

# FAN7390A

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

### Features

- Floating Channels for Bootstrap Operation to +600 V
- Typically 4.5 A / 4.5 A 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 ( $V_{SS}$ ) and Power (COM) Ground  $\pm 5V$  Offset
- 3.3 V and 5 V Input Logic Compatible
- Output In-phase with Input

### Applications

- Plasma Display Panel (PDP) Sustain Driver
- High Intensity Discharge (HID) Lamp Ballast
- SMPS
- Motor Driver

### Description

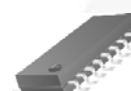
The FAN7390A is a monolithic high- and low-side gate-drive IC, which can drive high-speed MOSFETs and IGBTs that operate up to +600 V. It has a buffered output stage with all NMOS transistors designed for high pulse current driving capability and minimum cross-conduction.

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  $V_S = -9.8 V$  (typical) for  $V_{BS} = 15 V$ .

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.

14-SOP



### Ordering Information

| Part Number | Package | Operating Temperature Range | Packing Method |
|-------------|---------|-----------------------------|----------------|
| FAN7390AMX1 | 14-SOP  | -40°C ~ 125°C               | Tape & Reel    |

## Typical Application Circuit

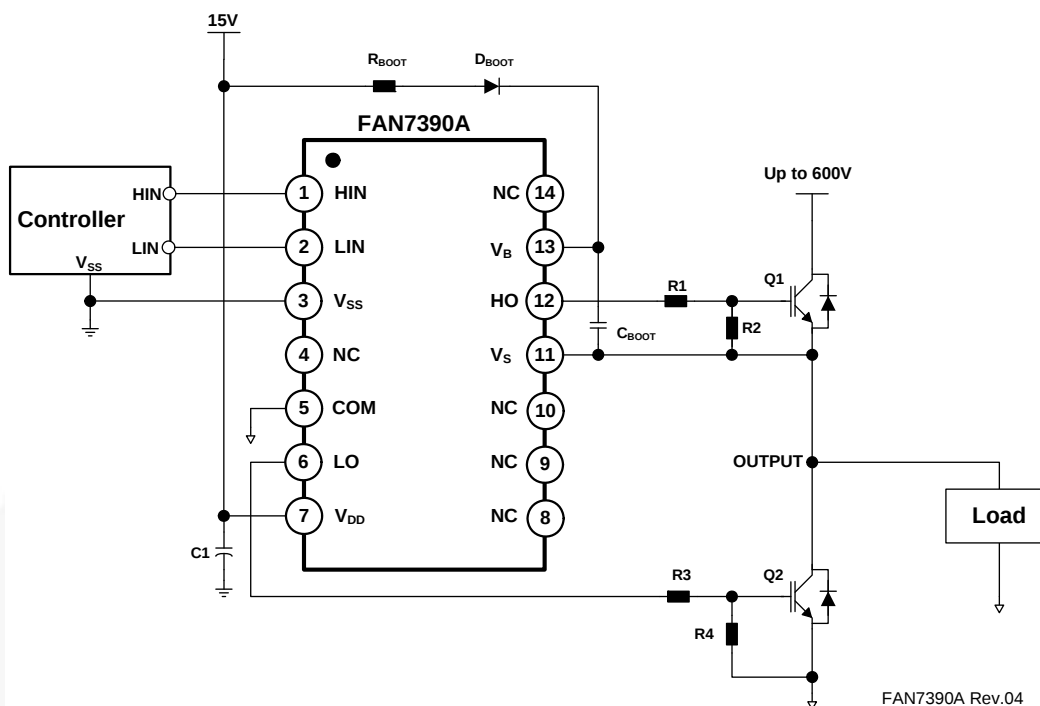


Figure 1. Application Circuit for Half-Bridge (Referenced 14-SOP)

