

Description

The AH5794 is a single chip solution for driving single-coil brushless direct current (BLDC) fans and motors. The integrated full-bridge driver output stage uses soft switching to minimize audible switching noise and electromagnetic interference (EMI) providing a low noise solution.

Low operating voltage down to 1.8V allows motor speed to be controlled by varying the supply voltage.

To help protect the motor coil, the AH5794 provides Rotor Lock Protection which shuts down the output drive if rotor lock is detected. The device automatically re-starts when the rotor lock is removed. Over temperature shutdown provides thermal protection for the device.

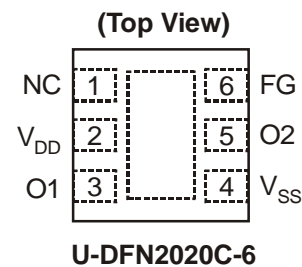
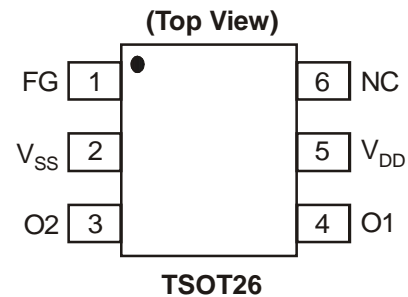
A Tachometer output is provided by open-drain Frequency Generator (FG) Pin which allows external interface to monitor motor rotation or speed. The FG output is the magnetic change frequency.

The AH5794 is available in space saving and low profile TSOT26 and U-DFN2020C-6 packages.

Features

- Supports single-coil full-wave BLDC fan drivers
- Built-in Hall sensor and input amplifier
- Operating voltage: 1.8V to 6V
- V_{DD} voltage speed control
- Soft switching for low noise DC fan motor applications
- Rotor Lock Protection (Lock detection, output shutdown and automatic re-start)
- Thermal protection
- Tachometer (FG) output
- No external timing capacitor - Reduces the numbers of external components required
- Low profile package: TSOT26 and U-DFN2020C-6
- Halogen and Antimony free "Green" packages.
- Lead Free Finish/ RoHS Compliant

