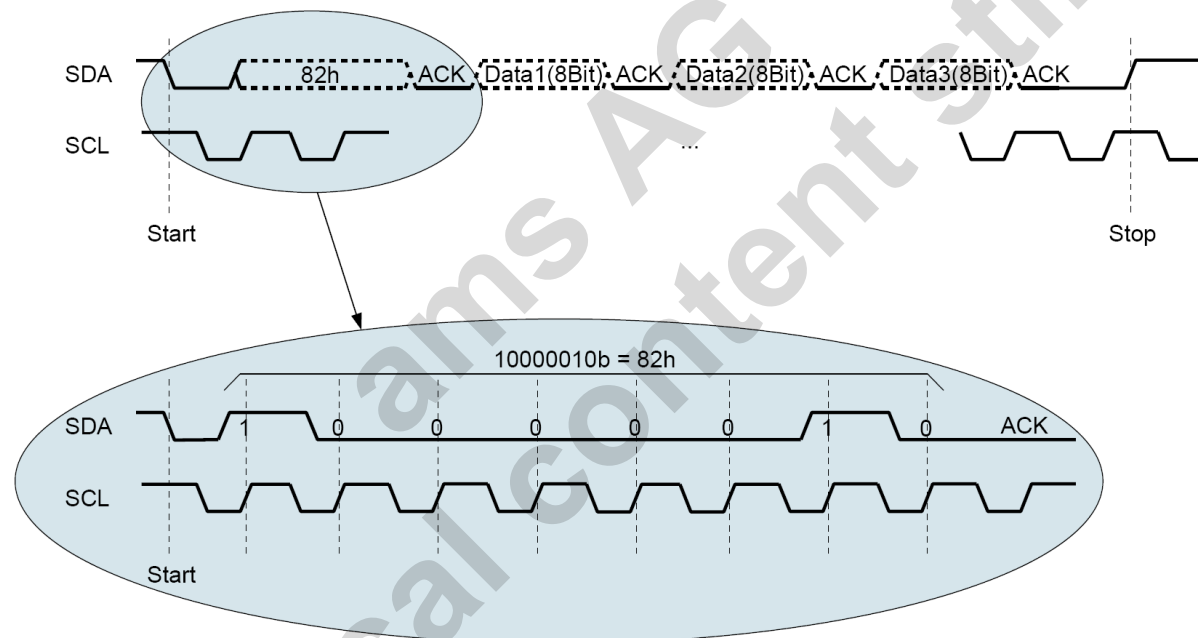


Data from the bus is always captured on the rising edge of the SCL signal; therefore the data on SDA has to be stable slightly before this rising edge.

The strobe command is merged with the interface commands and all other devices connected to the bus will ignore these commands. Only the AS3685 will also use these commands and switch on/off the flash led with the strobe pin (The strobe function can be enabled/disabled by the interface and its polarity is selectable):

Figure 11 – External circuit of the AS3685 using active High strobe function
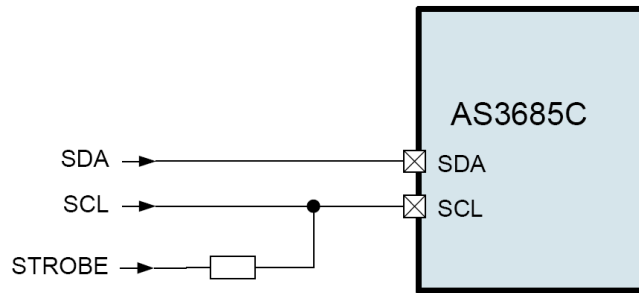


Using the above external circuit, an active strobe function can be implemented as follows:

Figure 12 – Timing Diagram of the AS3685 using active High strobe function
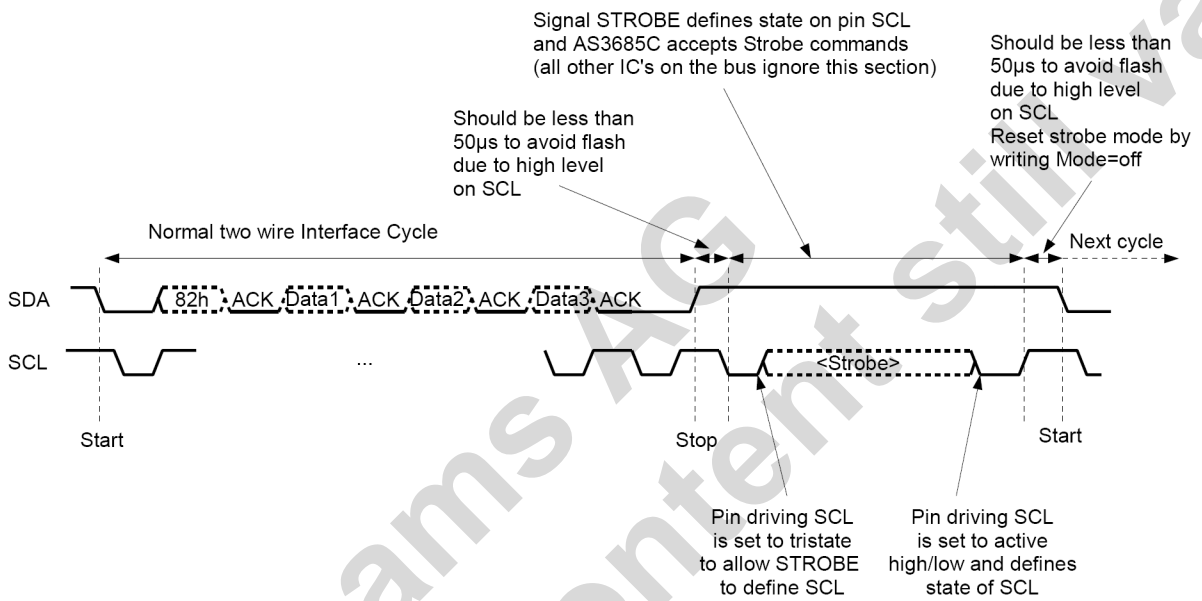