## Internal Block Diagram

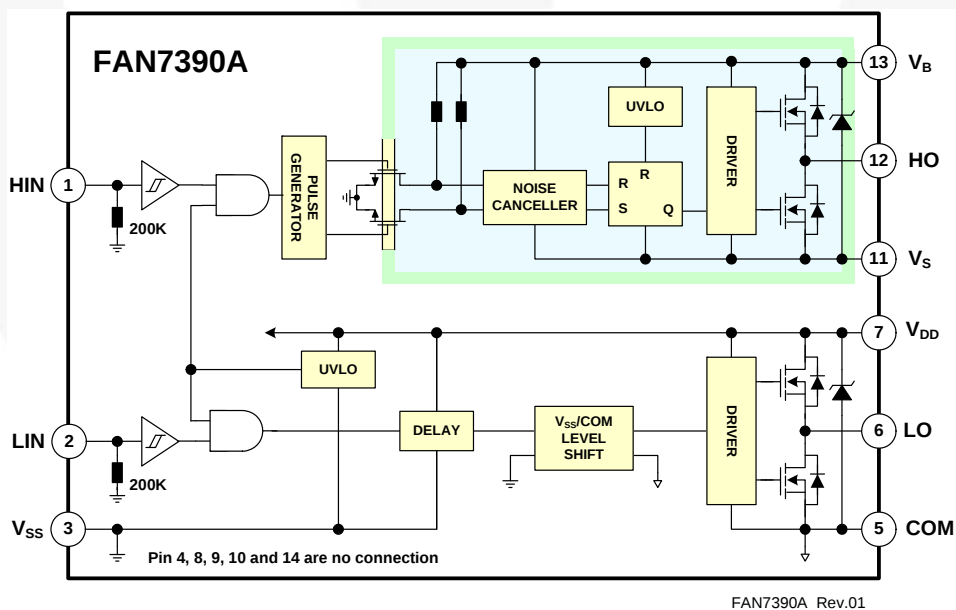


Figure 2. Functional Block Diagram (Referenced 14-SOP)

## Pin Configurations

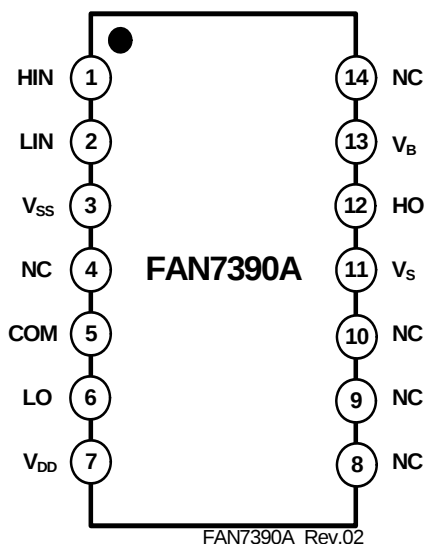


Figure 3. Pin Assignments (Top View)

## Pin Definitions

| 14-Pin          | Name            | Description                                  |
|-----------------|-----------------|----------------------------------------------|
| 1               | HIN             | Logic Input for High-Side Gate Driver Output |
| 2               | LIN             | Logic Input for Low-Side Gate Driver Output  |
| 3               | V <sub>SS</sub> | Logic Ground                                 |
| 5               | COM             | Low-Side Driver Return                       |
| 6               | LO              | Low-Side Driver Output                       |
| 7               | V <sub>DD</sub> | Low-Side and Logic Part Supply Voltage       |
| 11              | V <sub>S</sub>  | High-Voltage Floating Supply Return          |
| 12              | HO              | High-Side Driver Output                      |
| 13              | V <sub>B</sub>  | High-Side Floating Supply                    |
| 4, 8, 9, 10, 14 | NC              | No Connect                                   |

## 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.  $T_A=25^{\circ}\text{C}$ , unless otherwise specified.

| Symbol            | Characteristics                           | Min.              | Max.           | Unit                 |
|-------------------|-------------------------------------------|-------------------|----------------|----------------------|
| $V_S$             | High-Side Floating Supply Offset Voltage  | $V_B - V_{SHUNT}$ | $V_B + 0.3$    | V                    |
| $V_B$             | High-Side Floating Supply Voltage         | -0.3              | 625.0          | V                    |
| $V_{HO}$          | High-Side Floating Output Voltage, HO Pin | $V_S - 0.3$       | $V_B + 0.3$    | V                    |
| $V_{DD}$          | Low-Side and Logic Fixed Supply Voltage   | -0.3              | $V_{SHUNT}$    | V                    |
| $V_{LO}$          | Low-Side Output Voltage, LO Pin           | -0.3              | $V_{DD} + 0.3$ | V                    |
| $V_{IN}$          | Logic Input Voltage (HIN and LIN)         | $V_{SS} - 0.3$    | $V_{DD} + 0.3$ | V                    |
| $V_{SS}$          | Logic Ground                              | $V_{DD} - 25$     | $V_{DD} + 0.3$ | V                    |
| $dV_S/dt$         | Allowable Offset Voltage Slew Rate        |                   | 50             | V/ns                 |
| $P_D^{(1)(2)(3)}$ | Power Dissipation                         |                   | 1.0            | W                    |
| $\theta_{JA}$     | Thermal Resistance, Junction-to-Ambient   |                   | 110            | $^{\circ}\text{C/W}$ |
| $T_J$             | Junction Temperature                      |                   | +150           | $^{\circ}\text{C}$   |
| $T_{STG}$         | Storage Temperature                       |                   | +150           | $^{\circ}\text{C}$   |