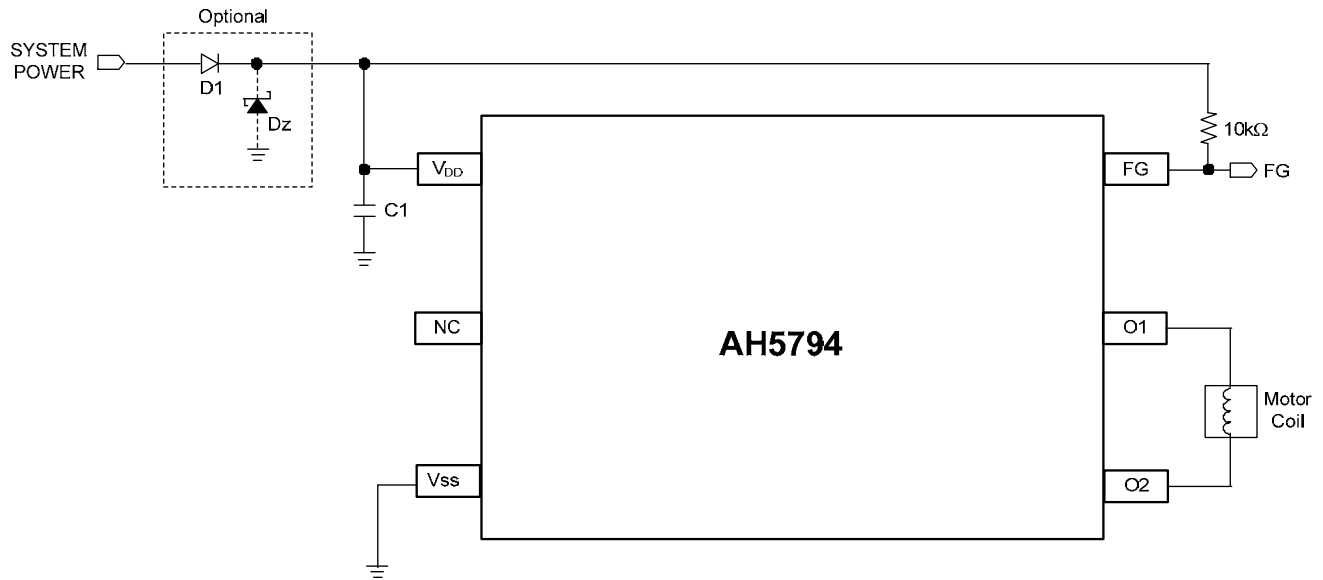
Pin Assignments



Applications

- 3V/ 3.3V/ 5V BLDC Cooling Fans
- Netbook/ Notebook BLDC fans
- Instruments cooling fans
- Low Voltage/ Low Power BLDC Motors

Typical Application Circuit

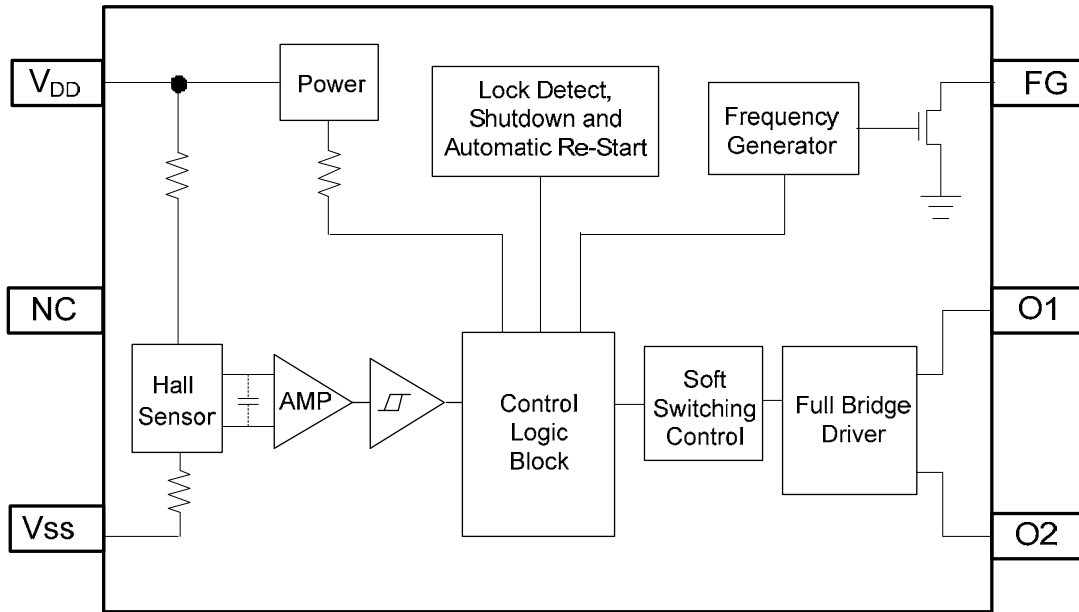


Pin Descriptions

| Pin Name | Description |
|-----------------|------------------------------|
| V _{DD} | Power supply pin |
| V _{SS} | Ground pin |
| O1 | Output driving & sinking pin |
| O2 | Output driving & sinking pin |
| NC | No connection |
| FG | Frequency generator (Note 1) |

Notes: 1. The FG output is the same as the magnetic change frequency.

Functional Block Diagram (Note 2)



Notes: 2.The AH5794 has an open-drain tachometer FG output that follows the magnetic change frequency. Typically a pull-up resistor of 10kΩ is recommended from FG pin to the supply voltage.

