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FAN7390
High-Current, High & Low-Side, Gate-Drive IC

Features

- Floating Channels for Bootstrap Operation to +600V
- Typically 4.5A/4.5A Sourcing/Sinking Current Driving Capability
- Common-Mode dv/dt Noise Canceling Circuit
- Built-in Under-Voltage Lockout for Both Channels
- Matched Propagation Delay for Both Channels
- Logic (V\text{SS}) and Power (COM) Ground +/- 7V Offset
- 3.3V and 5V Input Logic Compatible
- Output In-phase with Input

Applications

- PDP Sustain Driver
- HID Lamp Ballast
- SMPS
- Motor Driver

Description

The FAN7390 is a monolithic high- and low-side gate-drive IC, which can drive high speed MOSFETs and IGBTs that operate up to +600V. It has a buffered output stage with all NMOS transistors designed for high pulse current driving capability and minimum cross-conduction.

Fairchild’s high-voltage process and common-mode noise canceling techniques provide stable operation of the high-side driver under high dv/dt noise circumstances. An advanced level shift circuit offers high-side gate driver operation up to V_S=-9.8V (typical) for V_{BS}=15V.

The UVLO circuit prevents malfunction when V_{DD} and V_{BS} are lower than the specified threshold voltage.

The high current and low output voltage drop feature make this device suitable for the PDP sustain pulse driver, motor driver, switching power supply, and high-power DC-DC converter applications.

Ordering Information

<table>
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<tr>
<th>Part Number</th>
<th>Package</th>
<th>Operating Temperature Range</th>
<th>Packing Method</th>
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<tr>
<td>FAN7390MX</td>
<td>8-SOP</td>
<td>-40°C ~ 125°C</td>
<td>Tape &amp; Reel</td>
</tr>
<tr>
<td>FAN7390M1X</td>
<td>14-SOP</td>
<td></td>
<td>Tape &amp; Reel</td>
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Typical Application Circuit

Figure 1. Application Circuit for Half-Bridge (Referenced 8-SOP)

Figure 2. Application Circuit for Half-Bridge (Referenced 14-SOP)
Internal Block Diagram

**Figure 3.** Functional Block Diagram (Referenced 8-SOP)

**Figure 4.** Functional Block Diagram (Referenced 14-SOP)
Pin Configurations

Figure 5. Pin Assignments (Top View)