### Notes:

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

| Symbol   | Parameter                                | Min.         | Max.       | Unit               |
|----------|------------------------------------------|--------------|------------|--------------------|
| $V_B$    | High-Side Floating Supply Voltage        | $V_S + 10$   | $V_S + 20$ | V                  |
| $V_S$    | High-Side Floating Supply Offset Voltage | $6 - V_{DD}$ | 600        | V                  |
| $V_{HO}$ | High-Side Output Voltage                 | $V_S$        | $V_B$      | V                  |
| $V_{DD}$ | Low-Side and Logic Supply Voltage        | 10           | 20         | V                  |
| $V_{LO}$ | Low-Side Output Voltage                  | COM          | $V_{DD}$   | V                  |
| $V_{IN}$ | Logic Input Voltage (HIN and LIN)        | $V_{SS}$     | $V_{DD}$   | V                  |
| $T_A$    | Operating Ambient Temperature            | -40          | +125       | $^{\circ}\text{C}$ |

## Electrical Characteristics

$V_{BIAS}$  ( $V_{DD}$ ,  $V_{BS}$ )=15.0 V,  $V_S=V_{SS}=COM$ ,  $T_A=25^{\circ}C$ , 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.

| Symbol                                                        | Characteristics                                                                                        | Condition                                                                  | Min. | Typ. | Max. | Unit |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------|------|------|------|
| POWER SUPPLY SECTION (V <sub>DD</sub> AND V <sub>BS</sub> )   |                                                                                                        |                                                                            |      |      |      |      |
| V <sub>DDUV+</sub><br>V <sub>BSUV+</sub>                      | V <sub>DD</sub> and V <sub>BS</sub> Supply Under-Voltage Positive-Going Threshold                      |                                                                            | 8.0  | 8.8  | 9.8  | V    |
| V <sub>DDUV-</sub><br>V <sub>BSUV-</sub>                      | V <sub>DD</sub> and V <sub>BS</sub> Supply Under-Voltage Negative-Going Threshold                      |                                                                            | 7.4  | 8.3  | 9.0  |      |
| V <sub>DDUVH</sub><br>V <sub>BSUVH</sub>                      | V <sub>DD</sub> and V <sub>BS</sub> Supply Under-Voltage Lockout Hysteresis Voltage                    |                                                                            |      | 0.5  |      |      |
| I <sub>LK</sub>                                               | Offset Supply Leakage Current                                                                          | V <sub>B</sub> =V <sub>S</sub> =600 V                                      |      |      | 50   | μA   |
| I <sub>QBS</sub>                                              | Quiescent V <sub>BS</sub> Supply Current                                                               | V <sub>IN</sub> =0 V or 5 V                                                |      | 45   | 80   |      |
| I <sub>QDD</sub>                                              | Quiescent V <sub>DD</sub> Supply Current                                                               | V <sub>IN</sub> =0 V or 5 V                                                |      | 75   | 110  |      |
| I <sub>PBS</sub>                                              | Operating V <sub>BS</sub> Supply Current                                                               | f <sub>IN</sub> =20 kHz, rms value                                         |      | 530  | 640  | μA   |
| I <sub>PDD</sub>                                              | Operating V <sub>DD</sub> Supply Current                                                               | f <sub>IN</sub> =20 kHz, rms value                                         |      | 530  | 640  |      |
| SHUNT REGULATOR SECTION                                       |                                                                                                        |                                                                            |      |      |      |      |
| V <sub>SHUNT</sub>                                            | V <sub>DD</sub> and V <sub>BS</sub> Shunt Regulator Clamping Voltage                                   | V <sub>DD</sub> =Sweep or V <sub>BS</sub> =Sweep, I <sub>SHUNT</sub> =5 mA | 21   | 23   | 25   | V    |
| LOGIC INPUT SECTION (H <sub>IN</sub> , L <sub>IN</sub> )      |                                                                                                        |                                                                            |      |      |      |      |
| V <sub>IH</sub>                                               | Logic "1" Input Voltage                                                                                |                                                                            | 2.5  |      |      | V    |
| V <sub>IL</sub>                                               | Logic "0" Input Voltage                                                                                |                                                                            |      |      | 1.2  |      |
| I <sub>IN+</sub>                                              | Logic "1" Input Bias Current                                                                           | V <sub>IN</sub> =5 V                                                       |      | 25   | 50   | μA   |
| I <sub>IN-</sub>                                              | Logic "0" Input Bias Current                                                                           | V <sub>IN</sub> =0 V                                                       |      | 1.0  | 2.0  |      |
| R <sub>IN</sub>                                               | Input Pull-down Resistance                                                                             |                                                                            | 100  | 200  |      | KΩ   |
| GATE DRIVER OUTPUT SECTION (H <sub>O</sub> , L <sub>O</sub> ) |                                                                                                        |                                                                            |      |      |      |      |
| V <sub>OH</sub>                                               | High-Level Output Voltage, V <sub>BIAS</sub> -V <sub>O</sub>                                           | No Load                                                                    |      |      | 1.0  | V    |
| V <sub>OL</sub>                                               | Low-Level Output Voltage, V <sub>O</sub>                                                               | No Load                                                                    |      |      | 35   | mV   |
| I <sub>O+</sub>                                               | Output High, Short-Circuit Pulsed Current <sup>(4)</sup>                                               | V <sub>O</sub> =0 V, V <sub>IN</sub> =5 V,PW<10 μs                         | 3.5  | 4.5  |      | A    |
| I <sub>O-</sub>                                               | Output Low, Short-Crcuit Pulsed Current <sup>(4)</sup>                                                 | V <sub>O</sub> =15 V, V <sub>IN</sub> =0 V,PW<10 μs                        | 3.5  | 4.5  |      |      |
| V <sub>S</sub>                                                | Allowable Negative V <sub>S</sub> Pin Voltage for H <sub>IN</sub> Signal Propagation to H <sub>O</sub> |                                                                            |      | -9.8 | -7.0 | V    |
| V <sub>SS-COM</sub>                                           | V <sub>SS</sub> -COM/COM-V <sub>SS</sub> Voltage Endurability                                          |                                                                            | -5   |      | 5    | V    |