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$, unless otherwise noted, Note 3)

| Symbol | Characteristics | Values | Unit |
|---------------|---------------------------------|--------------|------------------|
| V_{DD} | Supply Voltage | 7 | V |
| $I_{O(PEAK)}$ | Maximum Output Current (Peak) | 1000 | mA |
| P_D | Power Dissipation | TSOT26 | 650 |
| | | U-DFN2020C-6 | 750 (Note 4) |
| T_{ST} | Storage Temperature Range | -65 ~ +150 | $^\circ\text{C}$ |
| ESD HBM | Human Body Model ESD Protection | 4 | kV |

- Notes:
- Stresses greater than the 'Absolute Maximum Ratings' specified above, may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time
 - U-DFN2020C-6 exposed pad soldered to minimum recommended landing pads (see Package Outline Dimension section) on a two-layer 2oz. copper FR4 PCB (1.6mm thickness) with no thermal vias in exposed PADS or any copper flood connecting to the landing pattern of the exposed pad.

Recommended Operating Conditions ($T_A = 25^\circ\text{C}$)

| Symbol | Parameter | Conditions | Min | Max | Unit |
|----------|-------------------------------------|------------------------------|-----|------|------------------|
| V_{DD} | Supply Voltage at V_{DD} pin | DC supply speed control mode | 1.8 | 6.0 | V |
| T_A | Operating Ambient Temperature Range | Operating | -40 | +105 | $^\circ\text{C}$ |

Electrical Characteristics ($T_A = 25^\circ\text{C}$, $V_{DD} = 5\text{V}$)

| Symbol | Characteristics | Conditions | Min | Typ. | Max | Unit |
|--------------------|---|---------------------------|------|------|-----|------------------|
| I_{DD} | Supply Current | No Load | - | 2.2 | - | mA |
| V_{OH} | Output Voltage High | $I_{OUT} = 300\text{mA}$ | 4.70 | 4.88 | - | V |
| | | $I_{OUT} = 500\text{mA}$ | 4.5 | 4.8 | - | V |
| V_{OL} | Output Voltage Low | $I_{OUT} = 300\text{mA}$ | - | 0.12 | 0.3 | V |
| | | $I_{OUT} = 500\text{mA}$ | - | 0.2 | 0.5 | V |
| $V_{OH} + V_{OL}$ | Output voltage of N- and PMOS combined | $I_{OUT} = 300\text{mA}$ | | 0.3 | 0.5 | V |
| | | $I_{OUT} = 500\text{mA}$ | | 0.5 | | V |
| T_{SW} | Output Switching Slope Duration | 17 Ω load on O1/O2 | - | 200 | - | μs |
| I_{LEAK} | FG Output Leakage Current | | - | - | 5 | μA |
| V_{FGOL} | FG Output Voltage Low | $I_{FG} = 5\text{mA}$ | - | - | 0.4 | V |
| T_{ON} | On Time | | 350 | 500 | 650 | ms |
| R_{DR} | Duty Ratio | T_{OFF} / T_{ON} | - | 10 | - | |
| $T_{J_SDN_TH}$ | IC junction temperature thermal shutdown threshold | | | 175 | | $^\circ\text{C}$ |
| $T_{J_SDN_HYST}$ | IC junction temperature thermal shutdown hysteresis | | | 25 | | $^\circ\text{C}$ |

Magnetic Characteristics ($T_A = 25^\circ\text{C}$, $V_{DD} = 1.8\text{V to } 6\text{V}$, Note 5)