Alternatively (if the device driving SCL has only the possibility to pulldown the SCL line, but does not actively control high/low/tristate of the SCL line) use following circuit:

Figure 13 – External circuit of the AS3685 using active Low strobe function
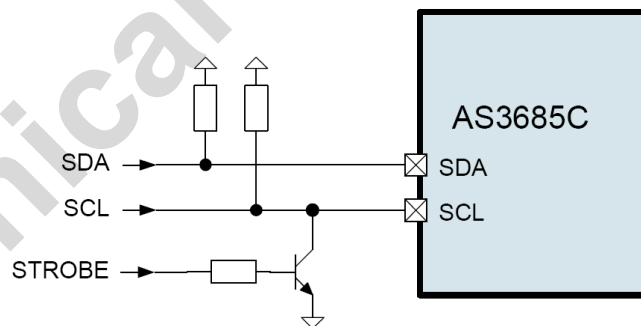
The control waveform is shown in the next figure:

*Figure* 14 – Timing Diagram of the AS3685 using active Low strobe function
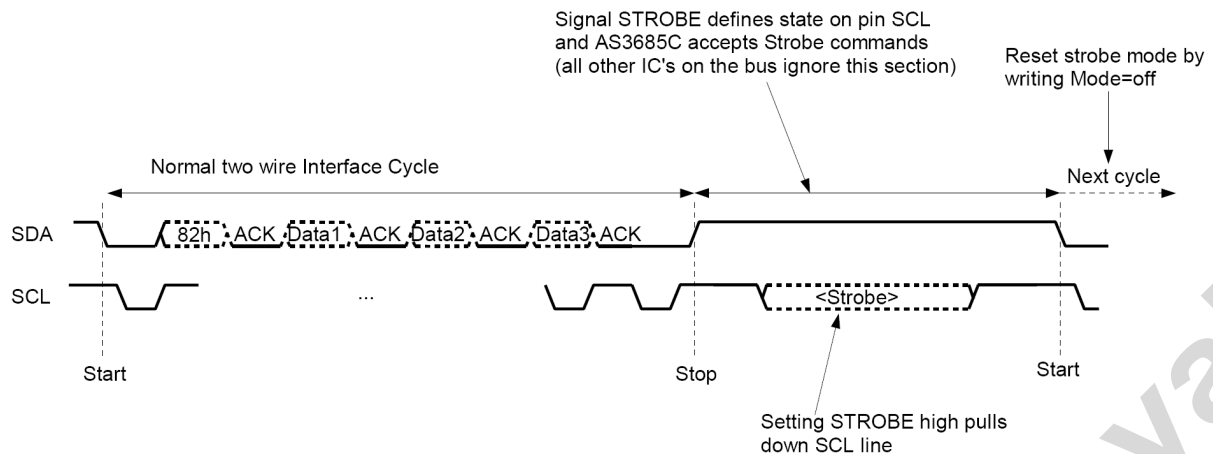


If the strobe function is not used at all, the interface can be addressed like a normal slave (only writing access). The strobe function does not violate the two wire interface specification.

Data1 setups the flash current from 0mA to 1000mA, Data2 can be used to set the preview current and Data3 will set the operating mode, can lock 1:2 charge pump mode and set or disable the flash mode timeout time.