### Note:

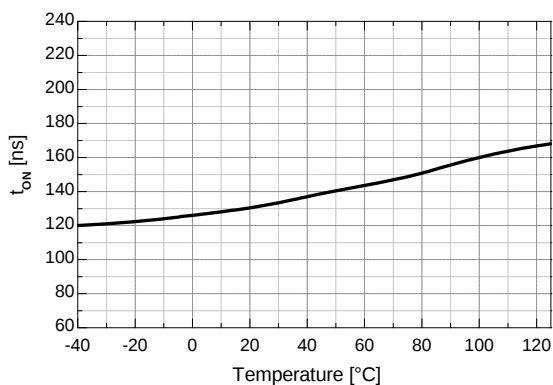
4. This parameter guaranteed by design.

## Dynamic Electrical Characteristics

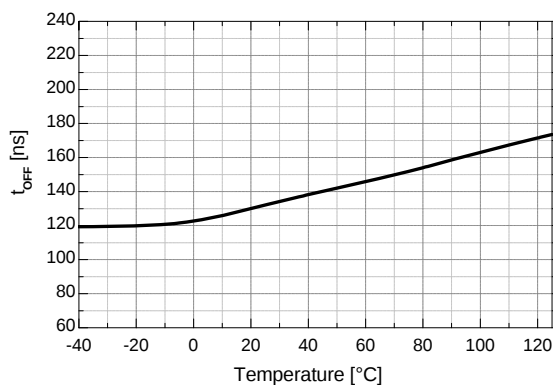
$V_{BIAS}$  ( $V_{DD}$ ,  $V_{BS}$ )=15.0 V,  $V_S=V_{SS}=COM=0$  V,  $C_L=1000$  pF and  $T_A=25^{\circ}C$  unless otherwise specified.

| Symbol    | Characteristics                     | Test Condition | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------------|----------------|------|------|------|------|
| $t_{on}$  | Turn-On Propagation Delay           | $V_S=0$ V      |      | 140  | 200  | ns   |
| $t_{off}$ | Turn-Off Propagation Delay          | $V_S=0$ V      |      | 140  | 200  |      |
| MT        | Delay Matching, HS & LS Turn-On/Off |                |      | 15   | 50   |      |
| $t_r$     | Turn-on Rise Time                   |                |      | 25   | 50   |      |
| $t_f$     | Turn-off Fall Time                  |                |      | 20   | 45   |      |

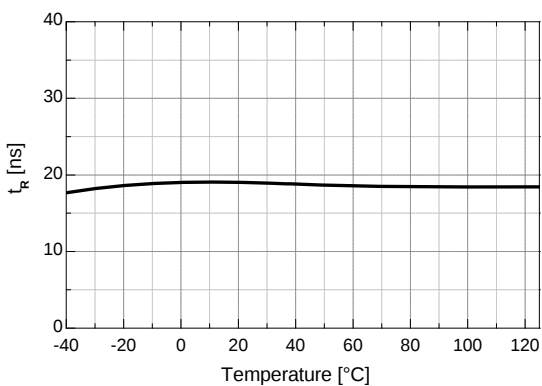
## Typical Characteristics



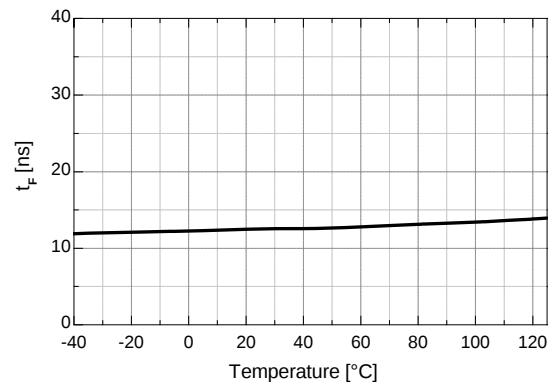
**Figure 4. Turn-On Propagation Delay vs. Temperature**