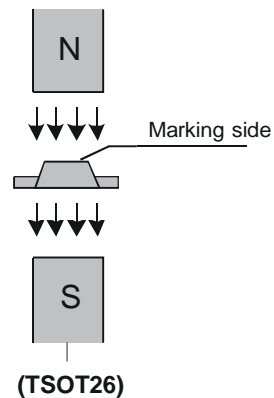
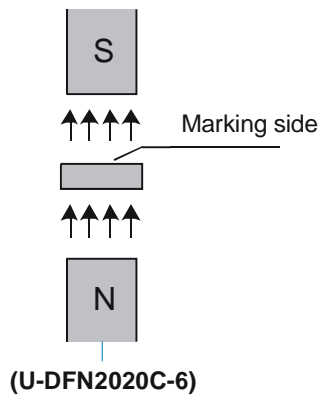
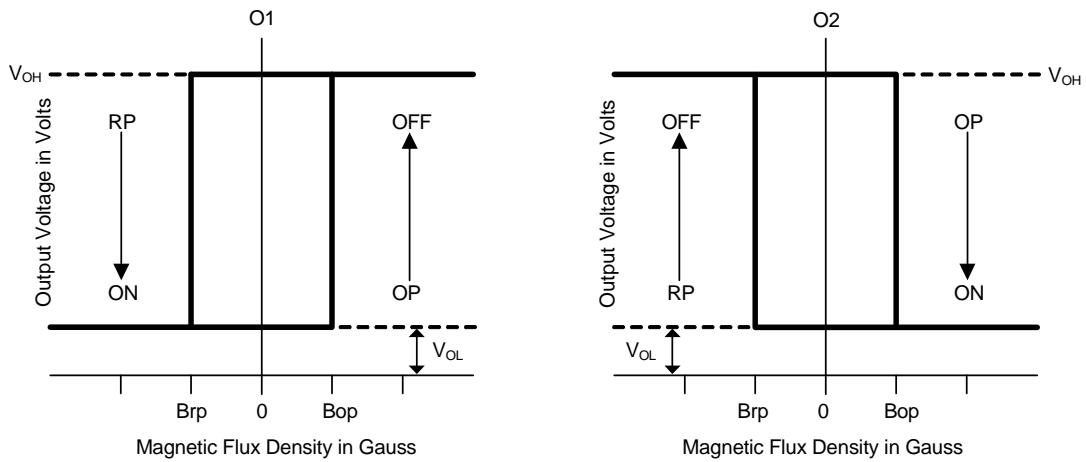
(1mT = 10 G)

| Symbol | Parameter | Min | Typ. | Max | Unit |
|----------|---------------|-----|------|-----|-------|
| B_{OP} | Operate Point | 10 | 25 | 50 | Gauss |
| B_{RP} | Release Point | -50 | -25 | -10 | |
| B_{hy} | Hysteresis | - | 50 | - | |

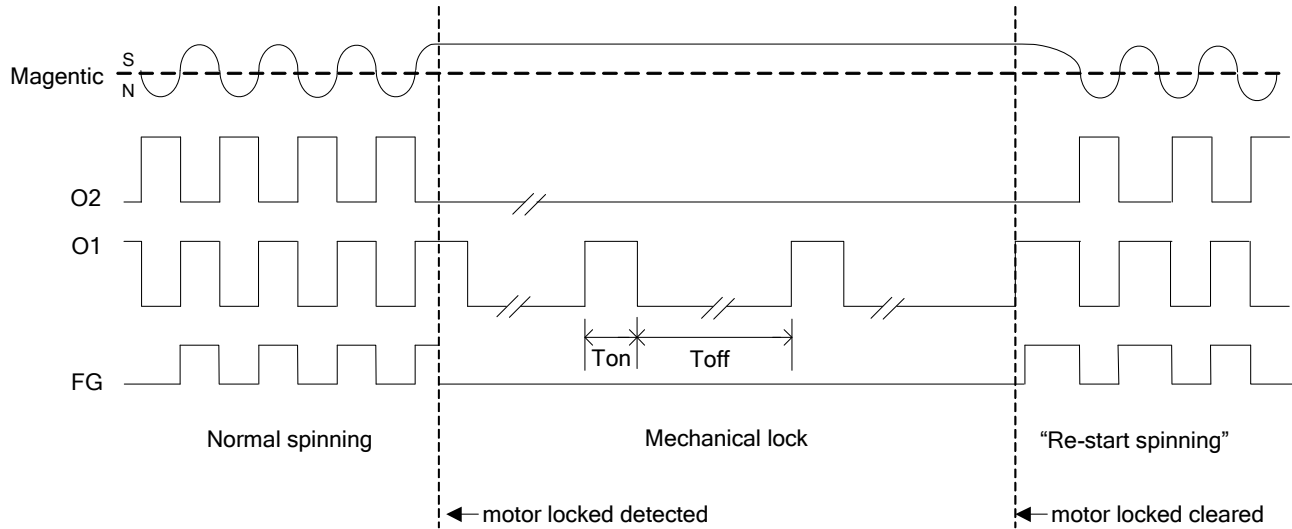
Notes: 5. Magnetic characteristics may vary with supply voltage, operating temperature and after soldering.