Table 7 – Current and Mode Setting for the AS3685

| Register | Purpose | Comments |
|---|---|---|
| Data1<7:0> | Current Setting Flash | Flash Mode current setting, Flash Timeout timer used if the mode setting uses this current<br><br>0mA to 1000mA  (for $R_{ISET}$=10kΩ)<br>0mA to 700mA    (for $R_{ISET}$=14.2kΩ) |
| Data2<6:0> | Current Setting Torch (Preview) | Torch (=Preview or Assist) Mode current setting, no timeout timer used for this current setting<br><br>0mA to 500mA     (for $R_{ISET}$=10kΩ)<br>0mA to 350mA     (for $R_{ISET}$=14.2kΩ) |
| Data2<7> | not used – leave at 0 | not used |
| Data3<2:0> | Mode setting | 000 … Off (Power down; Charge Pump in 1:1 mode)<br>001 … Indicator Mode<br>     Data2<7> = 0: ILED = 0.5mA<br>     Data2<7> = 1: ILED = 1.0mA<br>010 … Torch (=Preview) Mode (Data2 sets current)<br>011 … Flash Mode (Data1 sets current)<br>100 … Preview / Flash Mode, STROBE active high<br>     STROBE=H:  Flash mode (Data1 sets current)<br>     STROBE=L: Preview mode (Data2 sets current)<br>101 … Preview / Flash Mode, STROBE active low<br>     STROBE=L:  Flash mode (Data1 sets current)<br>     STROBE=H: Preview mode (Data2 sets current)<br>110 … Force Charge Pump into 1:1.5 mode; no current is flowing through the current sink (AS3685 can be used as voltage generator for e.g. backlight LEDs with additional external current source(s))<br>111 … Force Charge Pump into 1:2 mode; no current is flowing through the current sink (AS3685 can be used as voltage generator for e.g. backlight LEDs with additional external current source(s)) |

Table 7 – Current and Mode Setting for the AS3685

| Register | Purpose | Comments |
|---|---|---|
| Data3<3> | Avoid 1:2 Mode | 0 … Charge Pump can use 1:2 Mode<br>1 … Charge Pump does not use 1:2 Mode; ignored if Data3<2:0> is set to 111 (forced 1:2 mode) |
| Data3<7:4> | Flash Timeout Timer | 0000 … Disable Timeout timer for Flash Mode<br>0001 … 100ms Timeout timer for Flash Mode<br>0010 … 200ms Timeout timer for Flash Mode<br>…<br>1111 … 1500ms Timeout timer for Flash Mode |

## 7.2.1 AS3685 TXMask Function

If the battery has to supply two high currents at the same time (e.g. the AS3685 flash and a RF-power amplifier) it is possible, that the total current causes a high voltage drop on the battery resulting in a shutdown of the complete system. In order to avoid this shutdown, the AS3685 (AS3685A or AS3685B) can reduce its current with the signal 'TXMask' using the following circuit:

Figure 15 – TXMask function of the AS3685
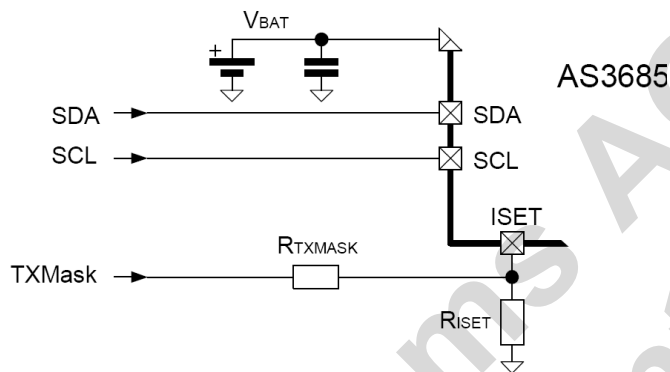


The TXMask signal is connected to e.g. the (RF-) power amplifier enable pin (active high if the PA is enabled). This reduces the flash current if the power amplifier is enabled and avoids the unexpected shutdown of the system.

**Note**: The internal flash timeout timer ($t_{FLASHTIMEOUT}$) to limit the total flash duration, is not affected by the TXMask function (see also section 'Flash Timeout').

The $I_{ISET}$ current (current into the pin ISET) for TXMask = 0 can be calculated with:

$$I_{ISET,TXMask=0} = \frac{V_{ISET}}{R_{ISET}} + \frac{V_{ISET}}{R_{TXMASK}} = \frac{1.3\,V}{R_{ISET}} + \frac{1.3\,V}{R_{TXMASK}}$$

For TXMask = 1 the current $I_{ISET}$ is reduced to:

$$I_{ISET,TXMask=1} = \frac{V_{ISET}}{R_{ISET}} + \frac{V_{ISET} - V(TXMask)}{R_{TXMASK}} = \frac{1.3\,V}{R_{ISET}} + \frac{1.3\,V - V(TXMask)}{R_{TXMASK}}$$

V(TXMask) is the actual voltage for the high level ('1') for the signal TXMask

The maximum flash current $I_{LEDMAX}$ for TXMask=0 or 1 can be calculated according to the following formula using the above obtained $I_{ISET}$ values:

$$I_{LEDMAX} = I_{FLASH2BIAS}\, I_{ISET} = 7650 \cdot I_{ISET}$$

Choose the values for $R_{ISET}$ and $R_{TXMASK}$ according to your application requirements.

## 7.3 Protection Functions

### 7.3.1 Overtemperature Protection

If the AS3685 junction temperature exceeds $T_{OVTEMP}$, the current sink will be disabled and the charge pump forced into 1:1 mode. If the junction temperature drops below $T_{OVTEMP} - T_{OVTEMPHYST}$, the device enables the current sink again and the charge pump resumes normal operation.

### 7.3.1.1 LED Shortcircuit protection

If the LED is shorted (VCP to ILED), then depending on the set current and the resulting high power dissipation inside the AS3685, the overtemperature protection will trigger. This protects the AS3685 and the system against damage. If the AS3685 is in off-mode, then shorting of the diode will have no influence on the system.