Pin Definitions

<table>
<thead>
<tr>
<th>8-Pin</th>
<th>14-Pin</th>
<th>Name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>HIN</td>
<td>Logic Input for High-Side Gate Driver Output</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>LIN</td>
<td>Logic Input for Low-Side Gate Driver Output</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>VSS</td>
<td>Logic Ground (FAN7390M1 only)</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>LO</td>
<td>Low-Side Driver Output</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>VDD</td>
<td>Low-Side and Logic Part Supply Voltage</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>VS</td>
<td>High-Voltage Floating Supply Return</td>
</tr>
<tr>
<td>7</td>
<td>12</td>
<td>HO</td>
<td>High-Side Driver Output</td>
</tr>
<tr>
<td>8</td>
<td>13</td>
<td>VB</td>
<td>High-Side Floating Supply</td>
</tr>
<tr>
<td>4, 8, 9, 10, 14</td>
<td>NC</td>
<td>No Connect</td>
<td></td>
</tr>
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Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. $T_A = 25^\circ C$, unless otherwise specified.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristics</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_S$</td>
<td>High-Side Floating Supply Offset Voltage</td>
<td>$V_B-25$</td>
<td>$V_B+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_B$</td>
<td>High-Side Floating Supply Voltage</td>
<td>-0.3</td>
<td>625.0</td>
<td>V</td>
</tr>
<tr>
<td>$V_{HO}$</td>
<td>High-Side Floating Output Voltage HO</td>
<td>$V_S-0.3$</td>
<td>$V_B+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DD}$</td>
<td>Low-Side and Logic Fixed Supply Voltage</td>
<td>-0.3</td>
<td>25.0</td>
<td>V</td>
</tr>
<tr>
<td>$V_{LO}$</td>
<td>Low-Side Output Voltage LO</td>
<td>-0.3</td>
<td>$V_{DD}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{IN}$</td>
<td>Logic Input Voltage (HIN and LIN)</td>
<td>$V_{SS}-0.3$</td>
<td>$V_{DD}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{SS}$</td>
<td>Logic Ground (FAN7390M1 only)</td>
<td>$V_{DD}-25$</td>
<td>$V_{DD}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$dV_S/dt$</td>
<td>Allowable Offset Voltage Slew Rate</td>
<td>50</td>
<td></td>
<td>V/ns</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Power Dissipation</td>
<td>8-SOP: 0.625</td>
<td></td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-SOP: 1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\theta_{JA}$</td>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>8-SOP: 200</td>
<td></td>
<td>°C/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-SOP: 110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_J$</td>
<td>Junction Temperature</td>
<td></td>
<td>+150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Storage Temperature</td>
<td></td>
<td>+150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Notes:
1. Mounted on 76.2 x 114.3 x 1.6mm PCB (FR-4 glass epoxy material).
2. Refer to the following standards:
   JESD51-2: Integral circuits thermal test method environmental conditions - natural convection
   JESD51-3: Low effective thermal conductivity test board for leaded surface mount packages
3. Do not exceed $P_D$ under any circumstances.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_B$</td>
<td>High-Side Floating Supply Voltage</td>
<td>$V_S+10$</td>
<td>$V_S+22$</td>
<td>V</td>
</tr>
<tr>
<td>$V_S$</td>
<td>High-Side Floating Supply Offset Voltage</td>
<td>6-$V_{DD}$</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>$V_{HO}$</td>
<td>High-Side Output Voltage</td>
<td>$V_S$</td>
<td>$V_B$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DD}$</td>
<td>Low-Side and Logic Supply Voltage</td>
<td>10</td>
<td>22</td>
<td>V</td>
</tr>
<tr>
<td>$V_{LO}$</td>
<td>Low-Side Output Voltage</td>
<td>COM</td>
<td>$V_{DD}$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{IN}$</td>
<td>Logic Input Voltage (HIN and LIN)</td>
<td>$V_{SS}$</td>
<td>$V_{DD}$</td>
<td>V</td>
</tr>
<tr>
<td>$T_A$</td>
<td>Operating Ambient Temperature</td>
<td>-40</td>
<td>+125</td>
<td>°C</td>
</tr>
</tbody>
</table>
Electrical Characteristics

$V_{BIAS} (V_{DD}, V_{BS}) = 15.0V, V_S = V_{SS} = COM, T_A = 25^\circ C$, unless otherwise specified. The $V_{IL}, V_{IH}$, and $I_{IN}$ parameters are referenced to $V_{SS}/COM$ and are applicable to the respective input signals $HIN$ and $LIN$. The $V_O$ and $I_O$ parameters are referenced to $COM$ and $V_S$ is applicable to the respective output signals $HO$ and $LO$.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristics</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DDUV+}$, $V_{BSUV+}$</td>
<td>$V_{DD}$ and $V_{BS}$ Supply Under-Voltage Positive-going Threshold</td>
<td>8.0</td>
<td>8.8</td>
<td>9.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{DDUV-}$, $V_{BSUV-}$</td>
<td>$V_{DD}$ and $V_{BS}$ Supply Under-Voltage Negative-going Threshold</td>
<td>7.4</td>
<td>8.3</td>
<td>9.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$I_{LK}$</td>
<td>Offset Supply Leakage Current $V_B = V_S = 600V$</td>
<td>50</td>
<td></td>
<td></td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>$I_{OBS}$</td>
<td>Quiescent $V_{BS}$ Supply Current $V_{IN} = 0V$ or 5V</td>
<td>45</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{ODD}$</td>
<td>Quiescent $V_{DD}$ Supply Current $V_{IN} = 0V$ or 5V</td>
<td>75</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{PBS}$</td>
<td>Operating $V_{BS}$ Supply Current $f_{IN} = 20kHz$, rms value</td>
<td>530</td>
<td>640</td>
<td></td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>$I_{PDD}$</td>
<td>Operating $V_{DD}$ Supply Current $f_{IN} = 20kHz$, rms value</td>
<td>530</td>
<td>640</td>
<td></td>
<td>µA</td>
<td></td>
</tr>
</tbody>
</table>