NEW PRODUCT

Operating Characteristics



Operating Characteristics (Note 6, 7, 8 and 9)



Truth Table

| O1 | O2 | FG |
|----|----|---------------|
| L | H | L |
| H | L | H |
| L | L | X (Note 9) |

- Notes:
- In "Normal spinning", the FG changes its state at each edge of O1.
 - When the motor locks with South pole at the Hall element, O2 is kept on "L" and O1 is a clock with T_{on}/T_{off} ratio. When motor locks with North pole at the Hall element, O1 is kept on "L", O2 is a clock with T_{on}/T_{off} ratio.
 - When "Re-start spinning" occurs, the motor speed ramps up to the "Normal Spinning" speed from zero. Speed ramp-up profile depends on motor characteristics.
 - X: H or L depends on magnetic pole North or South

Application Note

Motor Speed Control

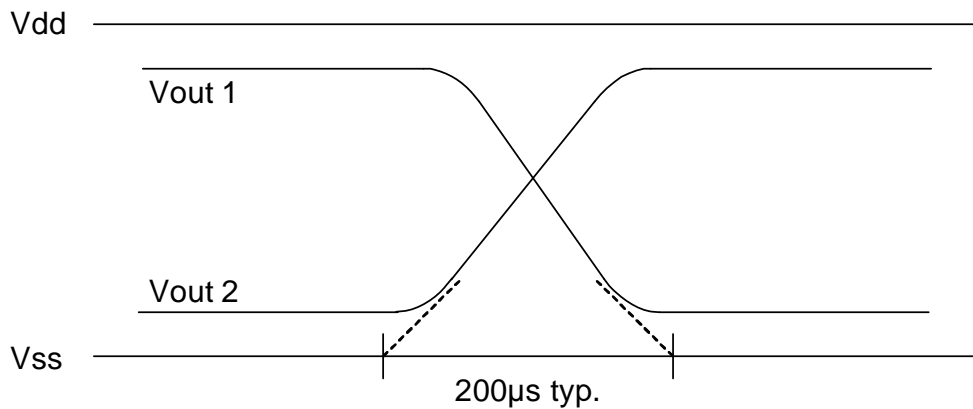
DC Supply Voltage (V_{DD}) Speed Control

Motor speed can be controlled by varying the V_{DD} supply voltage between 1.8V to 6V.

With 5V nominal motor, changing V_{DD} voltage between 5V to 1.8V, speed can be controlled from 100% to 36% typically.

Soft Switching

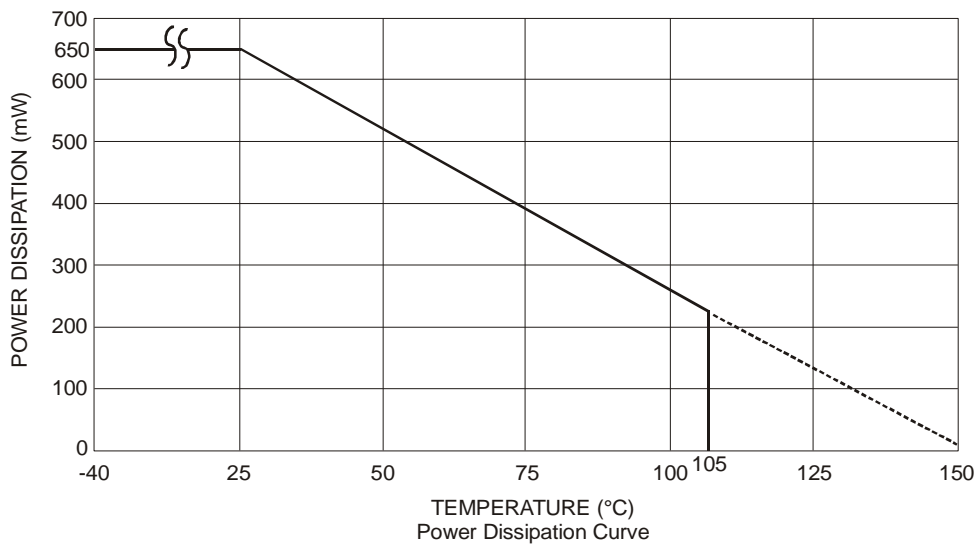
AH5794 uses soft switching of the motor coil current during commutation for to minimize audible switching noise and electromagnetic interference (EMI) to provide a low noise solution.



