

## 1.5MHz Synchronous Step-down DC-DC Converter

AP3410

### General Description

The AP3410 is a high efficiency step-down DC-DC voltage converter. The chip operation is optimized by peak-current mode architecture with built-in synchronous power MOSFET switchers. The oscillator and timing capacitors are all built-in providing an internal switching frequency of 1.5MHz that allows the use of small surface mount inductors and capacitors for portable product implementations.

Integrated Soft Start (SS), Under Voltage Lock Out (UVLO), Thermal Shutdown Detection (TSD) and Short Circuit Protection are designed to provide reliable product applications.

The device is available in adjustable output voltage version ranging from 0.6V to  $0.9 \times V_{IN}$  when input voltage range is from 2.5V to 5.5V, and is able to deliver up to 1.2A.

The AP3410 is available in SOT-23-5 and DFN-2x2-6 packages.

### Features

- High Efficiency Buck Power Converter
- Wide Input Voltage Range: 2.5V to 5.5V
- Adjustable Output Voltage: 0.6V to  $0.9 \times V_{IN}$
- Low  $R_{DS(ON)}$  Internal Switches: 200m $\Omega$  ( $V_{IN}=5V$ )
- Built-in Power Switches for Synchronous Rectification with High Efficiency
- Output Current: 1.2A
- Feedback Voltage: 600mV
- 1.5MHz Constant Frequency Operation
- Thermal Shutdown Protection
- Low Dropout Operation at 100% Duty Cycle
- No Schottky Diode Required
- Input Over Voltage Protection
- Output Over Voltage Protection
- Over Current Protection
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](#) or your local Diodes representative.  
<https://www.diodes.com/quality/product-definitions/>

### Applications

- Post DC-DC Voltage Regulation
- PDA and Notebook Computer

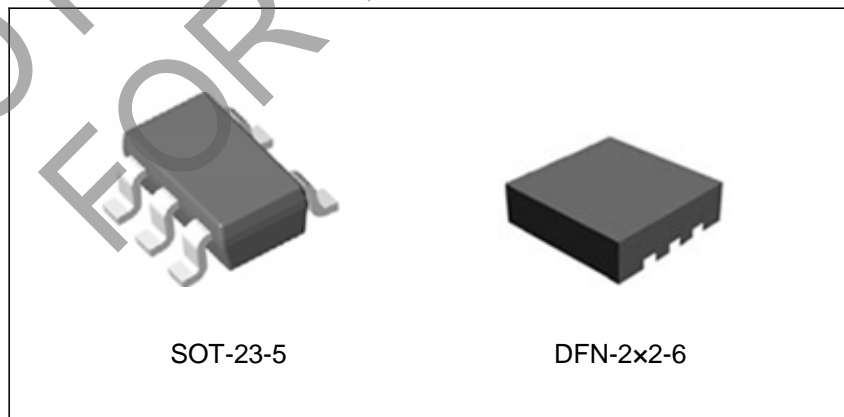


Figure 1. Package Types of AP3410

**1.5MHz Synchronous Step-down DC-DC Converter**

**AP3410**

**Pin Configuration**

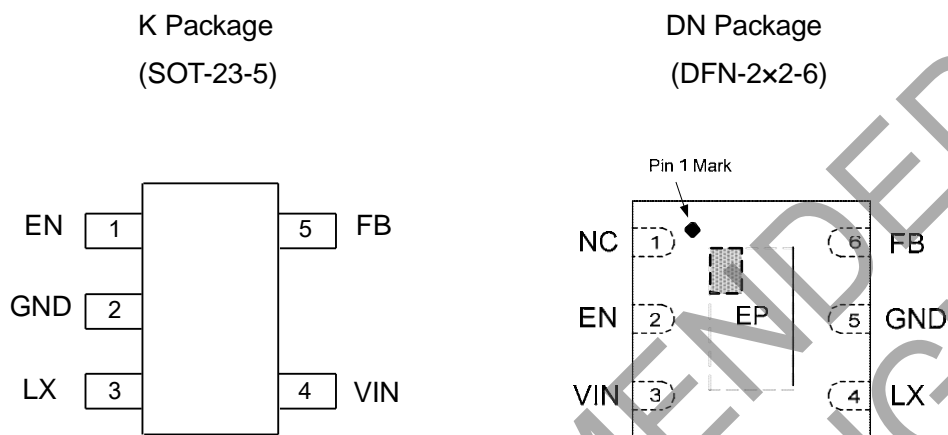


Figure 2. Pin Configuration of AP3410 (Top View)