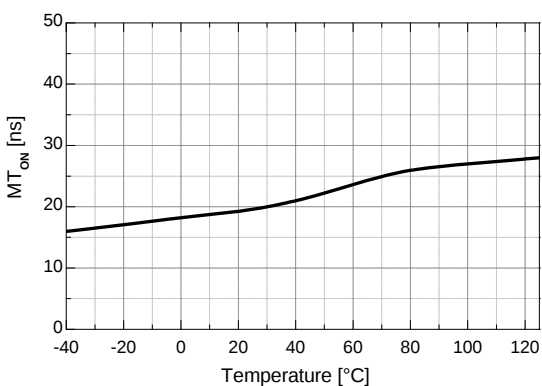
**Figure 5. Turn-Off Propagation Delay vs. Temperature**



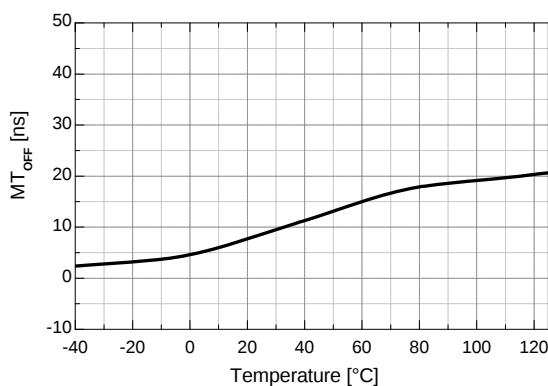
**Figure 6. Turn-On Rise Time vs. Temperature**