Thermal Performance Characteristics

(1) Package type: TSOT26

| | | | | | | | | | | |
|---------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| T_A (°C) | 25 | 50 | 60 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| P _D (mW) | 651 | 521 | 469 | 417 | 391 | 365 | 339 | 313 | 286 | 260 |
| T_A (°C) | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 |
| P _D (mW) | 234 | 208 | 182 | 156 | 130 | 104 | 78 | 52 | 26 | 0 |

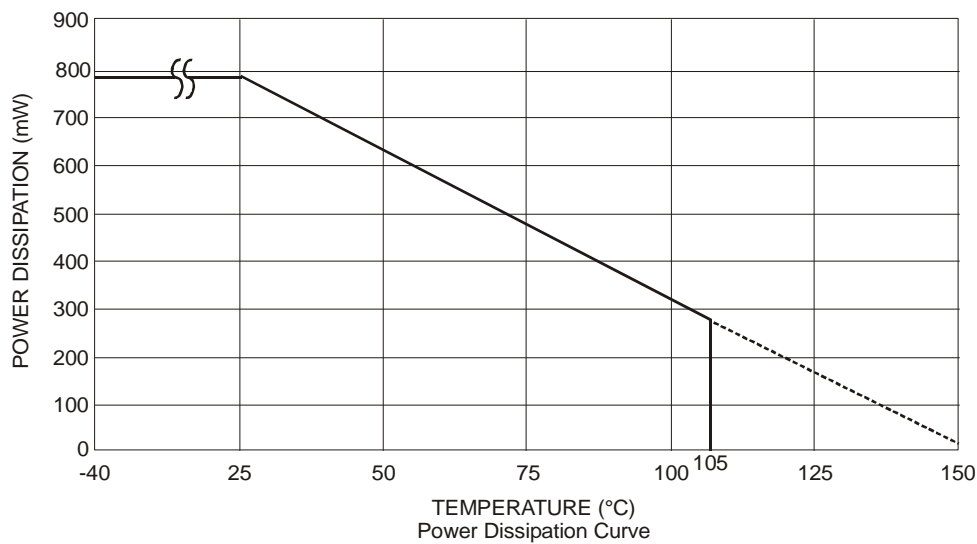


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Thermal Performance Characteristics (cont.)

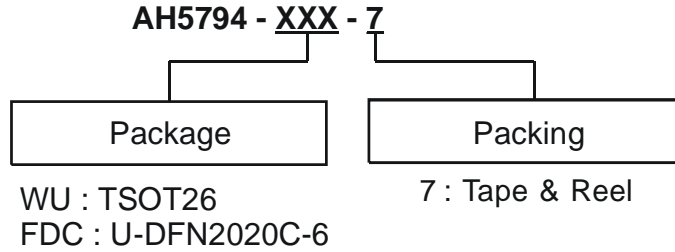
(2) Package type: U-DFN2020C-6 (Note 10)

| | | | | | | | | | | |
|---------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| T_A (°C) | 25 | 50 | 60 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| P _D (mW) | 781 | 625 | 563 | 500 | 469 | 438 | 406 | 375 | 344 | 313 |
| T_A (°C) | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 |
| P _D (mW) | 281 | 250 | 219 | 188 | 156 | 125 | 94 | 63 | 31 | 0 |



Notes: 10. U-DFN2020C-6 exposed pad soldered to minimum recommended landing pads (see Package Outline Dimension section) on a two-layer 2oz. copper FR4 PCB (1.6mm thickness) with no thermal vias in exposed PADs or any copper flood connecting to the landing pattern of the exposed pad.