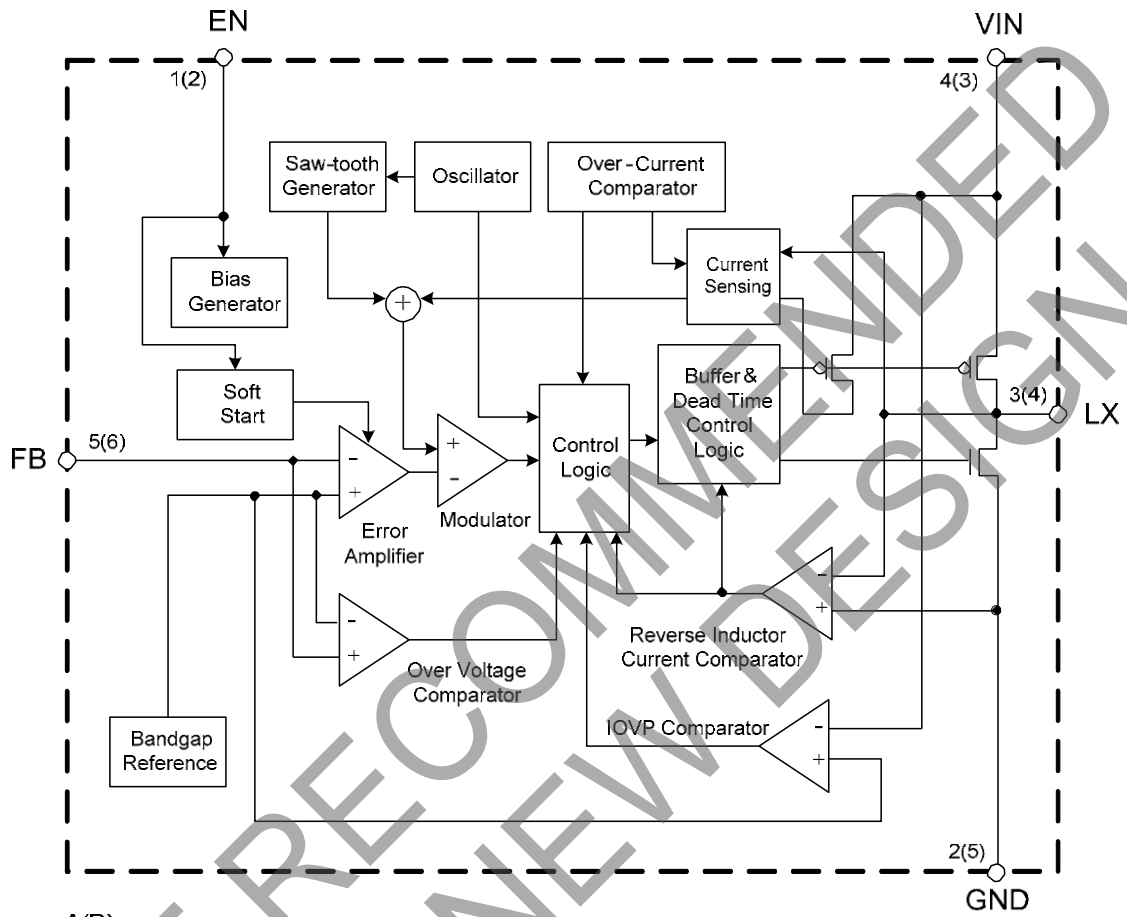
**Pin Description**

| Pin Number |           | Pin Name | Function                     |
|------------|-----------|----------|------------------------------|
| SOT-23-5   | DFN-2x2-6 |          |                              |
| 1          | 2         | EN       | Chip enable pin. Active high |
| 2          | 5         | GND      | Ground pin                   |
| 3          | 4         | LX       | Switch output pin            |
| 4          | 3         | VIN      | Power supply                 |
| 5          | 6         | FB       | Feedback voltage of output   |
|            | 1         | NC       | No internal connection       |