**Figure 7. Turn-Off Fall Time vs. Temperature**



**Figure 8. Turn-On Delay Matching vs. Temperature**



**Figure 9. Turn-Off Delay Matching vs. Temperature**

## Typical Characteristics (Continued)

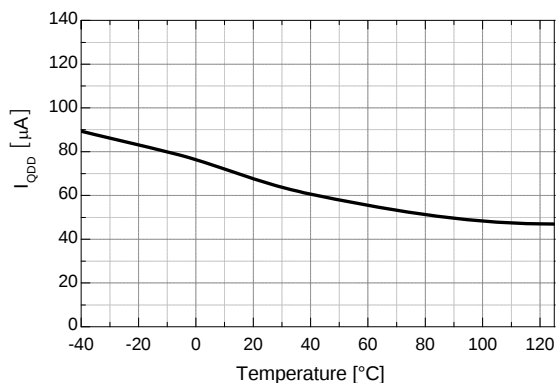


Figure 10. Quiescent  $V_{DD}$  Supply Current vs. Temperature

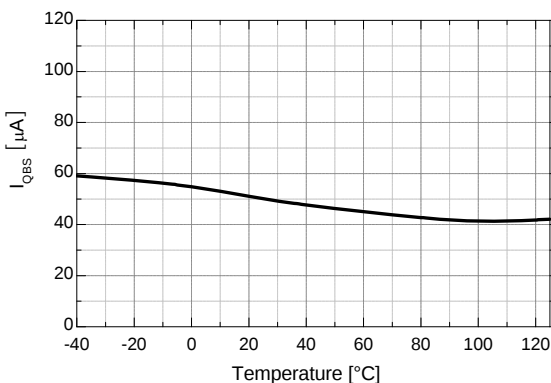


Figure 11. Quiescent  $V_{BS}$  Supply Current vs. Temperature

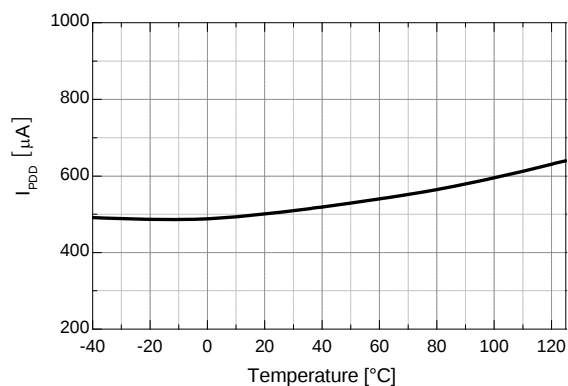


Figure 12. Operating  $V_{DD}$  Supply Current vs. Temperature

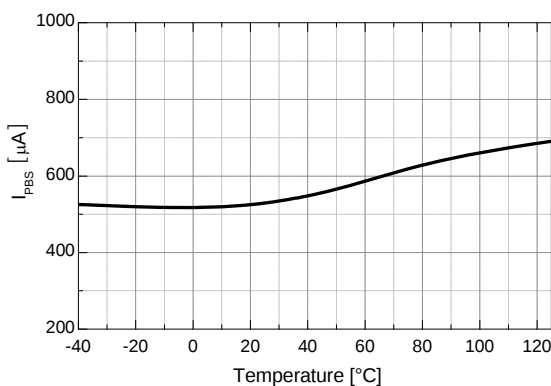


Figure 13. Operating  $V_{BS}$  Supply Current vs. Temperature

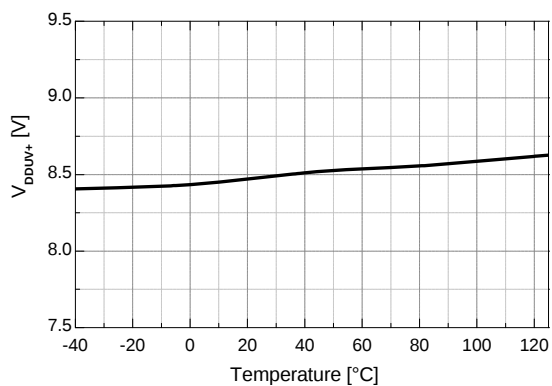


Figure 14.  $V_{DD}$  UVLO+ vs. Temperature

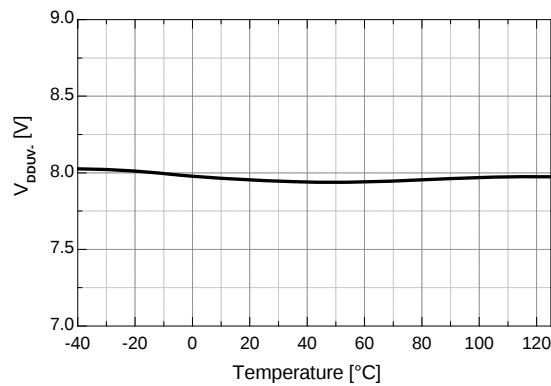


Figure 15.  $V_{DD}$  UVLO- vs. Temperature

## Typical Characteristics (Continued)

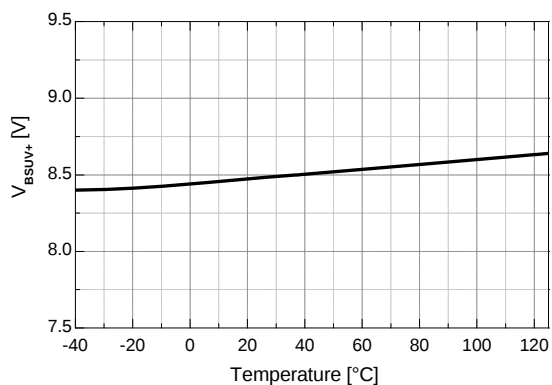