Ordering Information

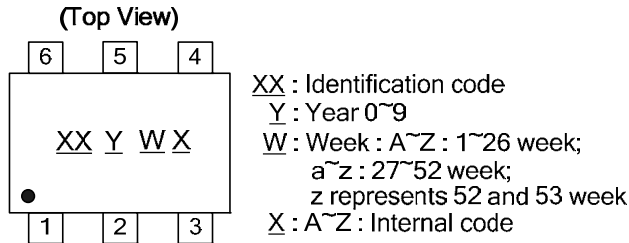


| Device | Package Code | Packaging (Note 11 & 12) | 7" Tape and Reel | |
|--------------|--------------|--------------------------|------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| AH5794-WU-7 | WU | TSOT26 | 3000/Tape & Reel | -7 |
| AH5794-FDC-7 | FDC | U-DFN2020C-6 | 3000/Tape & Reel | -7 |

Notes: 11. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>
 12. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. No purposely added lead. Halogen and Antimony free. Please visit our website at http://www.diodes.com/products/lead_free.html

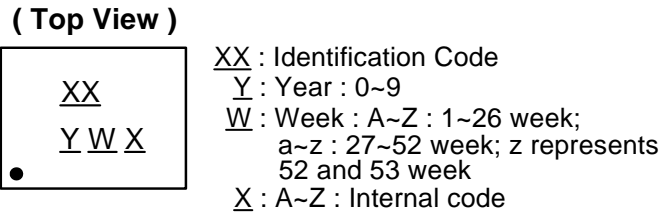
Marking Information

(1) Package type: TSOT26



| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| AH5794-WU-7 | TSOT26 | J4 |