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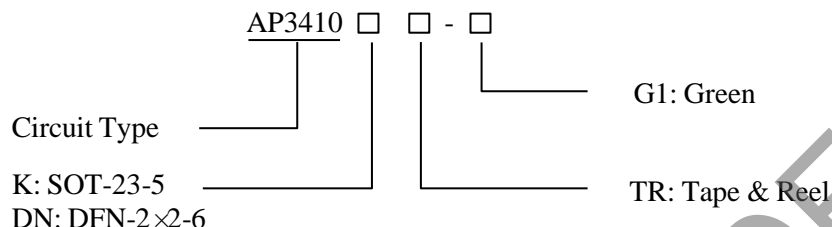
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**Functional Block Diagram**



A(B)  
A for SOT-23-5  
B for DFN-2x2-6

Figure 3. Functional Block Diagram of AP3410

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**AP3410**
**Ordering Information**


| Package   | Temperature Range | Part Number   | Marking ID | Packing Type |
|-----------|-------------------|---------------|------------|--------------|
| SOT-23-5  | -40 to 85 °C      | AP3410KTR-G1  | GHW        | Tape & Reel  |
| DFN-2×2-6 | -40 to 85 °C      | AP3410DNTR-G1 | CJ         | Tape & Reel  |

**Absolute Maximum Ratings (Note 1)**

| Parameter  | Symbol        | Value                |      | Unit |
|--|---------------|----------------------|------|------|
| Input Voltage for the MOSFET Switch                  | $V_{IN}$      | 0 to 6.0             |      | V    |
| Enable Input Voltage                                 | $V_{EN}$      | -0.3 to $V_{IN}+0.3$ |      | V    |
| LX Pin Switch Current                                | $I_{LX}$      | 1.8                  |      | A    |
| Power Dissipation (on PCB, $T_A=25\text{ °C}$ )      | $P_D$         | SOT-23-5             | 0.4  | W    |
|  |               | DFN-2×2-6            | 1.89 |      |
| Thermal Resistance (Junction to Ambient, Simulation) | $\theta_{JA}$ | SOT-23-5             | 250  | °C/W |
|  |               | DFN-2×2-6            | 53   |      |
| Thermal Resistance (Junction to Case, Simulation)    | $\theta_{JC}$ | SOT-23-5             | 130  | °C/W |
| Operating Junction Temperature                       | $T_J$         | 155                  |      | °C   |
| Storage Temperature                                  | $T_{STG}$     | -55 to 150           |      | °C   |
| Operating Temperature                                | $T_{OP}$      | -40 to 85            |      | °C   |
| ESD (Machine Model)                                  | $V_{MM}$      | 200                  |      | V    |
| ESD (Human Body Model)                               | $V_{HBM}$     | 2000                 |      | V    |

Note 1: Stresses greater than 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 Ratings” for extended periods may affect device reliability.

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**Recommended Operating Conditions**

| Parameter                      | Symbol   | Min | Max | Unit |
|--------------------------------|----------|-----|-----|------|
| Supply Input Voltage           | $V_{IN}$ | 2.5 | 5.5 | V    |
| Operating Ambient Temperature  | $T_A$    | -40 | 85  | °C   |
| Operating Junction Temperature | $T_J$    | -40 | 125 | °C   |

**Electrical Characteristics**

$V_{IN}=V_{EN}=5V$ ,  $V_{OUT}=1.2V$ ,  $V_{FB}=0.6V$ ,  $L=2.2\mu H$ ,  $C_{IN}=4.7\mu F$ ,  $C_{OUT}=10\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified.