Figure 16.  $V_{BS}$  UVLO+ vs. Temperature

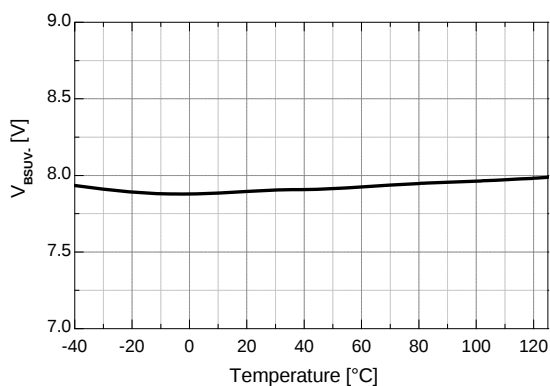


Figure 17.  $V_{BS}$  UVLO- vs. Temperature

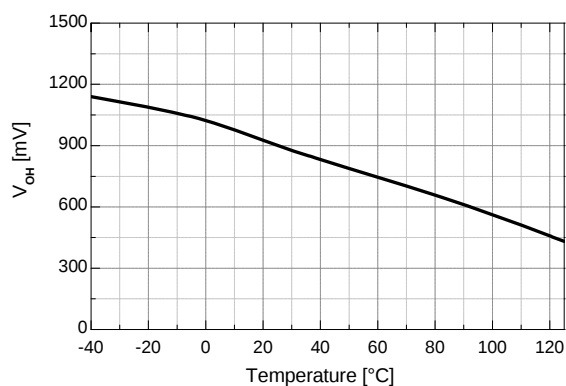


Figure 18. High-Level Output Voltage vs. Temperature

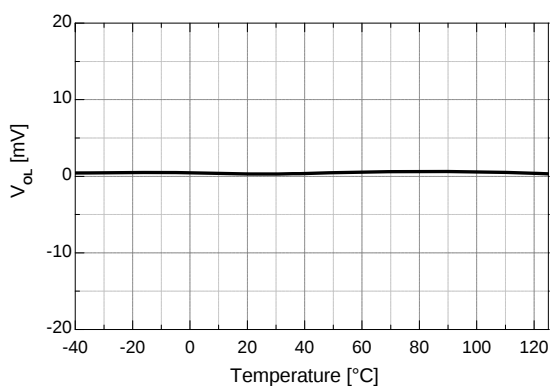


Figure 19. Low-Level Output Voltage vs. Temperature

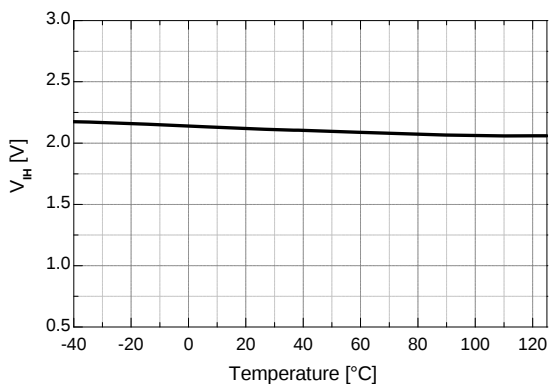


Figure 20. Logic HIGH Input Voltage vs. Temperature

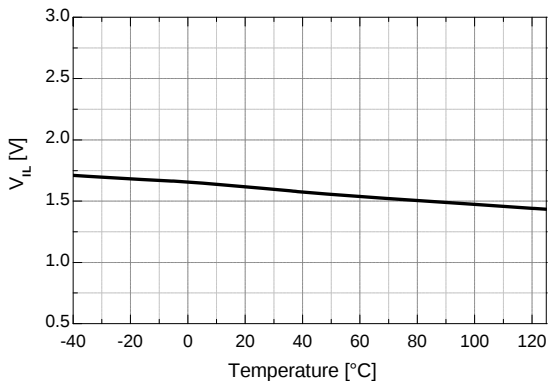
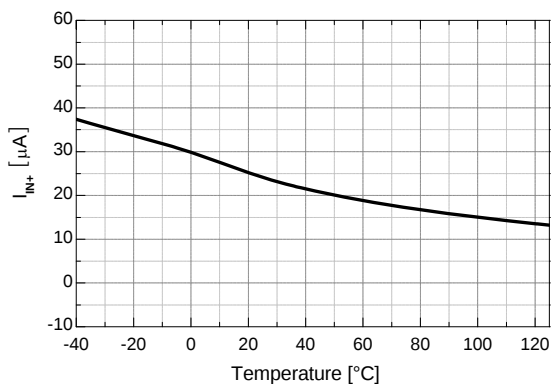
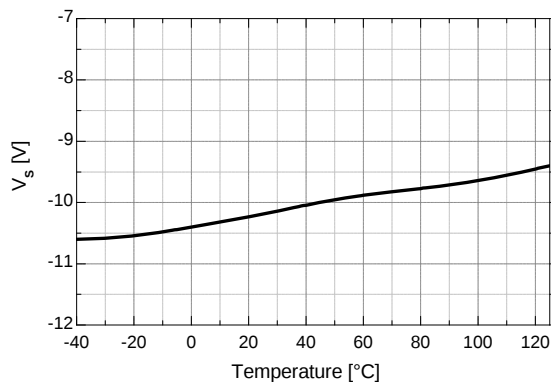


Figure 21. Logic LOW Input Voltage vs. Temperature

## Typical Characteristics (Continued)



**Figure 22. Logic Input High Bias Current vs. Temperature**



**Figure 23. Allowable Negative  $V_S$  Voltage vs. Temperature**

## Switching Time Definitions

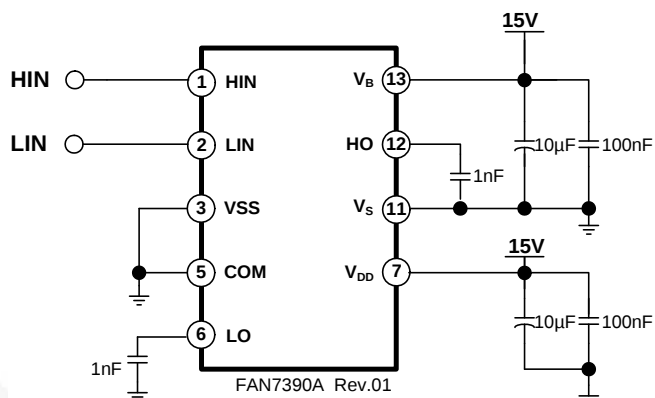


Figure 24. Switching Time Test Circuit (Referenced 8-SOP)

