Flash Current & Flash Timer Programmable 1A Flash LED Driver

FEATURES

- **Flash LED Current up to 1A Among Full Power Supply Range**

- **8 Flash LED Current Levels Selectable by 1-wire Interface:**

  100%*I$_{FLASH}$, 90%*I$_{FLASH}$……30%*I$_{FLASH}$

- **2 Flash Timeout Levels Selectable by 1-wire Interface: 220ms, 1.3s**

- **Ultra low R$_{DSON}$: 0.4Ω(1X Mode), 2Ω(2X Mode)**

- **PWM Dimming Control in Torch Mode**

- Automatic 1X/2X Mode Switchover

- Up to 92% Efficiency in Torch Mode

- Low 47mV Reference for Low Loss Sensing

- Built-In Soft Start Limits Inrush Current

- Over-Temperature Protection

- Over-Voltage and Short-Circuit Protection

- Low Ripple and EMI

- Available in 3mm*3mm-10L DFN Package

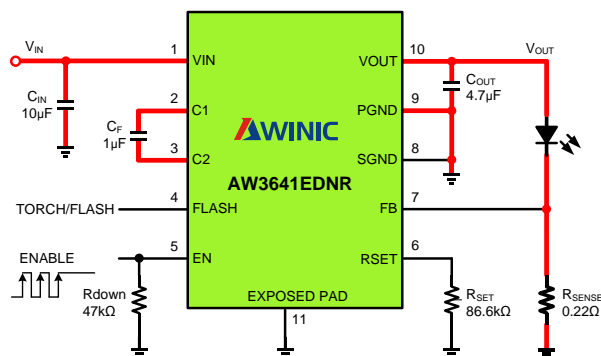## APPLICATIONS

- Mobile Phones

- PAD

GENERAL DESCRIPTION

The AW3641E is a current-regulated charge pump ideal for powering high brightness LEDs for camera flash applications. The charge pump can be set to regulate two current levels for FLASH and TORCH modes.

The AW3641E incorporates a 1-wire interface to program the flash LED current at 8 levels and flash timeout at 2 levels.

The AW3641E supports PWM dimming to adjust the LED brightness during torch application by simply providing a PWM signal to FLASH pin.
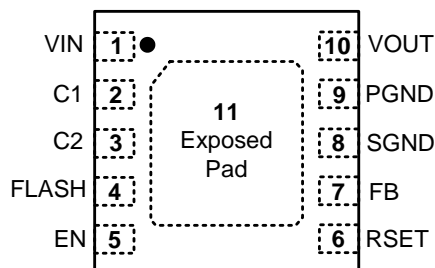
The AW3641E features an ultra low R$_{DSON}$, and automatically switches modes between 1X and 2X, not only ensuring that LED current does not depend on the forward voltage, but also optimizing the efficiency at the whole power supply and load range.

The AW3641E also features an automatic soft-start mode to limit inrush current, as well as over-temperature, over-voltage and short-circuit protection.

The AW3641E is available in a small 3mm*3mm DFN-10L package and is specified over the -40℃ to +85℃ ambient temperature range.
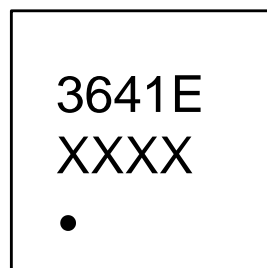
TYPICAL APPLICATION CIRCUIT

Figure 1   Typical Application Circuit of AW3641E

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PIN CONFIGURATION AND TOP MARK

AW3641EDNR TOP VIEW

AW3641EDNR MARKING

```
VIN   [1] ●        [10]  VOUT
C1    [2]          [9]   PGND
C2    [3]    11    [8]   SGND
          Exposed
FLASH [4]   Pad   [7]   FB
EN    [5]          [6]   RSET
```

DFN3x3-10L Package

```
3641E
XXXX
●
```

3641E-AW3641EDNR
XXXX-Manufacture Date Code

Figure 2   Pin Configuration and Top Mark

PIN DEFINITION

| No.	NAME	DESCRIPTION
1	VIN	Input voltage for the charge pump. Decouple with 10µF ceramic capacitor (X5R/X7R) close to the pins of the IC.
2	C1	Positive input for the external flying capacitor. Connect a ceramic 1µF capacitor (X5R/X7R) close to the pins of the IC.
3	C2	Negative input for the external flying capacitor. Connect a ceramic 1µF capacitor (X5R/X7R) close to the pins of the IC.
4	FLASH	Logic input to toggle operation between FLASH and TORCH mode. In Torch mode, FB is regulated to the internal 47mV reference. In Flash mode, FB reference voltage can be adjusted by changing the resistor from R_{SET} pin to ground. Choose the external current sense resistor (R_{SENSE}) based on desired current in Torch mode and Flash mode
5	EN	Shutdown control input. Connect to logic high for normal operation, and logic low for shutdown. In FLASH mode, the flash current and timeout period can be adjusted by EN 1-wire pulse control signal.
6	RSET	Connect a resistor from this pin to ground. When in FLASH mode (FLASH = High), this resistor sets the current regulation point according to the following equation: $V_{FB}=(1.26V/R_{SET})\times10.2k\Omega$
7	FB	Feedback input for the current control loop. Connect directly to the current sense resistor: $I_{LED}=V_{FB}/R_{SENSE}$
8	SGND	Internal ground pin. Control circuitry returns current to this pin.
9	PGND	Power ground pin. Flying capacitor current returns through this pin.
10	VOUT	Charge Pump Output Voltage. Decouple with an external X5R/X7R capacitor. A 4.7µF capacitor is recommended.
11	Exposed Pad	Exposed Pad must be soldered to the PCB board and connected to GND.

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FUNCTIONAL BLOCK DIAGRAM
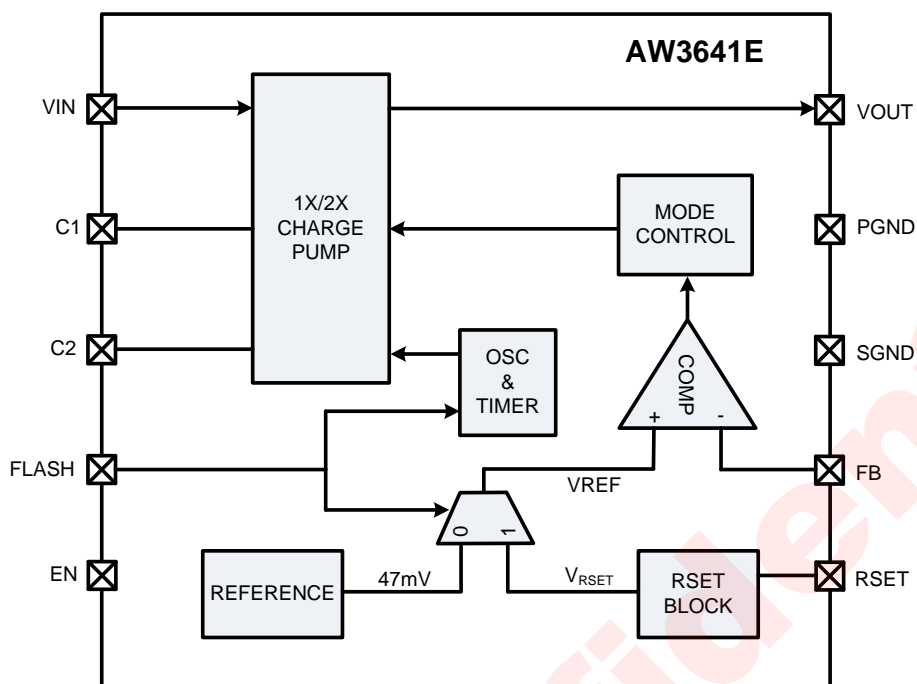
Figure 3   Functional Block Diagram