| Parameters                        | Symbol                   | Conditions   | Min   | Typ | Max   | Unit      |
|-----------------------------------|--------------------------|--|-------|-----|-------|-----------|
| Input Voltage Range               | $V_{IN}$                 |  | 2.5   |     | 5.5   | V         |
| Shutdown Current                  | $I_{OFF}$                | $V_{EN}=0$   |       |     | 0.1   | $\mu A$   |
| Active Current                    | $I_{ON}$                 | $V_{FB}=0.55V$                                     |       | 220 |       | $\mu A$   |
| Regulated Feedback Voltage        | $V_{FB}$                 |  | 0.588 | 0.6 | 0.612 | V         |
| Regulated Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | $V_{IN}=2.5V$ to $5.5V$ ,<br>$I_{OUT}=0$ to $1.2A$ | -3    |     | 3     | %         |
| Peak Inductor Current             | $I_{PK}$                 |  | 1.5   | 1.9 |       | A         |
| Oscillator Frequency              | $f_{OSC}$                | $V_{IN}=2.5V$ to $5.5V$                            | 1.2   | 1.5 | 1.8   | MHz       |
| PMOSFET $R_{DS(ON)}$              | $R_{DS(ON)P}$            | $V_{IN}=5V$  |       | 200 |       | $m\Omega$ |
| NMOSFET $R_{DS(ON)}$              | $R_{DS(ON)N}$            | $V_{IN}=5V$  |       | 200 |       | $m\Omega$ |
| EN High Level Input Voltage       | $V_{EN\_H}$              |  | 1.5   |     |       | V         |
| EN Low Level Input Voltage        | $V_{EN\_L}$              |  |       |     | 0.4   | V         |
| EN Input Current                  | $I_{EN}$                 |  |       |     | 0.1   | $\mu A$   |
| Soft Start Time                   | $t_{SS}$                 |  |       | 400 |       | $\mu s$   |
| Maximum Duty Cycle                | $D_{MAX}$                |  | 100   |     |       | %         |
| Under Voltage Lock Out Threshold  | $V_{UVLO}$               | Rising   |       | 2.3 |       | V         |
|                                   |                          | Falling  |       | 2.1 |       |           |
|                                   |                          | Hysteresis   |       | 0.2 |       |           |
| Thermal Shutdown                  | $T_{SD}$                 | Hysteresis=30 °C                                   |       | 155 | 160   | °C        |

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**Typical Performance Characteristics**

$V_{IN}=5V$ ,  $T_A=25\text{ }^\circ\text{C}$ , unless otherwise noted.

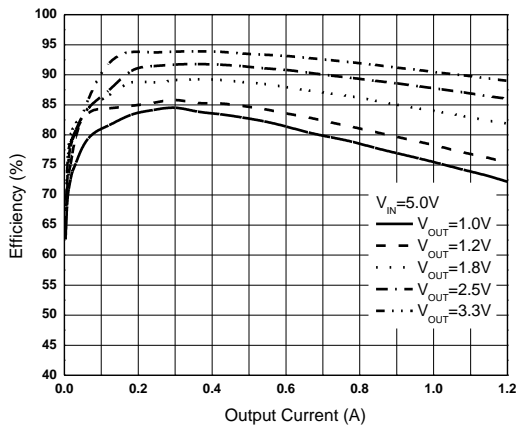


Figure 4. Efficiency vs. Output Current

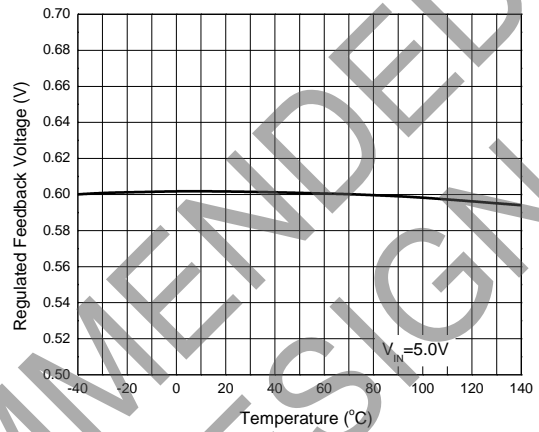


Figure 5. Regulated Feedback Voltage vs. Temperature

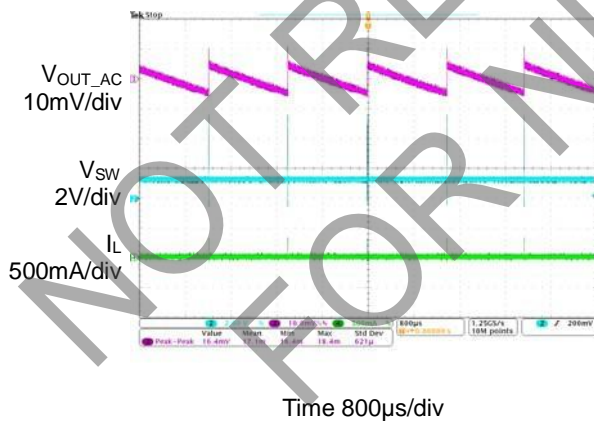


Figure 6. Output Ripple ( $I_{OUT}=0A$ )