Note: Do not short VCP to VSS if the supply is not current limited (e.g. by an internal protection inside the battery), as there is an internal diode between VBAT (anode) and VCP (cathode).

### 7.3.2 Flash Timeout

The flash duration of a single flash is limited automatically to $t_{FLASHTIMEOUT}$ (applies only for 'Flash' mode(s)). This protects the flash LED against thermal damage.

## 7.4 Layout Recommendations

To improve the heat dissipation, use a massive ground plane.

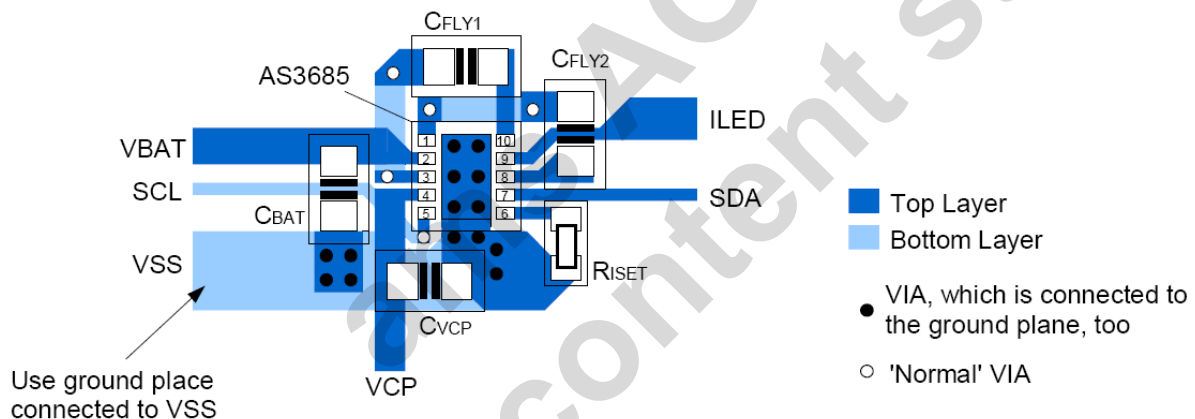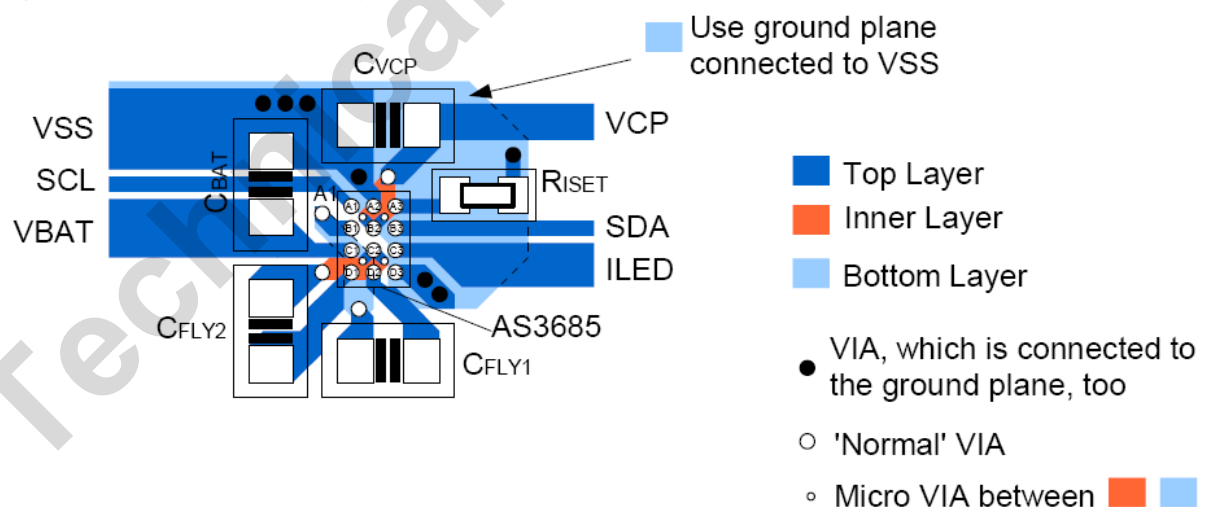Figure 16 – AS3685 DFN10 3x3mm Layout Recommendation



Figure 17 – AS3685 WL-CSP 2x1.5mm Layout Recommendation

# 8 External Components

## 8.1 Capacitor and Resistor Selection

Use low-ESR ceramic capacitors with X7R or X5R dielectric. These capacitors allow good filtering and have a wide temperature range. The connections of all external capacitors should be kept as short as possible. All resistors should have a tolerance of ±1%.