TYPICAL APPLICATION CIRCUITS

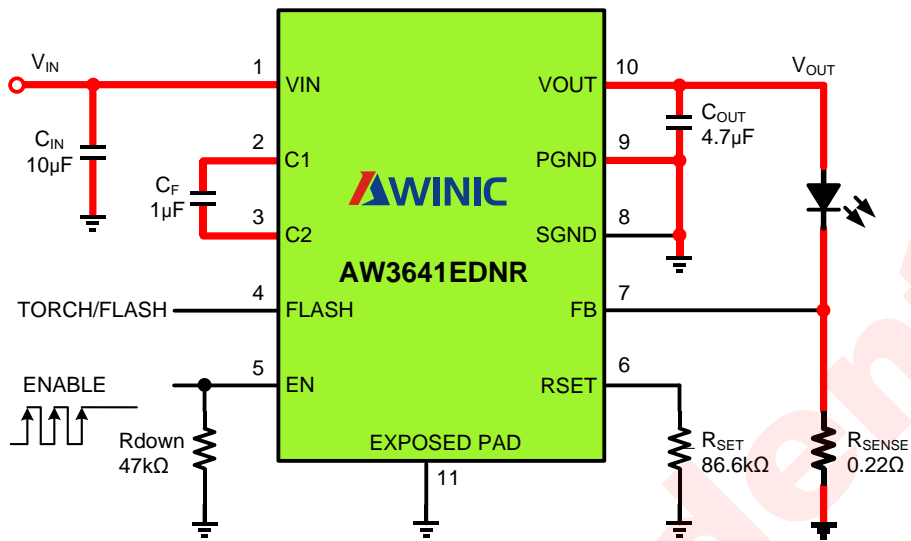The typical application is shown *Figure 4*, where I_{FLASH}=675mA，I_{TORCH}=214mA.

Figure 4   Typical Application of 700mA Flash Current

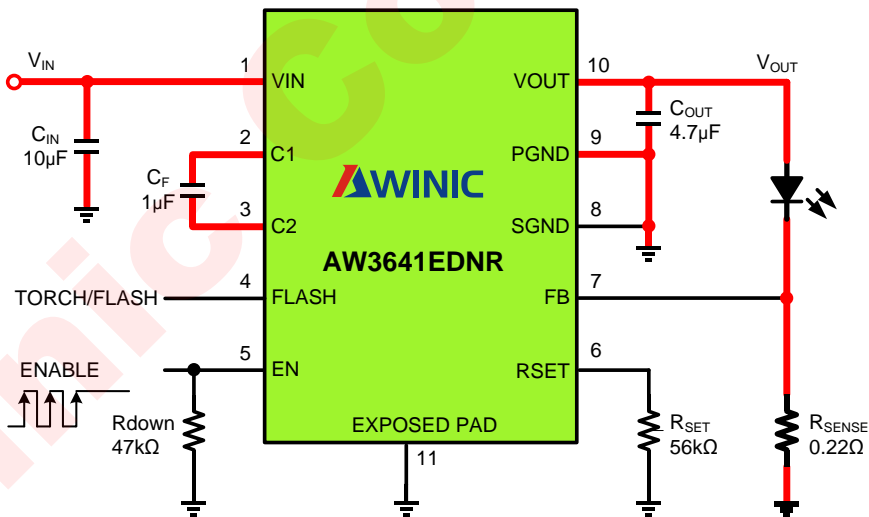The typical application is shown *Figure 5*, where I_{FLASH}=1.04A，I_{TORCH}=214mA.

Figure 5   Typical Application of 1A[(NOTE1)] Flash Current

NOTE1:   The exact flash current is 1.04A due to the typical value R_{SET}=56kΩ and R_{SENSE}=0.22Ω.

$I_{FLASH}=V_{FB} / R_{SENSE}=(1.26V/R_{SET}) \times 10.2k\Omega / R_{SENSE}=1.04A.$

The AW3641E also can be used to drive two flash LEDs in portable equipment, the schematic is shown in *Figure 6*. In this application, $I_{FLASH\_D1}=I_{FLASH\_D2}=488mA$, $I_{TORCH\_D1}=I_{TORCH\_D2}=100mA$.
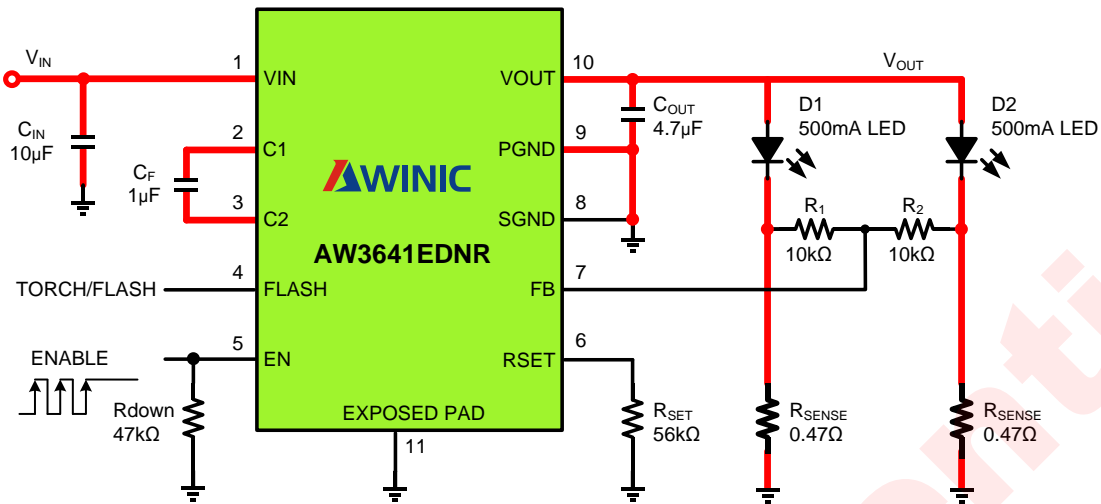

Figure 6   Two Flash LEDs Application

Notice for Typical Application Circuits:

1. *C_{IN}, C_F, C_{OUT}, R_{SET}, R_{SENSE} close to the pins of the IC, and the ground terminal of R_{SENSE} close to the SGND/PGND pins of the IC.*

2. *Red line is high current path. Consider driving ability, for example，$I_{OUT}=700mA$，the power path V_{OUT}--LED--R_{SENSE}--GND should be as short and wide as possible, at least 30mil trace is recommended ($I_{OUT}=700mA$).The power path between Battery and V_{IN}, at least 60mil trace is recommended ($I_{IN}=1.4A$ @2X Mode).*

3. *For better thermal performance and noise performance, the Exposed Pad, PGND pin and SGND pin should be connected directly to a large area of the PCB ground plane.*

ORDERING INFORMATION

Part Number	Temperature	Package	Marking	Delivery Form
AW3641EDNR	-40℃～85℃	DFN 3mm*3mm-10L	3641E	6000 units/ Tape and Reel

AW3641E □ □ □

Shipping
R: Tape & Reel

Package Type
DN: DFN
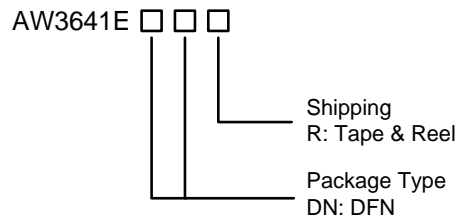
ABSOLUTE MAXIMUM RATINGS(NOTE2)

PARAMETERS	RANGE
Voltage at VIN,VOUT	-0.3V to 6V
Voltage at EN, FLASH	−0.3V to the lesser of (VIN+0.3V) w/ 6V max
Output Current Pulse(Flash)	1.2A
Output Current Continuous(Torch)	0.4A
Junction to Ambient Thermal Resistance θ_{JA}	57℃/W
Ambient Temperature	-40℃ to 85℃
Max Junction Temperature T_{JMAX}	150℃
Storage Temperature T_{STG}	-65℃ to 150℃
Lead Soldering Temperature, 10 Seconds	260℃
ESD, All Pins(NOTE3)	
HBM	8000V
CDM	2000V
MM	350V
Latch-up	
Testing Standard： JEDEC STANDARD NO.78B DECEMBER 2008	+IT：+450mA -IT：-450mA

NOTE2: Stresses beyond those listed under absolute maximum ratings 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 under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods my affect device reliability.