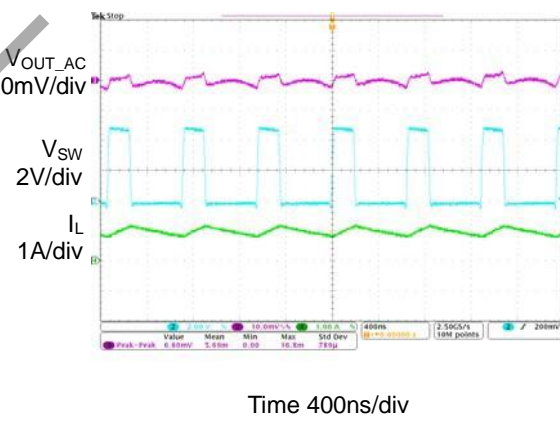


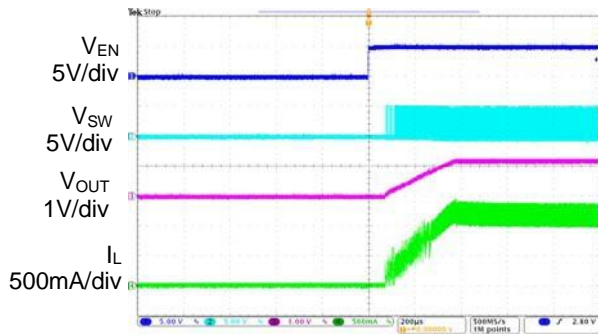
Figure 7. Output Ripple ( $I_{OUT}=1.2A$ )

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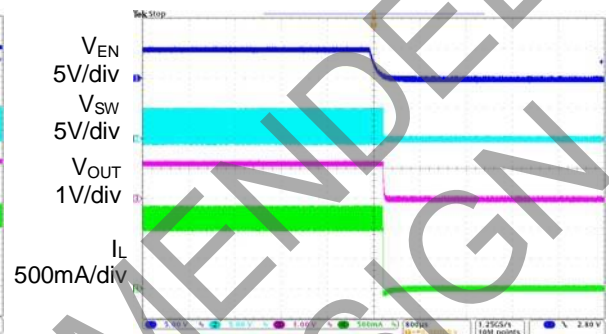
**Typical Performance Characteristics (Continued)**

$V_{IN}=5V$ ,  $T_A=25\text{ }^\circ\text{C}$ , unless otherwise noted.



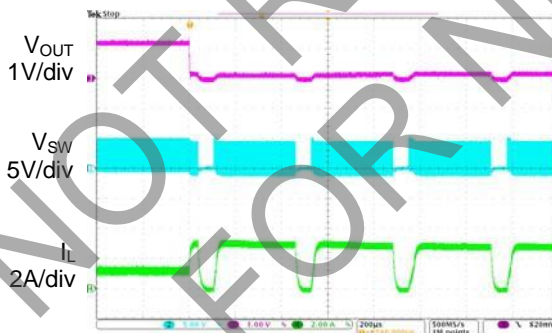
Time 200µs/div

Figure 8. Enable Turn On ( $I_{OUT}=1.2A$ )



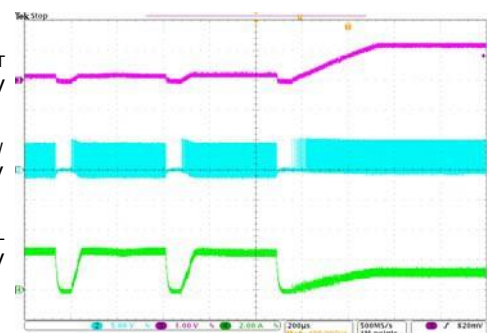
Time 800µs /div

Figure 9. Enable Turn Off ( $I_{OUT}=1.2A$ )



Time 200µs/div

Figure 10. Short Circuit Protection ( $I_{OUT}=1.2A$ )



Time 200µs /div

Figure 11. Short Circuit Protection Recovery ( $I_{OUT}=1.2A$ )