## 8.2 Usage of PCB Wire Inductance

The inductance between the battery and pin $V_{BAT}$ can be used as a filter to reduce disturbance on the battery. Instead of using one capacitor ($C_{BAT}$) it is recommended to split $C_{BAT}$ into $C_{BAT1}$ and $C_{BAT2}$ with the capacitance of

$$C_{BAT1} = C_{BAT2} = C_{BAT}$$

It is recommended to apply a minimum of 20nH (maximum 200nH) with low impedance. This inductance can be realized on the PCB without any discrete coil. Assuming that a 1mm signal line corresponds to approximately 1nH (valid if the length (L) is significantly bigger than the width (W) of the line (L/W <10)), a line length of

$$20mm < L < 200mm$$

is recommended. The shape of the line is not important.
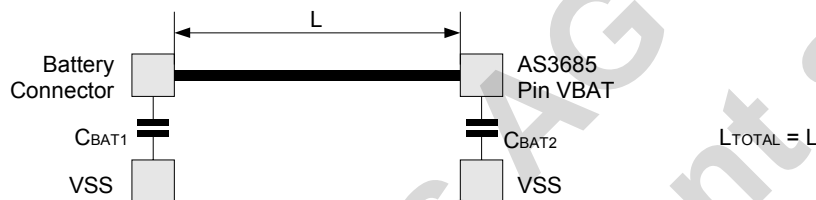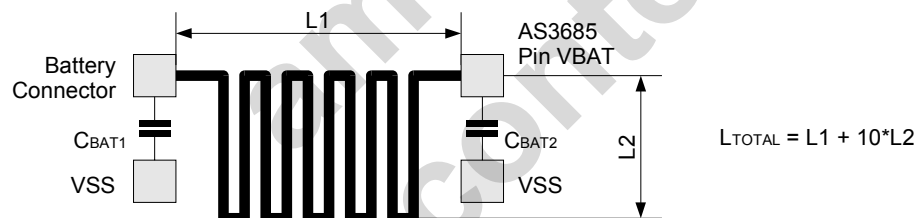
Figure 18 – PCB Wire Inductance Example1



Figure 19 – PCB Wire Inductance Example2



## 8.3 External Component Specifications

*Table* 8 – External Components List

| Part | Value Min | Value Typ | Value Max | Tol (Min) | Rating (Max) | Notes | Package (min) |
|------|------|------|------|------|------|------|------|
| $C_{BAT}$ [1] | | 2.2μF | | +/-20% | 6.3V | Ceramic, X5R<br>e.g. Murata GRM21BR71A225KA01L | 0603 |
| $C_{FLY1}$, $C_{FLY2}$ | | 1.0μF | | +/-20% | 6.3V | Ceramic, X5R<br>e.g. Murata GRM188R60J105K | 0603<br>(0402, 0405) |
| $C_{VCP}$ | | 2.2μF | | +/-20% | 6.3V | Ceramic, X5R<br>e.g. Murata GRM21BR71A225KA01L | 0603 |
| $R_{ISET}$ | 10kΩ | | 130kΩ | +/-1% | | Current Set Resistor | 0201 |
| $R_{TXMASK}$ | See section 'TXMask function' | | | +/-1% | | TXMask Set Resistor | 0201 |
| $D_{LED}$ | Flash Led | | | | | | |

**Notes:**

1. See section 'Usage of PCB Wire Inductance'

# 9 Pinout and Packaging

## 9.1 DFN10 3x3mm

### 9.1.1 Pin Assignments DFN10 3x3mm

*Figure* 20 –Pin Assignments DFN10 3x3mm
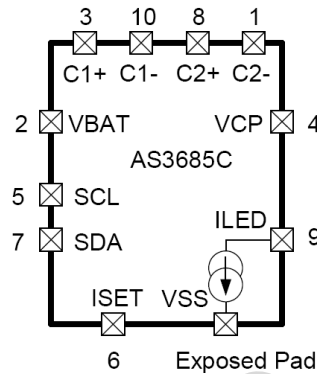


### 9.1.2 Pin Descriptions DFN10 3x3mm

*Table* 9 – Pin Type Descriptions DFN10 3x3mm

| Pin Type | Description |
|----------|-------------|
| AI/O | Analog Pin |
| DI | Digital Input |
| S | Supply Pin |

*Table* 10 – Pin Descriptions DFN10 3x3mm

| Pin Number | Pin Name | Type | Description |
|------------|----------|------|-------------|
| 1 | C2- | AI/O | Flying Capacitor 2 connection – connect 1$\mu$F ceramic capacitor $C_{FLY2}$ between C2- and C2+ |
| 2 | VBAT | S | Battery Supply Voltage |
| 3 | C1+ | AI/O | Flying Capacitor 1 connection – connect 1$\mu$F ceramic capacitor $C_{FLY1}$ between C1- and C1+ |
| 4 | VCP | AI/O | Charge Pump Output voltage – connect flash LED anode to this pin and add $C_{VCP}$ capacitor with 2.2$\mu$F to VSS |
| 5 | SCL | DI | Digital Control Signal two wire interface clock input |
| 6 | ISET | AI/O | Current Generator input pin – connect current set resistor $R_{ISET}$ between this pin and VSS (and optional $R_{TXMASK}$) |
| 7 | SDA | DI/O | Digital Input/Output Control two wire interface data signal |
| 8 | C2+ | AI/O | Flying Capacitor 2 connection – connect 1$\mu$F ceramic capacitor $C_{FLY2}$ between C2- and C2+ |
| 9 | ILED | AI/O | Current Source input pin – connect flash LED cathode to this pin |
| 10 | C1- | AI/O | Flying capacitor 1 connection – connect 1$\mu$F ceramic capacitor $C_{FLY1}$ between C1- and C1+ |
| Exposed Pad | VSS | S | Ground Connection – a proper thermal connection with several vias to the ground plane is recommended |