NOTE3: The human body model is a 100-pF capacitor discharged through a 1.5kΩ resistor into each pin. The machine model is a 200-pF capacitor discharged directly into each pin. Testing standard：MIL-STD-883G Method 3015.7.
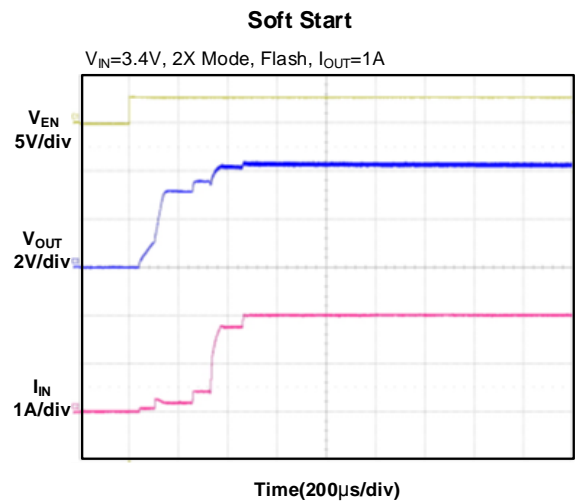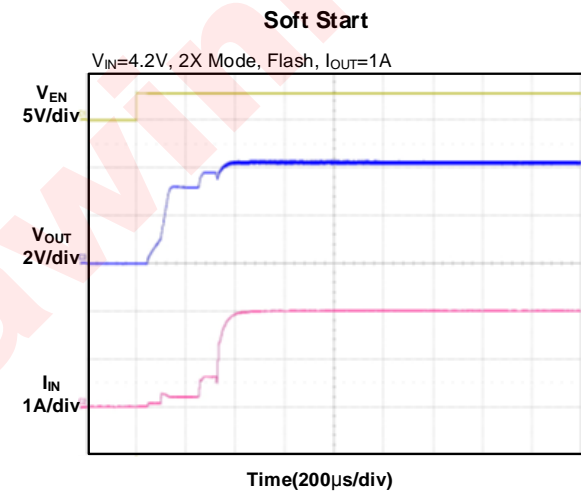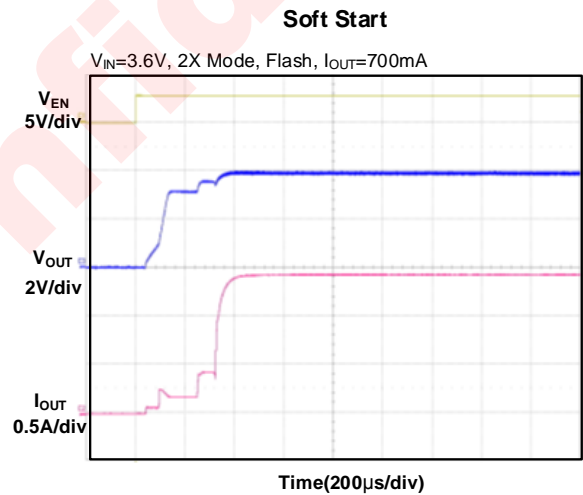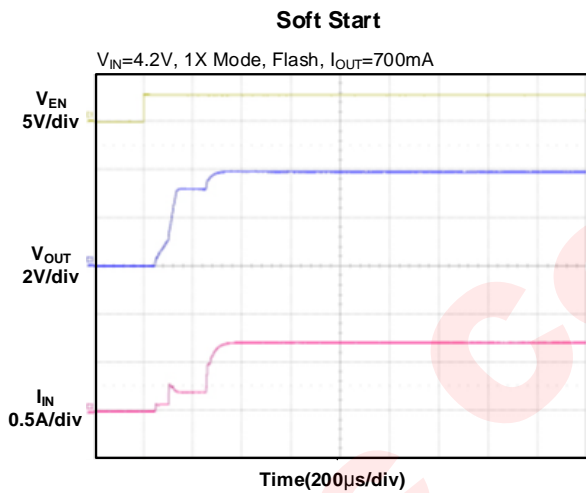
ELECTRICAL CHARACTERISTICS

Test Condition: T_A = 25℃, VIN = 3.6V, EN = VIN, FLASH =VIN (Unless otherwise specified)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
SUPPLY VOLTAGE AND CURRENT						
V_{IN}	Input voltage range		2.8		5.5	V
I_{SD}	Shutdown Current	EN=0V		0.1	1	µA
I_Q	Quiescent Current	FLASH=0V，I_{LOAD}=100uA		0.4		mA
		FLASH=V_{IN}，2X Mode		6		mA
F_{OSC}	Oscillator Frequency		1.4	1.9	2.4	MHz
R_{DSON_2X}	Charge Pump Equivalent Resistance (2X mode)			2		Ω
R_{DSON_1X}	Charge Pump Equivalent Resistance (1X mode)			0.4		Ω
V_{FB}	FB Reference Voltage	FLASH=V_{IN}, R_{SET}=86.6kΩ	137	150	160	mV
		FLASH=GND	42	47	52	
I_{FB}	FB Pin Current	V_{FB}=0.3V			1	µA
V_{IH}	EN, FLASH Logic High		1.3			V
V_{IL}	EN, FLASH Logic Low				0.4	V
I_{EN}	EN, FLASH Pin Current			5		µA
T_{ON}	V_{OUT} Turn-on Time	V_{IN} = 3.6V, FB within 90% of regulation		500		µs
T_{FLASH}	Flash Timeout Period	1-wire pulse rising edge number: 1~8	180	220	310	ms
		1-wire pulse rising edge number: 9~16	1.05	1.3	1.85	s
T_{SD}	Thermal Shutdown Temperature			147		℃

TYPICAL CHARACTERISTICS

Test Condition: C_{IN}=10μF, C_{OUT}=4.7μF, C_F=1μF (Unless otherwise specified)
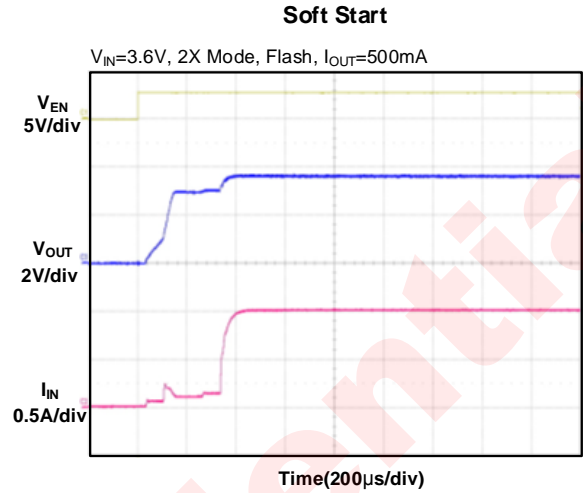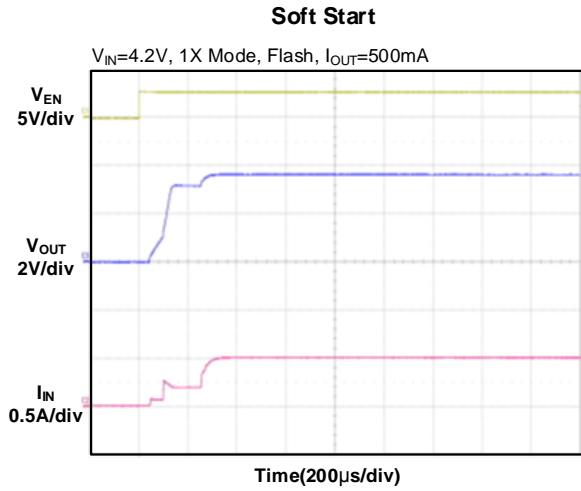
Soft Start

V_{IN}=4.2V, 1X Mode, Flash, I_{OUT}=500mA

Soft Start

V_{IN}=3.6V, 2X Mode, Flash, I_{OUT}=500mA

Soft Start

V_{IN}=4.2V, 1X Mode, Flash, I_{OUT}=700mA

Soft Start

V_{IN}=3.6V, 2X Mode, Flash, I_{OUT}=700mA

Soft Start

V_{IN}=4.2V, 2X Mode, Flash, I_{OUT}=1A

Soft Start

V_{IN}=3.4V, 2X Mode, Flash, I_{OUT}=1A

Test Condition: C_{IN}=10µF, C_{OUT}=4.7µF, C_F=1µF (Unless otherwise specified)