**1.5MHz Synchronous Step-down DC-DC Converter**

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**Typical Application**

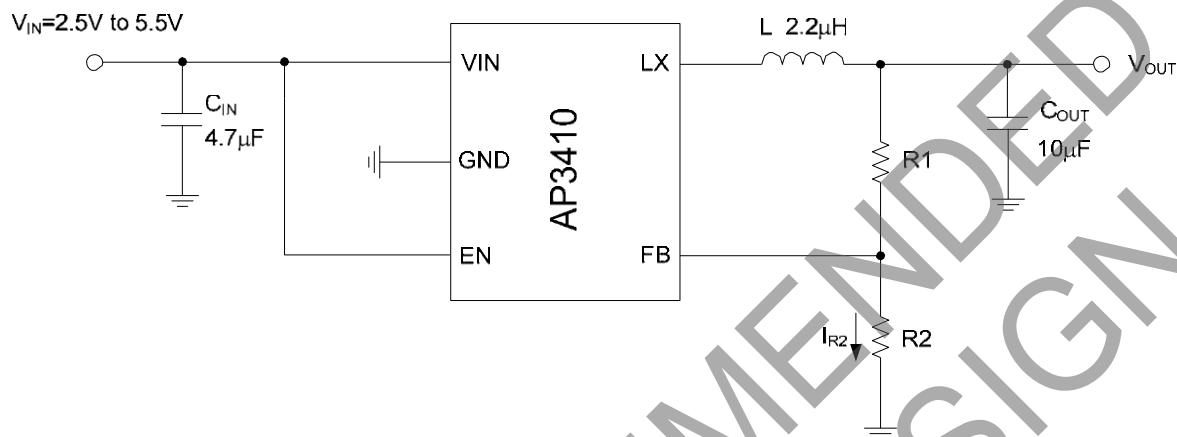


Figure 12. Typical Applications of AP3410

**Table 1. Component Guide**

| V <sub>OUT</sub> (V) | R1 (kΩ) | R2 (kΩ) | L (µH) |
|----------------------|---------|---------|--------|
| 3.3                  | 450     | 100     | 2.2    |
| 2.5                  | 320     | 100     | 2.2    |
| 1.8                  | 200     | 100     | 2.2    |
| 1.2                  | 100     | 100     | 2.2    |
| 1.0                  | 66      | 100     | 2.2    |



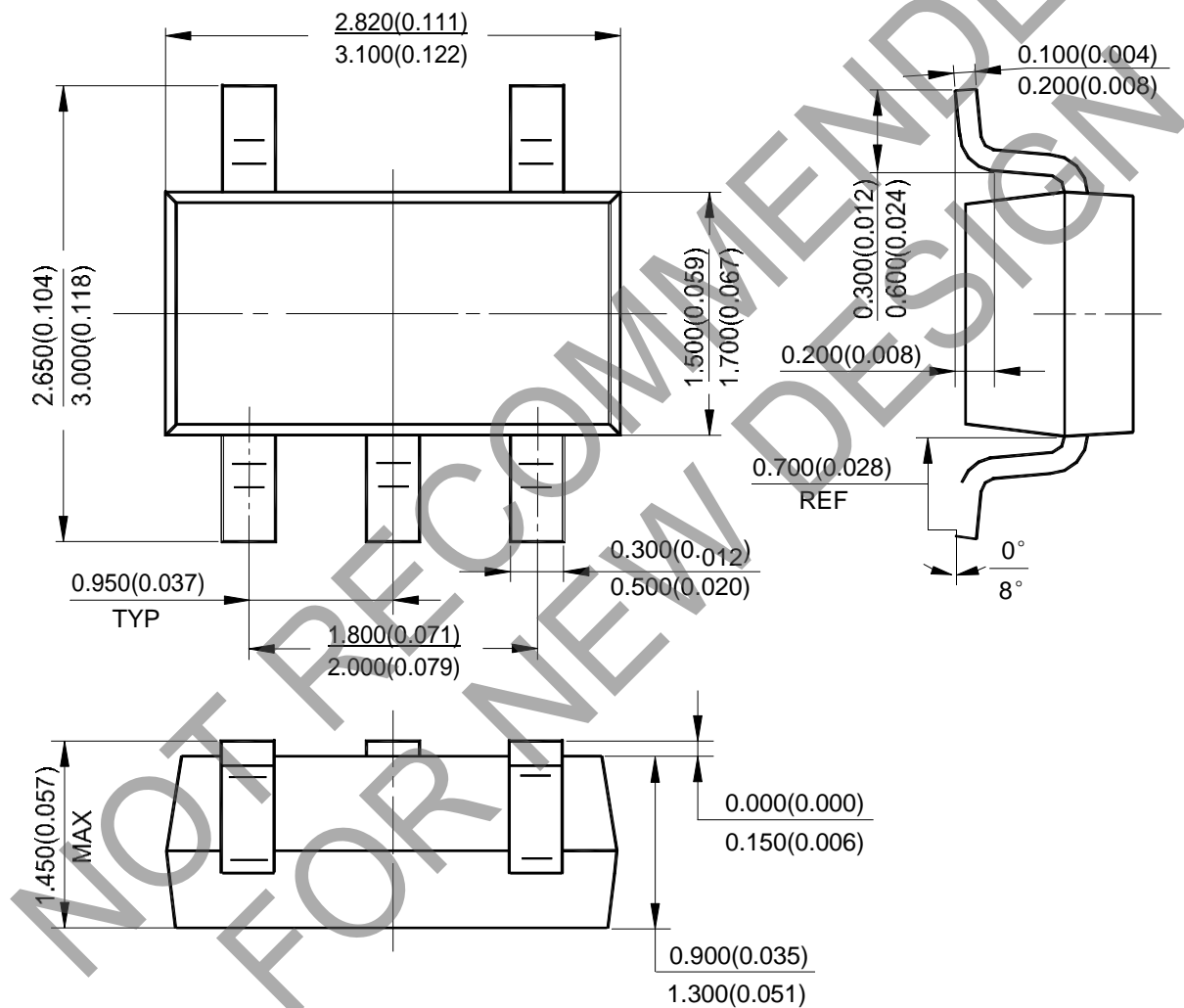
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**Mechanical Dimensions**