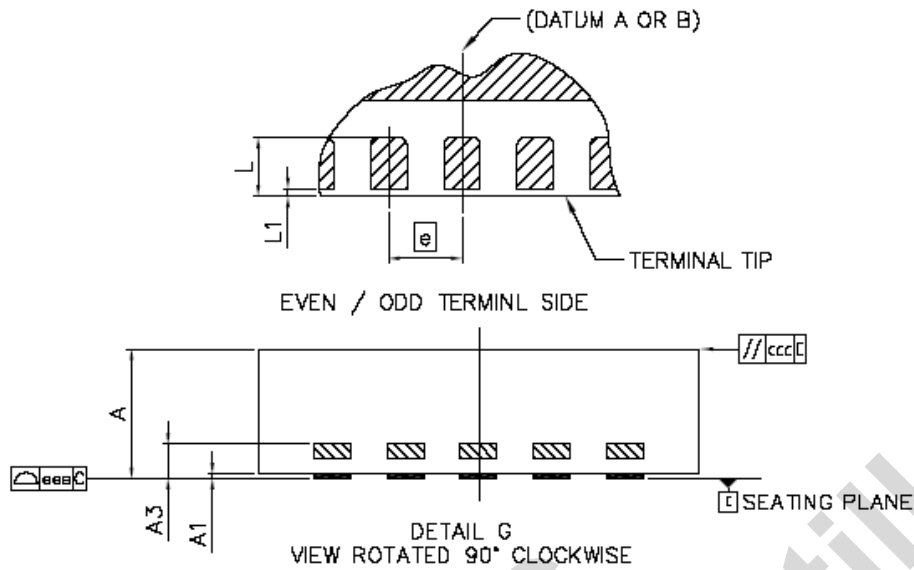## 9.1.3  Package Drawings and Marking DFN10 3x3

*Figure* 21 – DFN10 – 3x3mm Pacakge Drawing
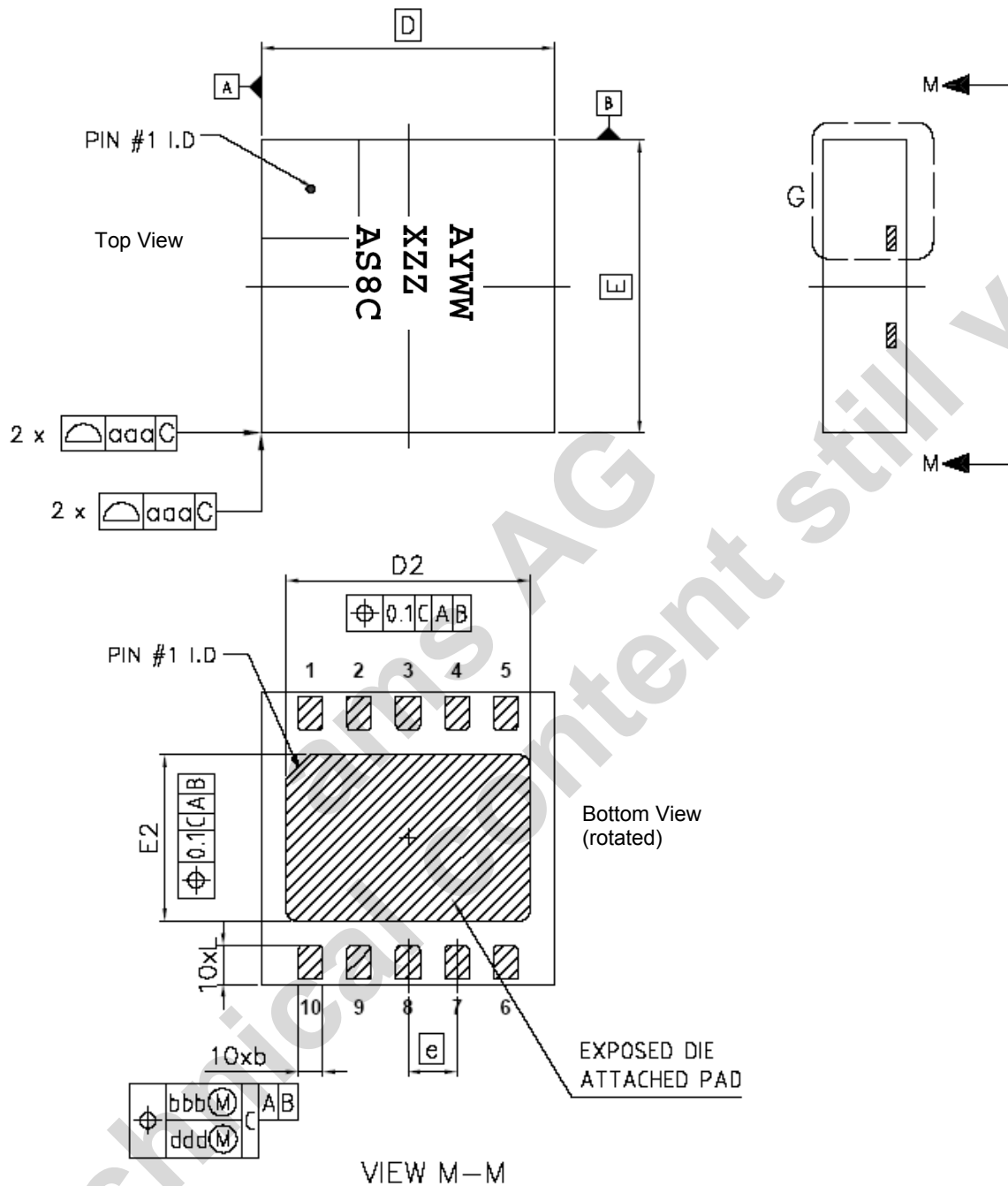