Soft Start

V_{IN}=3.6V, 1X Mode,Torch, I_{OUT}=214mA

Time(200µs/div)

Soft Start

V_{IN}=3.6V, 1X Mode, Torch, I_{OUT}=140mA

Time(200µs/div)

Flash time 220ms

V_{IN}=4.2V, I_{FLASH}=1A

Time(50ms/div)

Flash time 1.3s

V_{IN}=4.2V, I_{FLASH}=1A

Time(200ms/div)
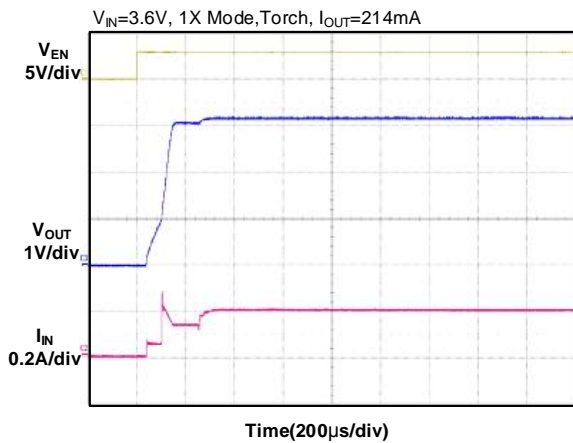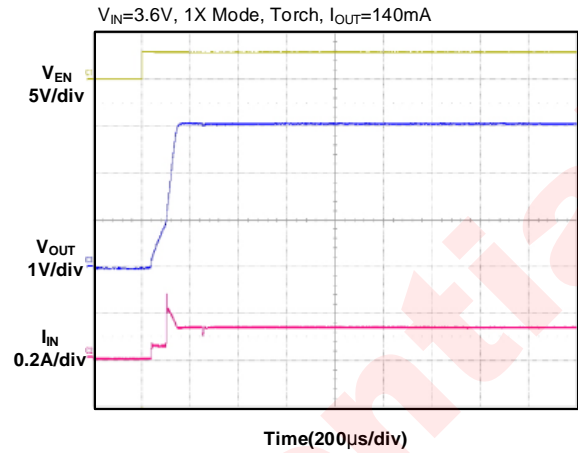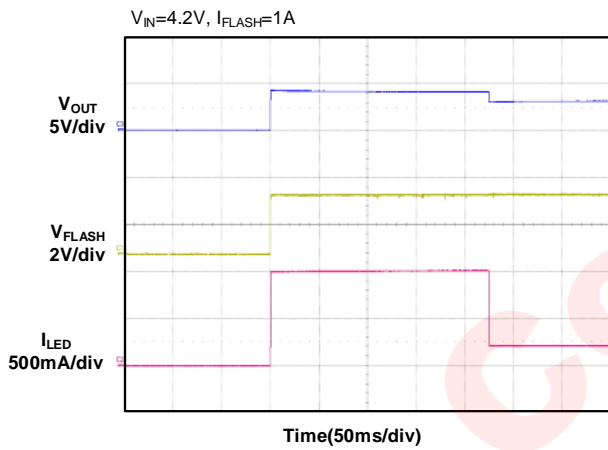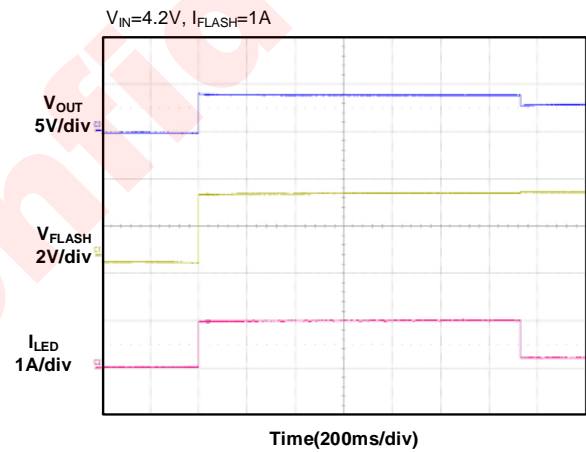
Flash Current Setting by 1-Wire Interface

V_{IN}=4.2V, I_{FLASH}=1A (Pulse=1)

Time(200ms/div)
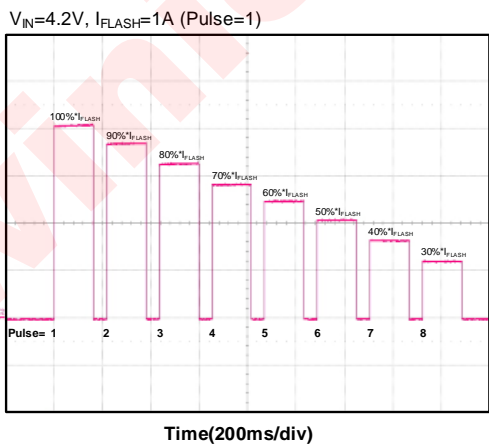
PWM Dimming for Torch Current

V_{IN}=4.2V, I_{FLASH}=1A, I_{TORCH}=0.1A, Duty=20%

Time(50µs/div)
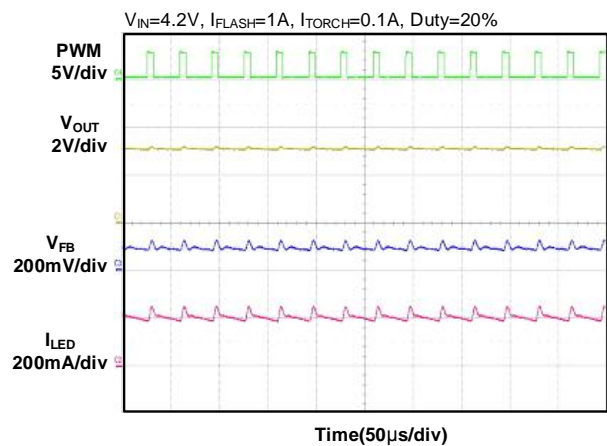
Test Condition: C$_{IN}$=10μF, C$_{OUT}$=4.7μF, C$_F$=1μF (Unless otherwise specified)

Torch 1X to Flash 2X

V$_{IN}$=3.6V, I$_{FLASH}$=1A, I$_{TORCH}$=214mA

V$_{FLASH}$ 5V/div
V$_{OUT}$ 2V/div
V$_{FB}$ 200mV/div
I$_{LED}$ 1A/div

Time(50ms/div)

Torch 1X to Flash 1X

V$_{IN}$=4.2V, I$_{FLASH}$=500mA, I$_{TORCH}$=214mA

V$_{FLASH}$ 5V/div
V$_{OUT}$ 2V/div
V$_{FB}$ 100mV/div
I$_{LED}$ 500mA/div

Time(50ms/div)

Output Ripple

V$_{IN}$=4.2V, 1X Mode, Torch, I$_{LED}$=214mA

V$_{IN}$ AC coupled 20mV/div
V$_{OUT}$ AC coupled 20mV/div

Time(1μs/div)

Output Ripple

V$_{IN}$=4.2V, 1X Mode, Flash, I$_{LED}$=500mA

V$_{IN}$ AC coupled 20mV/div
V$_{OUT}$ AC coupled 20mV/div

Time(1μs/div)

Output Ripple

V$_{IN}$=3.6V, 2X Mode, Flash, I$_{LED}$=500mA

V$_{IN}$ AC coupled 100mV/div
V$_{OUT}$ AC coupled 100mV/div

Time(1μs/div)

Output Ripple

V$_{IN}$=3.6V, 2X Mode, Flash, I$_{LED}$=1A

V$_{IN}$ AC coupled 100mV/div
V$_{OUT}$ AC coupled 100mV/div

Time(1μs/div)

Test Condition: C_{IN}=10μF, C_{OUT}=4.7μF, C_F=1μF (Unless otherwise specified)