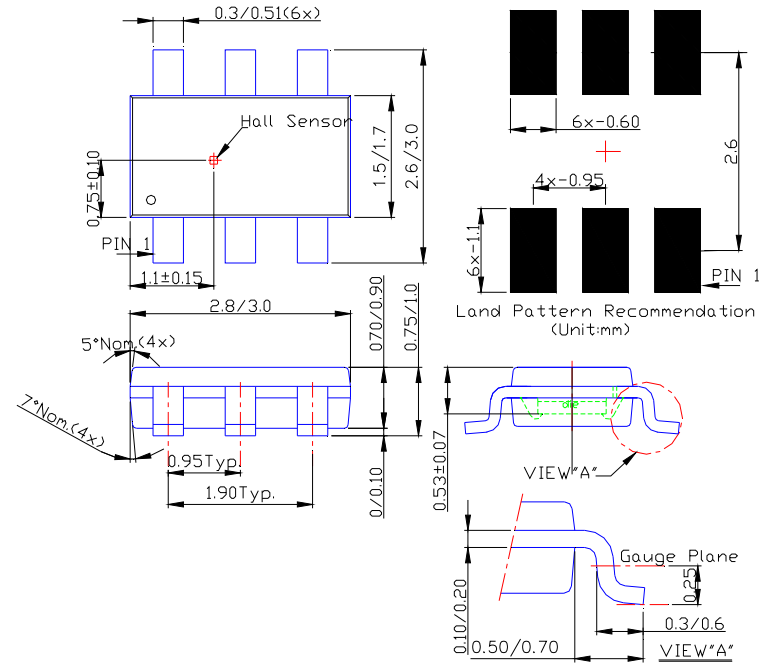
(2) Package type: U-DFN2020C-6



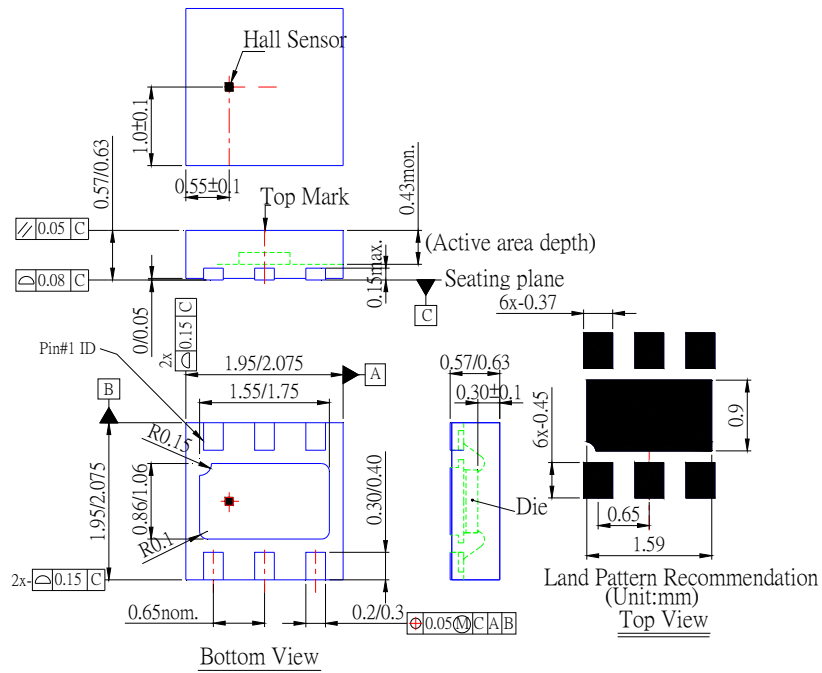
| Part Number | Package | Identification Code |
|--------------|--------------|---------------------|
| AH5794-FDC-7 | U-DFN2020C-6 | J4 |

Package Outline Dimensions (All Dimensions in mm)

(1) Package type: TSOT26

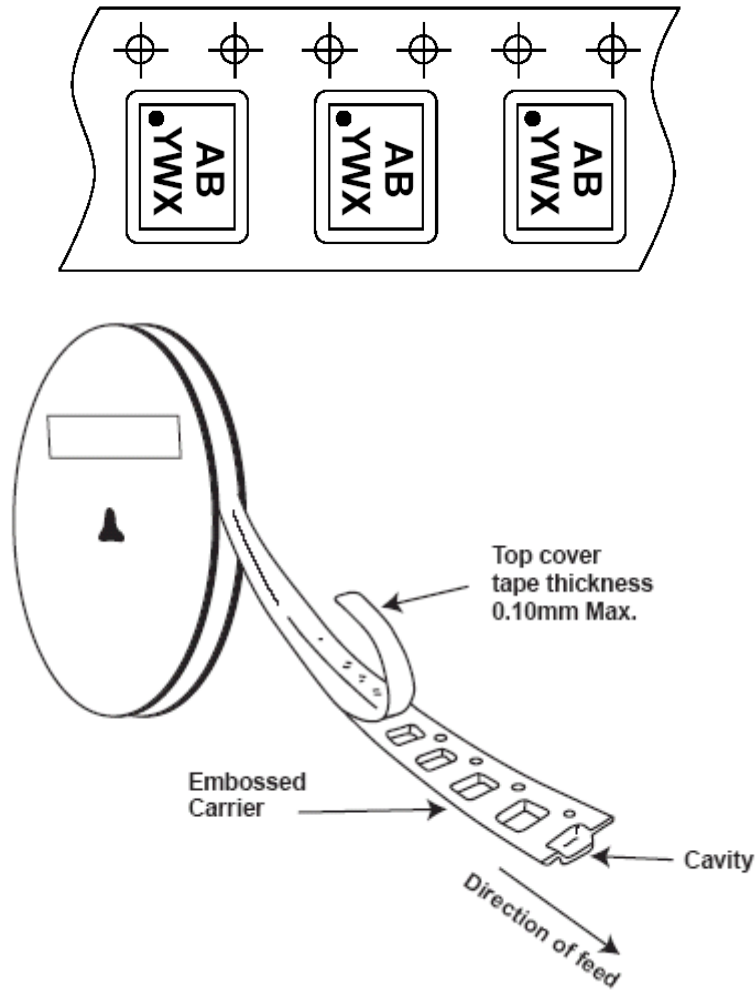


(2) Package Type: U-DFN2020C-6



Taping Orientation

(1) Package Type: U-DFN2020C-6



Notes: 11. The taping orientation of the other package type can be found on our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

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