**Marking:**

Line 1:  AYWW
  A = Pb-Free Identifier
  Y = Year
  WW = Week
Line 2:  XZZ
  X = Plant Identifier
  ZZ = Letters of Free Choice
Line 3:  AS8C for AS3685C

*Figure* 22 – DFN10 – 3x3mm Detail Dimensions



| DIM | MIN | NOM | MAX | NOTES |
|-----|-----|-----|-----|-------|
| A | 0.80 | 0.85 | 0.90 | 1.0 DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994. |
| A1 | 0.00 | | 0.05 | |
| A3 | | 0.203 REF | | 2.0 ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES. |
| b | 0.20 | 0.25 | 0.30 | 3.0 DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS |
| D | | 3.00 BSC | | MEASURED BETWEEN 0.25mm AND 0.30mm FROM TERMINAL TIP. |
| E | | 3.00 BSC | | DIMENSION L1 REPRESENTS TERMINAL FULL BACK FROM PACKAGE EDGE UP TO 0.1mm IS ACCEPTABLE. |
| D2 | 2.40 | 2.50 | 2.60 | |
| E2 | 1.60 | 1.70 | 1.80 | 4.0 COPLANARITY APPLIES TO THE EXPOSED HEAT SLUG AS WELL AS THE TERMINAL. |
| e | | 0.50 BSC | | |
| L | 0.35 | 0.40 | 0.45 | 5.0 RADIUS ON TERMINAL IS OPTIONAL. |
| L1 | | | 0.10 | |
| aaa | | 0.10 | | |
| bbb | | 0.10 | | |
| ccc | | 0.10 | | |
| ddd | | 0.05 | | |
| eee | | 0.08 | | |

## 9.2   WL-CSP 2x1.5mm (Wafer Level Chip Scale Package)

### 9.2.1   Pin Assignments WL-CSP 2x1.5mm

*Figure* 23 – WL-CSP 2x1.5mm Pin Assignments
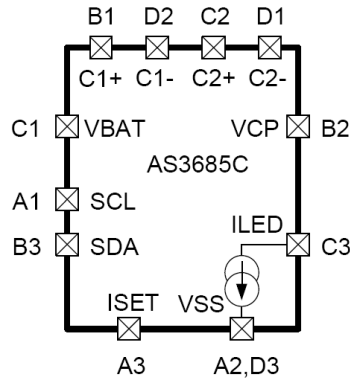


### 9.2.2   Pin Descriptions WL-CSP 2x1.5mm

*Table* 11 – Pin Type Descriptions WL-CSP 2x1.5mm

| Pin Type | Description |
|---|---|
| AI/O | Analog Pin |
| DI | Digital Input |
| S | Supply Pin |

*Table* 12 – Pin Descriptions WL-CSP 2x1.5mm

| Pin Number | Pin Name | Type | Description |
|---|---|---|---|
| A1 | SCL | DI | Digital Control Signal two wire interface clock input |
| A2 | VSS | S | Ground Connection – a proper thermal connection to the ground plane is recommended |
| A3 | ISET | AI/O | Current Generator input pin – connect current set resistor $R_{ISET}$ between this pin and VSS (and optional $R_{TXMASK}$) |
| B1 | C1+ | AI/O | Flying Capacitor 1 connection – connect 1$\mu$F ceramic capacitor $C_{FLY1}$ between C1- and C1+ |
| B2 | VCP | AI/O | Charge Pump Output voltage – connect flash LED anode to this pin and add $C_{VCP}$ capacitor with 2.2$\mu$F to VSS |
| B3 | SDA | DI/O | Digital Input/Output Control two wire interface data signal |
| C1 | VBAT | S | Battery Supply Voltage |
| C2 | C2+ | AI/O | Flying Capacitor 2 connection – connect 1$\mu$F ceramic capacitor $C_{FLY2}$ between C2- and C2+ |
| C3 | ILED | AI/O | Current Source input pin  – connect flash LED cathode to this pin |
| D1 | C2- | AI/O | Flying Capacitor 2 connection – connect 1$\mu$F ceramic capacitor $C_{FLY2}$ between C2- and C2+ |
| D2 | C1- | AI/O | Flying capacitor 1 connection – connect 1$\mu$F ceramic capacitor $C_{FLY1}$ between C1- and C1+ |
| D3 | VSS | S | Ground Connection – a proper thermal connection to the ground plane is recommended |