Output Current vs. Input Voltage
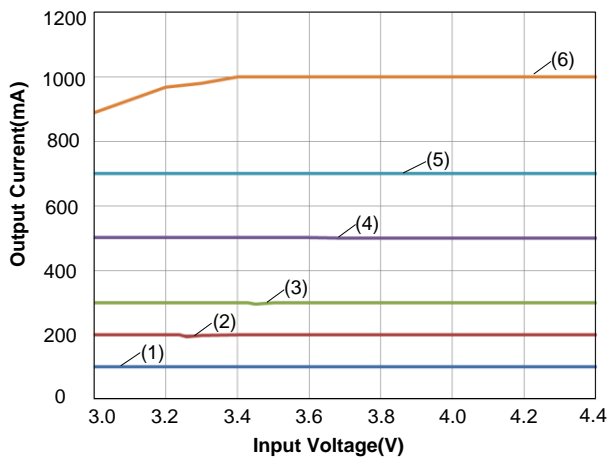
(1) Torch 100mA, V_F=2.93V   (2) Torch 200mA, V_F=3.12V
(3) Flash 300mA, V_F=3.19V   (4) Flash 500mA, V_F=3.46V
(5) Flash 700mA, V_F=3.62V   (6) Flash 1000mA, V_F=3.98V

Battery Current vs. Input Voltage
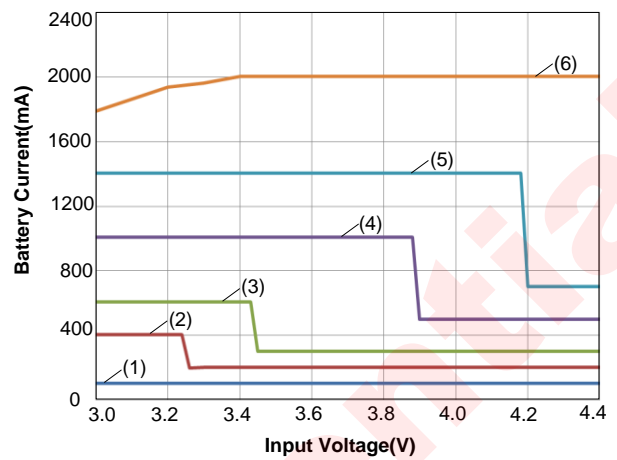
(1) Torch 100mA, V_F=2.93V   (2) Torch 200mA, V_F=3.12V
(3) Flash 300mA, V_F=3.19V   (4) Flash 500mA, V_F=3.46V
(5) Flash 700mA, V_F=3.62V   (6) Flash 1000mA, V_F=3.98V

Efficiency vs. Input Voltage

(1) Torch 100mA, V_F=2.93V   (2) Torch 200mA, V_F=3.12V
(3) Flash 300mA, V_F=3.19V   (4) Flash 500mA, V_F=3.46V
(5) Flash 700mA, V_F=3.62V   (6) Flash 1000mA, V_F=3.98V

DETAILED FUNCTIONAL DESCRIPTION

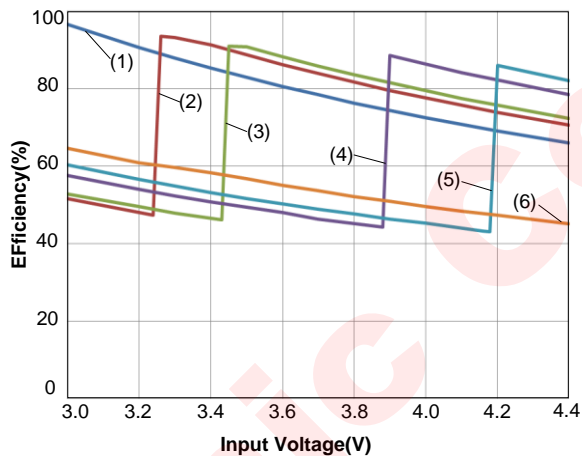The AW3641E is a charge pump regulator designed to drive white LEDs supplied by a Li-Ion battery of 2.8V to 4.4V for digital still camera Flash and Torch applications. The AW3641E is pin selectable to operate in either Flash or Torch mode. Flash mode is usually with a pulse of about 200 to 300 milliseconds to generate a high intensity Flash. Torch can be used continuously at a lower output current than Flash and is often used for several seconds in a digital still camera "movie" mode.

Adaptive Charge Pump

The AW3641E also has two operating modes to control the output current: the 1X mode and 2X mode. After 50µs' delay of the enable pin EN receiving logic high, the Bandgap reference wakes up. Then AW3641E goes through a soft-start mode designed to limit inrush current. The AW3641E starts in the 1X mode firstly, which acts like a linear regulator to control the output current by continuously monitoring the feedback pin FB. In 1X mode, if the FB pin is below the reference voltage for more than 8µs, the AW3641E will automatically switch to 2X mode. In 2X mode, if the working condition satisfy $V_{IN} > V_{OUT} + I_{OUT}*R_{DSON\_1X} + \Delta V$ for more than 32µs, it will switch back to 1X mode, otherwise stay in 2X mode. Wherein ΔV is a fixed hysteresis voltage, R_{DSON_1X} is the equivalent resistance in 1X mode.

Flash Mode

Flash mode is activated by pulling the EN and FLASH pin high. And the feedback regulation voltage V_{FB}, which is set by the resistor R_{SET} connected between the RSET pin and SGND pin, equals to

$$V_{FB} = (1.26V/R_{SET})*10.2k\Omega \text{ (Flash mode)}$$

Where 1.26V is the internal Bandgap reference voltage and 10.2kΩ is an internal resistance used to scale the R_{SET} current. Typically, R_{SET} ranges from 42kΩ to 170kΩ, with V_{FB} corresponding from 306mV to 76mV. Then, the output current I_{OUT} can be calculated for both Flash and Torch modes by the equation:

$$I_{OUT} = V_{FB} / R_{SENSE}$$

For example , in *Figure 4*, R_{SENSE}=0.22Ω，R_{SET}=86.6kΩ，it's obtained:

$$V_{FB} = (1.26V/86.6k\Omega)*10.2k\Omega = 148.4mV$$

$$I_{FLASH} = 148.4mV/0.22\Omega = 675mA$$

Once the R_{SENSE} and R_{SET} is selected, the AW3641E provides 8 flash LED current levels from 100%* I_{FLASH} to 30%* I_{FLASH} in 10%* I_{FLASH} steps by 1-wire interface in the EN pin.

Torch Mode

Setting the EN pin to logic high and the FLASH pin to logic low, the AW3641E will enter Torch mode. The feedback voltage V_{FB} is regulated to be 47mV, which can't be adjusted by external components.

$$V_{FB} = 47mV \text{ (Torch Mode)}$$

For example , in *Figure 4*, R_{SENSE}=0.22Ω，it's obtained:

$$I_{TORCH} = 47mV/0.22\Omega = 214mA$$

Flash Timeout Protection

The duration of a single flash is limited automatically to $T_{TIMEOUT}$, which applies only for Flash mode. This protects the flash LED against thermal damage.

The AW3641E also provides 2 flash timeout levels (220ms/1.3s) by 1-wire interface in the EN pin.

1-wire Interface

The AW3641E incorporates a 1-wire interface to program the flash LED current at 8 levels and flash timeout at 2 levels.

The relationship between the number of 1-wire pulse rising edge and flash LED current & flash timeout is shown in *Table 1*.