**SOT-23-5**

**Unit: mm(inch)**



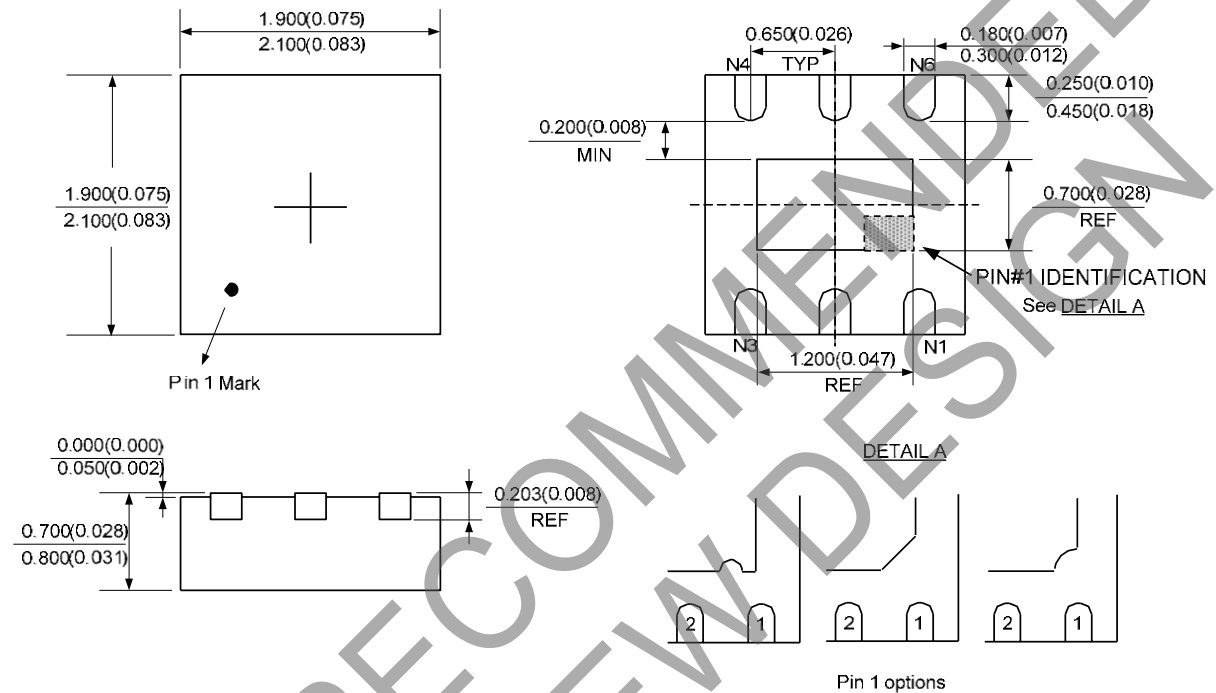
**1.5MHz Synchronous Step-down DC-DC Converter**

**AP3410**

**Mechanical Dimensions (Continued)**

**DFN-2x2-6**

**Unit: mm(inch)**



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