Note:
4. This parameter guaranteed by design.

Dynamic Electrical Characteristics

$V_{BIAS} (V_{DD}, V_{BS}) = 15.0V, V_S = V_{SS} = COM = 0V, C_L = 1000pF$ and $T_A = 25^\circ C$ unless otherwise specified.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristics</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{on}$</td>
<td>Turn-on Propagation Delay $V_S = 0V$</td>
<td></td>
<td>140</td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{off}$</td>
<td>Turn-off Propagation Delay $V_S = 0V$</td>
<td>140</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT</td>
<td>Delay Matching, HS &amp; LS Turn-on/off</td>
<td>0</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_r$</td>
<td>Turn-on Rise Time</td>
<td>25</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_f$</td>
<td>Turn-off Fall Time</td>
<td>20</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Typical Characteristics

Figure 6. Turn-on Propagation Delay vs. Temperature

Figure 7. Turn-off Propagation Delay vs. Temperature

Figure 8. Turn-on Rise Time vs. Temperature

Figure 9. Turn-off Fall Time vs. Temperature

Figure 10. Turn-on Delay Matching vs. Temperature

Figure 11. Turn-off Delay Matching vs. Temperature
Typical Characteristics (Continued)

Figure 12. Quiescent $V_{DD}$ Supply Current vs. Temperature

Figure 13. Quiescent $V_{BS}$ Supply Current vs. Temperature

Figure 14. Operating $V_{DD}$ Supply Current vs. Temperature

Figure 15. Operating $V_{BS}$ Supply Current vs. Temperature.

Figure 16. $V_{DD}$ UVLO+ vs. Temperature

Figure 17. $V_{DD}$ UVLO- vs. Temperature
Typical Characteristics (Continued)

Figure 18. \( V_{BS\ UVLO^+} \) vs. Temperature

Figure 19. \( V_{BS\ UVLO^-} \) vs. Temperature

Figure 20. High-Level Output Voltage vs. Temperature

Figure 21. Low-Level Output Voltage vs. Temperature

Figure 22. Logic High Input Voltage vs. Temperature

Figure 23. Low Input Voltage vs. Temperature
Typical Characteristics (Continued)

![Graph 1: Logic Input High Bias Current vs. Temperature](image1)

**Figure 24. Logic Input High Bias Current vs. Temperature**

![Graph 2: Allowable Negative V_S Voltage vs. Temperature](image2)

**Figure 25. Allowable Negative V_S Voltage vs. Temperature**
Switching Time Definitions

Figure 26. Switching Time Test Circuit (Referenced 8-SOP)

Figure 27. Input/Output Timing Diagram

Figure 28. Switching Time Waveform Definitions

Figure 29. Delay Matching Waveform Definitions
Physical Dimensions

Figure 30. 8-Lead Small Outline Package (SOP)

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Figure 31. 14-Lead Small Outline Package (SOP)

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Quiet Series™
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<th>Definition of Terms</th>
<th>Definition</th>
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<td>Datasheet Identification</td>
<td>Product Status</td>
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<td></td>
<td>Formative / In Design</td>
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<tr>
<td>Advance Information</td>
<td>Preliminary</td>
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Rev. 162
Mouser Electronics

Authorized Distributor

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- FAN7390M1X
- FAN7390N
- FAN7390MX