Table 1   flash LED current & flash timeout adjusting by 1-wire interface

Pulse	EN Waveform	Flash Timeout ($T_{TIMEOUT}$)	Flash LED Current
1	⌐		100%*I_{FLASH}
2	⌐⌐		90%*I_{FLASH}
3	⌐⌐⌐		80%*I_{FLASH}
4	⌐⌐⌐⌐		70%*I_{FLASH}
5	············	220ms	60%*I_{FLASH}
6	············		50%*I_{FLASH}
7	············		40%*I_{FLASH}
8	············		30%*I_{FLASH}
9	············		100%*I_{FLASH}
10	············		90%*I_{FLASH}
11	············		80%*I_{FLASH}
12	············		70%*I_{FLASH}
13	············	1.3s	60%*I_{FLASH}
14	············		50%*I_{FLASH}
15	············		40%*I_{FLASH}
16	············		30%*I_{FLASH}

The 1-wire pulse timing sequence is shown in *Figure 7*. The duration of logic high (T_{HI}) and logic low (T_{LO}) is recommended between 0.75us to 10us. And shutdown duration T_{OFF} should be longer than 500us.
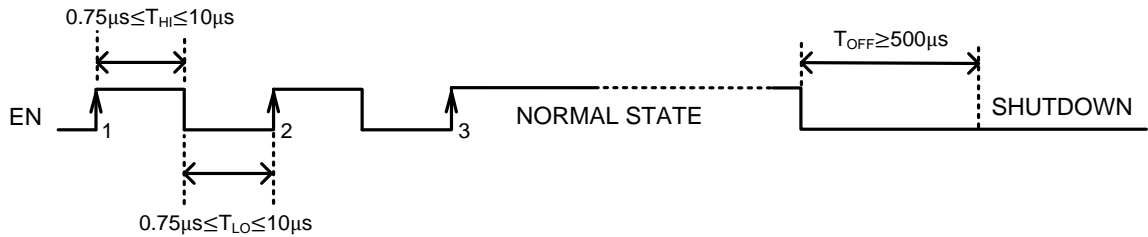
Figure 7　1-wire pulse timing sequence（take 80%*I$_{FLASH}$/220ms for example）

Flash Current & R$_{DSON}$

For 1X/2X mode charge pump flash LED driver, the maximum drive capacity in 1X mode is:

$$V_{IN} - I_{OUT}*R_{DSON\_1X} = V_{OUT}$$

The maximum drive capacity in 2X mode is:

$$2*V_{IN} - I_{OUT}*R_{DSON\_2X} = V_{OUT}$$

The output voltage V$_{OUT}$ depends on the flash LED forward voltage V$_F$. However, V$_F$ is widely dispersed. For example, for 1A flash LED, V$_F$ varies from minimum 2.95V to maximum 4.35V, whose deviation reaches1.4V. Assuming such condition: the LED driver supplied by a battery with voltage V$_{IN}$ = 3.6V，and driving a flash LED with V$_F$=4.35V. It's estimated that V$_{OUT}$=V$_F$+V$_{FB}$≈4.5V. According to the formula of 2X mode charge pump, the equivalent resistance on 2X mode must satisfy:

$$R_{DSON\_2X} < (2*V_{IN} - V_{OUT}) / I_{OUT}=(2*3.6V - 4.5V)/1A = 2.7Ω.$$

That means driving the 1A flash LED with V$_F$ = 4.35V, R$_{DSON\_2X}$ should not exceed 2.7Ω. The equivalent resistance of AW3641E in is 2X mode R$_{DSON\_2X}$ = 2Ω, equivalent resistance in 1X mode is R$_{DSON\_1X}$ = 0.35Ω, ensuring 1A output current in the whole battery voltage range, even for the worst V$_F$.

When V$_F$ < V$_{IN}$ - I$_{OUT}$*R$_{DSON\_1X}$ = 3.6V - 1A*0.35Ω = 3.25V, the AW3641E can work in 1X mode, with higher overall efficiency.

PWM Dimming

The AW3641E supports PWM dimming to adjust the LED brightness during Torch application by simply providing a PWM signal to FLASH pin. In this condition, the AW3641E switches between FLASH mode and TORCH mode. For AW3641E, the dimming frequency is recommended between 20kHz to 50kHz. The relationship between the output current I$_{OUT}$ and the duty cycle of PWM signal D is written as below:

$$I_{TORCH\_PWM} = I_{FLASH}*D + I_{TORCH}*(1-D)$$

In which I$_{FLASH}$ is output current setting for FLASH mode and I$_{TORCH}$ is output current setting for TORCH mode. For example, if I$_{TORCH}$ = 100mA, I$_{FLASH}$ = 700mA and D=20%, the output current increases to:

$$I_{TORCH\_PWM}＝700mA*20\% + 100mA*(1-20\%)=220mA^{(NOTE4)}$$

The PWM dimming sequence is shown in *Figure 8*. Firstly, setting the EN pin to logic high and the FLASH pin to logic low, the AW3641E will enter Torch mode. After a delay of T$_{DELAY}$, PWM signal may be applied to the Flash pin, where the T$_{DELAY}$ must be longer than 2ms.
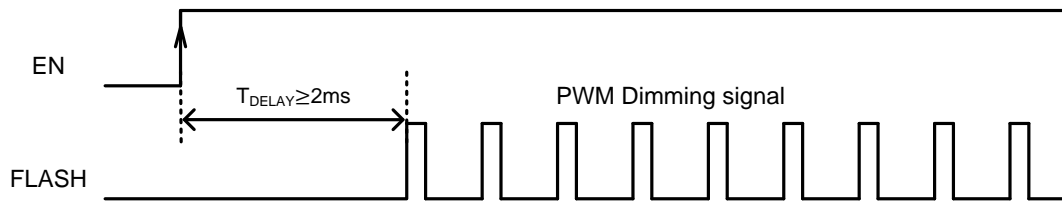
Figure 8   PWM dimming sequence

NOTE4:   The I_{TORCH_PWM} must be less than the LED DC Forward Current which is described in the LED datasheet, and usually Don't exceed 350mA.

Over-Voltage Protection (OVP)

The AW3641E provides over-voltage protection. If the output voltage rises above the threshold of 5.5V, the over voltage protection shuts down all the output switches, to prevent the output voltage from rising further. After that, when the output voltage drops below 5.3V, the device resumes normal operation.

Over-Temperature Protection

When the temperature of the AW3641E rises above 135℃, the AW3641E begins to reduce the output current, and when the temperature rises above 147℃, the over-temperature protection circuitry turns off the output switches to prevent damage to the device. If the temperature drops back down below 125℃, the device automatically recovers and executes a soft start cycle.

Short-Circuit Protection

When the VOUT pin is shorted to GND, which makes the V_{OUT} falls below to 1V, the device stops switching and operates as a current source limiting the output current to 70mA.

APPLICATION INFORMATION

Capacitor Selection

The AW3641E requires three capacitors. The recommended value: Input Capacitance C_{IN} = 10μF, output capacitor C_{OUT} = 4.7μF, flying capacitor C_F = 1μF.

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.

Table 2   Recommended Capacitor Value and Size

Part	Value	Withstanding Voltage	Size	Vendor
C_{IN}	10μF	6.3V	0603	EYANG or Murata
C_{OUT}	4.7μF	6.3V	0402	EYANG or Murata
C_F	1μF	5V	0402	EYANG or Murata

Resistor Selection/Current Setting

Step1: Select R_{SENSE}

The sense resistor R_{SENSE} is determined by the desired output current in Torch mode by the equation:

$$R_{SENSE} = V_{FB\_TORCH} / I_{TORCH}$$

Where V_{FB_TROCH} = 47mV (Torch Mode)

Step2: Calculate V_{FB}

Once the R_{SENSE} resistor has been selected for Torch mode, the feedback voltage in Flash mode V_{FB_FLASH} is obtained using the following equation:

$$V_{FB\_FLASH} = I_{FLASH} * R_{SENSE} \text{ (Flash Mode)}$$

Where I_{FLASH} is the flash LED current.

Step3: Select R_{SET}

R_{SET} resistor can be selected for Flash mode using the following equation:

$$R_{SET} = (1.26V/V_{FB\_FLASH}) * 10.2kΩ \quad \text{(Flash Mode)}$$

For an example of 200mA Torch mode and 800mA Flash mode:

1) the values R_{SENSE} = 47mV/200mA = 0.235Ω;

2) V_{FB} = 800mA×0.235Ω = 188mV (Flash Mode);

3) R_{SET} = (1.26V/188mV)×10.2kΩ = 68.4kΩ are calculated;

The power consumption on R_{SENSE} in the Flash mode would be:

$$P_{RSENSE\_FLASH} = V_{FB\_FLASH} * I_{FLASH} = 188mV * 800mA = 150mW.$$

The normal 0603 surface mount resistor is rated as 0.1 Watt for continuous power and 0.2 Watt for pulsed power, and the normal 0805 surface mount resistor is rated as 0.125 Watt for continuous power and 0.25 Watt for pulsed power, the power 0805 surface mount resistor is rated as 0.25 Watt for continuous power and 0.5 Watt for pulsed power. The P_{RSENSE_FLASH} power can be calculated and resistor size selected accordingly.