### 9.2.3 Package Drawings and Marking WL-CSP 2x1.5mm

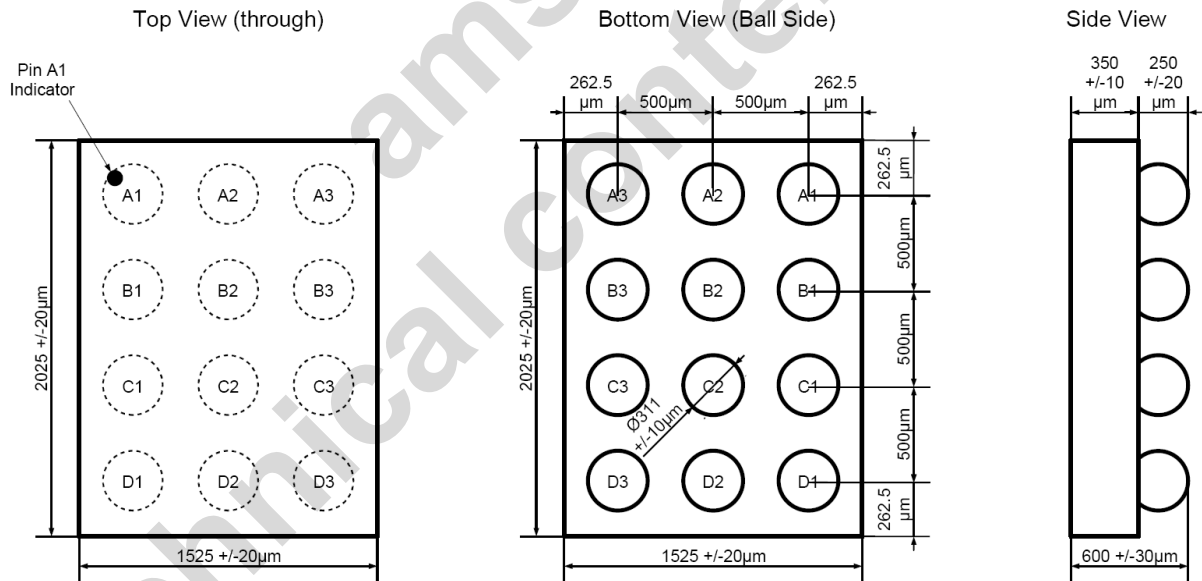*Figure* 24 – WL-CSP 2x1.5mm Package Drawing
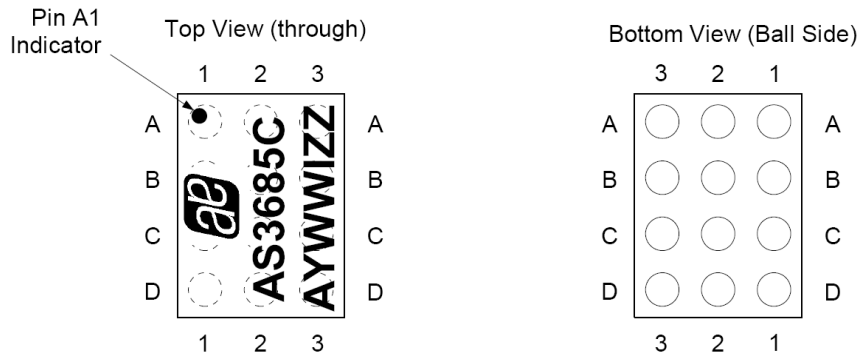


**Marking:**

Line 1:    austriamicrosystems logo
Line 2:    AS3685C
Line 3:    AYWWIZZ
       A = Pb-Free Identifier
       Y = Year
       WW = Week
       I = Plant Identifier
       ZZ = Letters of Free Choice

*Figure* 25 – WL-CSP 2x1.5mm Detail Dimensions

# 10 Ordering Information

*Table* 13 – Delivery Information

| Part Number | Marking | Package Type | Delivery Form | Description |
|---|---|---|---|---|
| AS3685C-ZWLT | AS3685C | WL-CSP 2x1.5mm | Tape&Reel | AS3685C Interface Wafer Level Chip Scale Package, Size 2x1.5mm, 4x3 balls, 0.5mm pitch, RoHS compliant / Pb-free |
| AS3685C-ZDFT[1] | AS8C | DFN 10 3x3mm | Tape&Reel | AS3685C Interface DFN Package, 3x3mm, 10 pins, 0.4mm pitch, RoHS compliant / Pb-free |

**Description:**

AS3685C-ZPPT

AS3685

| C | ... | AS3685C Interface Version Two wire interface signal with STROBE |
|---|---|---|
| - | | |
| Z | ... | Temperature range: Z = -30°C – 85°C |
| PP | ... | Package: WL = Wafer Level Chip Scale Package DF = DFN10 |
| T | ... | Delivery Form: T = Tape&Reel |

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[1] Contact austriamicrosystems for availability.

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