Considering the power deviation, it is strongly recommended to use the power 0805 surface mount resistor. Referring to the following *Table 3* to choose R_SENSE size.

Table 3   Typical R_SENSE Resistor Value and Size

Part	Resistance	Tolerance(+/-)	I_{FLASH}(A)	P_{RSENSE}(W)	Type	Size
R_SENSE	0.22Ω	1%	0.5	0.055	Normal	0603
R_SENSE	0.22Ω	1%	0.7	0.108	Normal	0805
R_SENSE	0.22Ω	1%	1.0	0.22	Power	0805
R_SENSE	0.33Ω	1%	0.5	0.083	Normal	0805
R_SENSE	0.33Ω	1%	0.7	0.16	Power	0805
R_SENSE	0.47Ω	1%	0.5	0.12	Normal	0805
R_SENSE	0.47Ω	1%	0.7	0.23	Power	0805

The range of normal R_SET resistor values and sizes are shown here in *Table 4*.

Table 4   R_SET Resistor Value and Size

Part	Resistance	Tolerance(+/-)	Size	Vendor
R_SET	56kΩ	1%	0402	EYANG or Murata
R_SET	61kΩ	1%	0402	EYANG or Murata
R_SET	68kΩ	1%	0402	EYANG or Murata
R_SET	75kΩ	1%	0402	EYANG or Murata
R_SET	82kΩ	1%	0402	EYANG or Murata
R_SET	91kΩ	1%	0402	EYANG or Murata
R_SET	100kΩ	1%	0402	EYANG or Murata
R_SET	110kΩ	1%	0402	EYANG or Murata
R_SET	120kΩ	1%	0402	EYANG or Murata
R_SET	130kΩ	1%	0402	EYANG or Murata
R_SET	140kΩ	1%	0402	EYANG or Murata
R_SET	150kΩ	1%	0402	EYANG or Murata

PCB LAYOUT CONSIDERATION

To achieve adequate electrical and thermal performance, careful attention must be paid to the PCB layout. In the worst-case operating condition, the chip must dissipate considerable power at full load. Adequate heat-sinking must be achieved to ensure intended operation.

1. The flying capacitor C_F should be connected close to the chip. Trace length should be kept short to minimize path resistance and potential coupling. The input and output capacitors should also be placed as close to the chip as possible.

2. Keep the IC far from FM, RF and PA modules to avoid EMI interference.

3. The bottom of the package features an exposed metal paddle. The exposed paddle acts, thermally, to transfer heat from the chip and, electrically, as a ground connection.
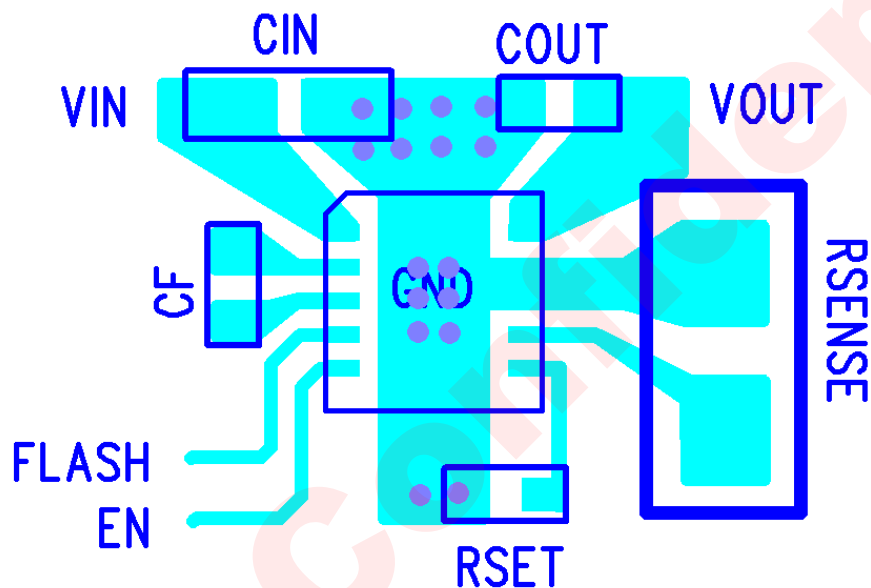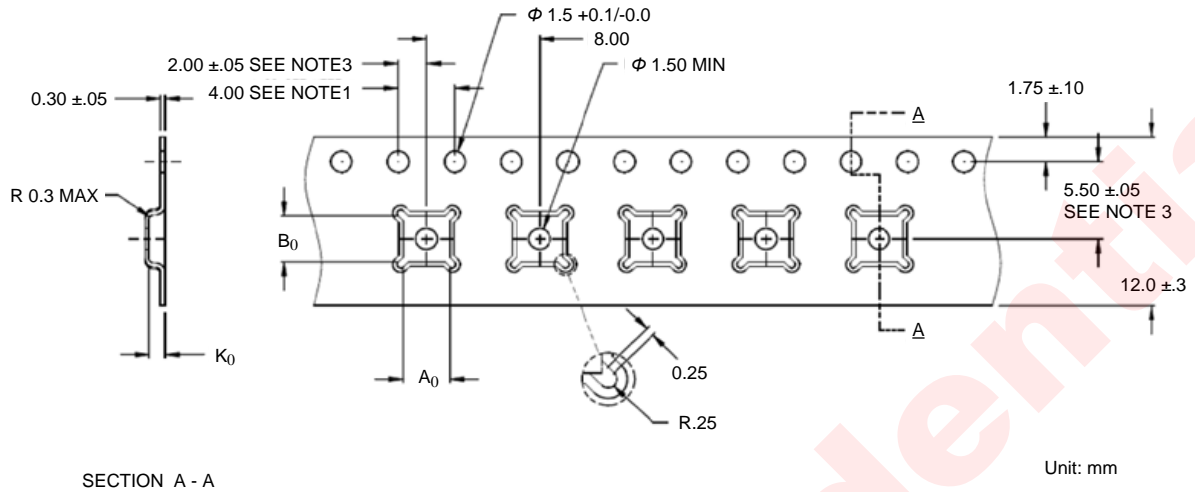

Figure 9   AW3641E PCB Layout Consideration

TAPE AND REEL INFORMATION

Carrier Tape

Φ 1.5 +0.1/-0.0
8.00
Φ 1.50 MIN

2.00 ±.05 SEE NOTE3
4.00 SEE NOTE1

0.30 ±.05

1.75 ±.10

A

R 0.3 MAX

B_0

A

K_0

5.50 ±.05
SEE NOTE 3

12.0 ±.3

A_0

0.25

R.25

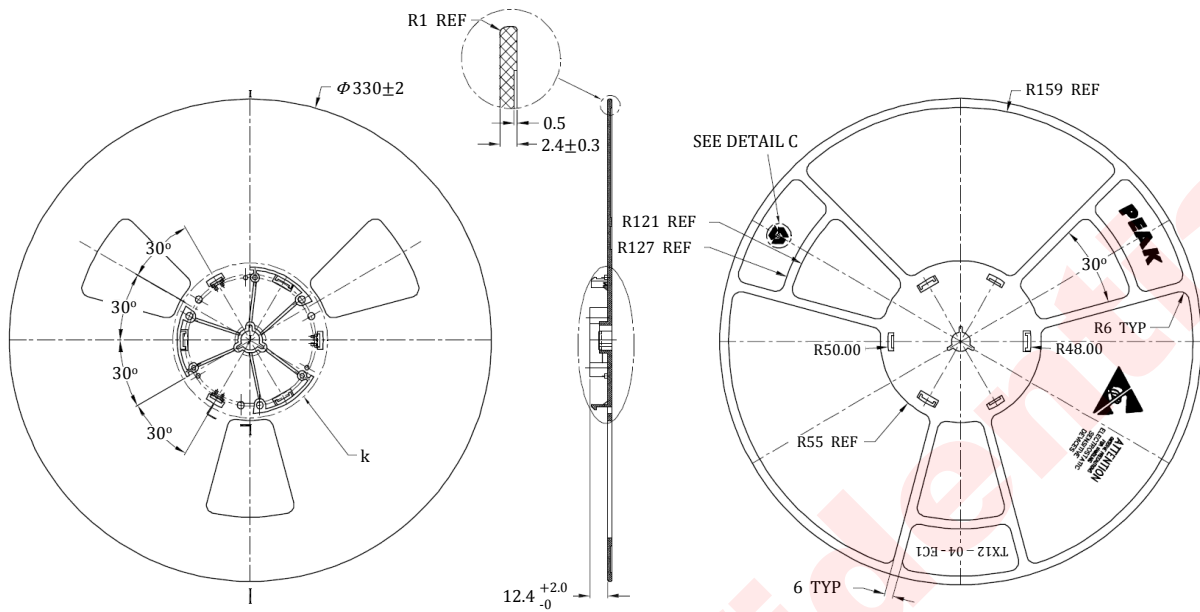SECTION A - A

Unit: mm

A_0 = 3.30
B_0 = 3.30
K_0 = 1.10

NOTES:
1. 10 SPROCKET HOLE CLIMULATIVE TOLERANCE ±0.2
2. CAMBER IN CMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED
   AS TRUE POSITION OF POCKET, NOT OCKET HOLE
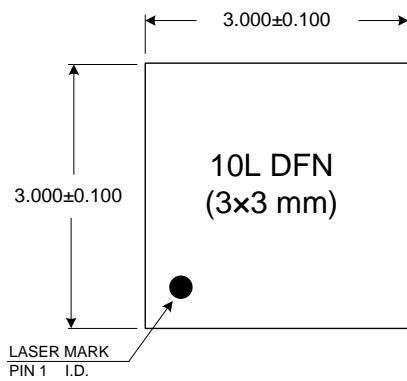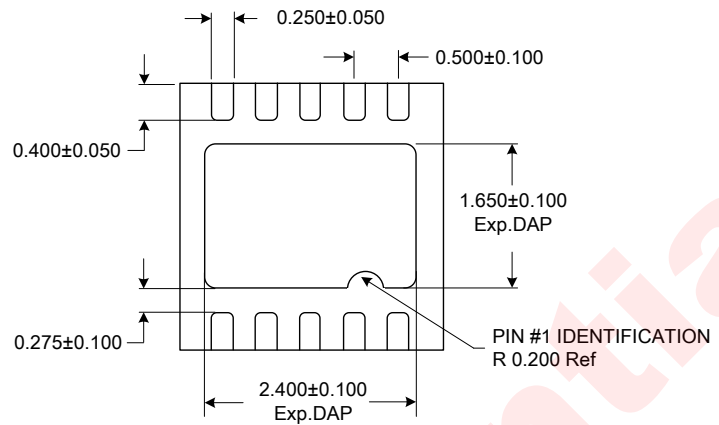
Pin 1 direction

Pin 1
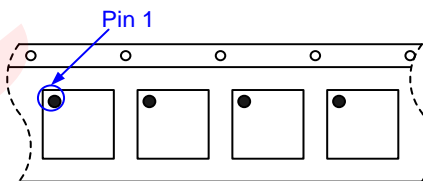
Reel

NOTES:
UNLESS OTHERWISE SPECIFIED
1. MATERIAL: DISSIPATIVE (BLACK)
2. FLANGE WARPAGE: 3 MM MAXIMUM
3. ALL DIMENSIONS ARE IN MM
4. ESD – SURFACE RESISTIVITY
– 10^5 TO 10^{11} OHMS/SQ
5. GENERAL TOLERANCE: –X.X=±0.4，–X.XX=±0.20
6. TOTAL THICKNESS OF REEL: 18.4 MAX
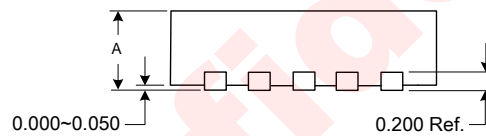7. PART NO: TX12–04-EC1

PACKAGE DESCRIPTION

Top View

unit : mm		DFN
A	MAX	0.800
	NOM	0.750
	MIN	0.700

Bottom View

Side View
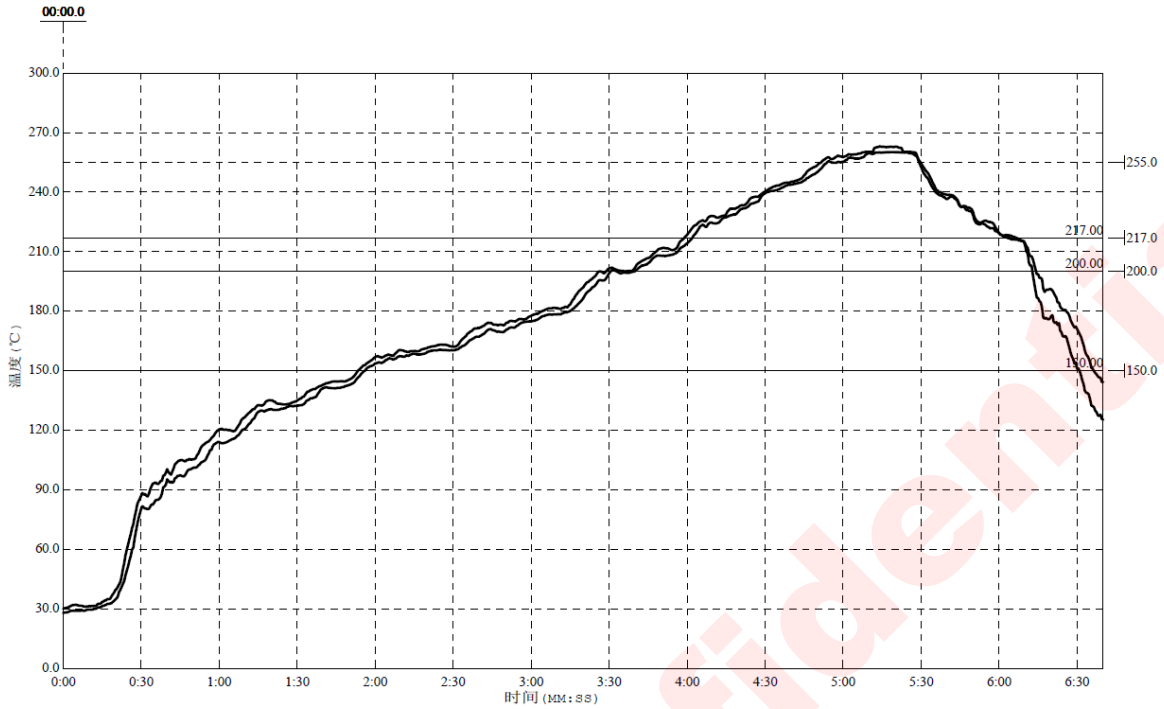
REFLOW

Figure 22   Package Reflow Oven Thermal Profile

Reflow Note	spec
Average ramp-up rate (217℃ to Peak)	Max. 3℃/sec
Time of Preheat temp.(from 150℃ to 200℃)	60-120sec
Time to be maintained above 217℃	60-150sec
Peak Temperature	>260℃
Time within 5℃ of actual peak temp	20-40sec.
Ramp-down rate	Max. 6℃/sec
Time from 25℃ to peak temp	Max. 8min.

REVISION HISTORY

Vision	Date	Change Record
V0.9	Mar 2014	AW3641EDNR Datasheet Preliminary
V1.0	Oct 2014	AW3641EDNR Datasheet Released
V1.1	Feb 2015	Add PWM dimming sequence description *(Page14-15)*
V1.2	Aug 2015	Add recommended land pattern *(Page21)*
V1.3	Mar 2019	Modify diagrams in typical characteristics *(Page9-10)*

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