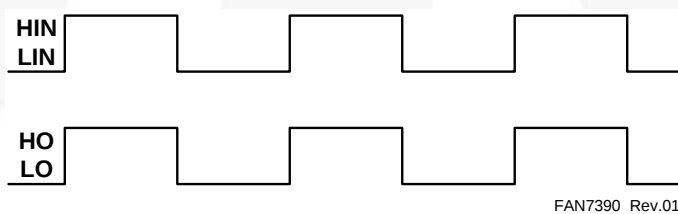


Figure 25. Input / Output Timing Diagram

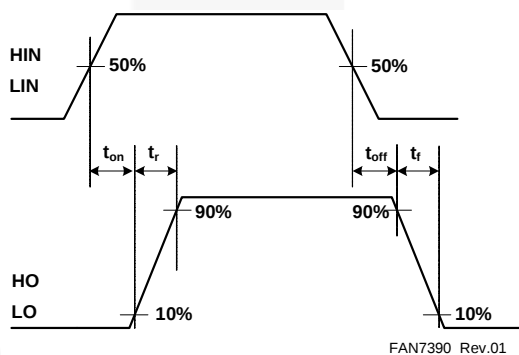


Figure 26. Switching Time Waveform Definitions

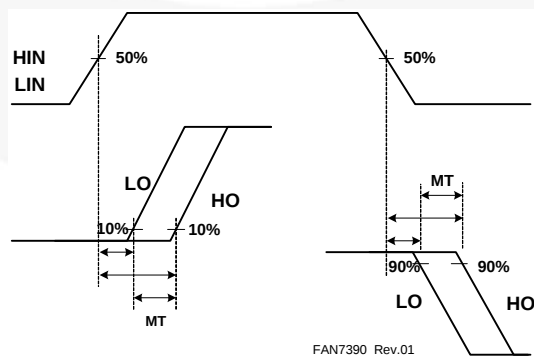
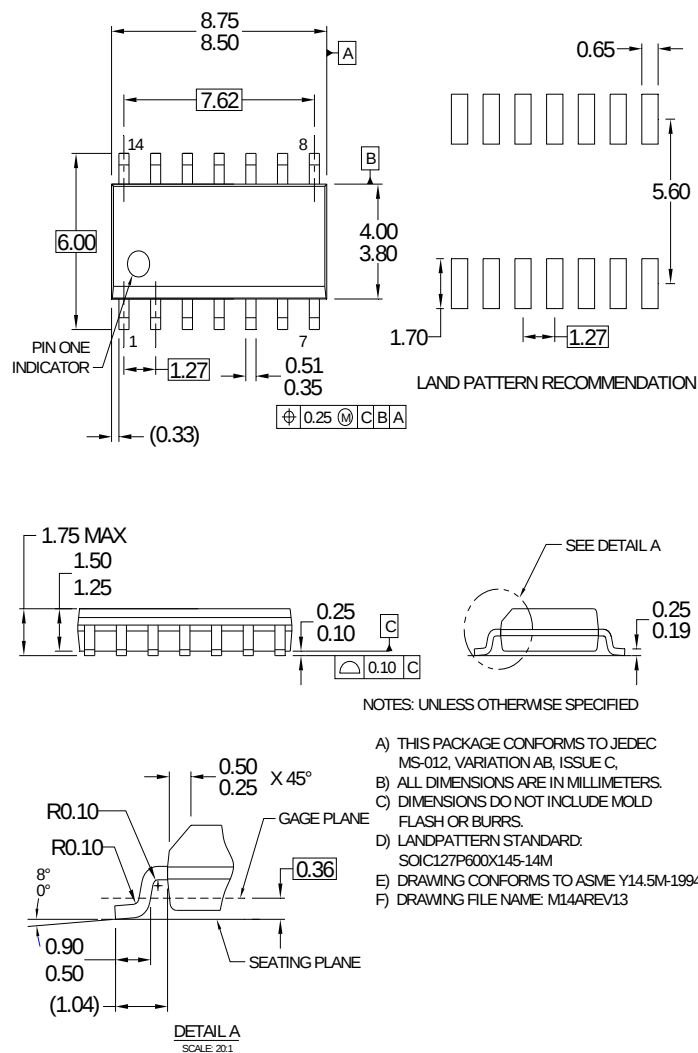


Figure 27. Delay Matching Waveform Definitions

## Package Dimensions



**Figure 28. 14-Lead, Small Outline Package (SOP)**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

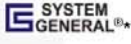
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

<http://www.fairchildsemi.com/packaging/>.



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| 2Cool™                                                                            | F-PFS™                                         | PowerTrench®                                                                      | The Power Franchise®                                                                |
| AccuPower™                                                                        | FRFET®                                         | PowerXS™                                                                          | the power franchise                                                                 |
| AX-CAP™*                                                                          | Global Power Resource™                         | Programmable Active Droop™                                                        | TinyBoost™                                                                          |
| BitSIC™                                                                           | GreenBridge™                                   | QFET®                                                                             | TinyBuck™                                                                           |
| Build it Now™                                                                     | Green FPS™                                     | QS™                                                                               | TinyCalc™                                                                           |
| CorePLUS™                                                                         | Green FPS™ e-Series™                           | Quiet Series™                                                                     | TinyLogic®                                                                          |
| CorePOWER™                                                                        | Gmax™                                          | RapidConfigure™                                                                   | TINYOPTO™                                                                           |
| CROSSVOLT™                                                                        | GTO™                                           |  | TinyPower™                                                                          |
| CTL™                                                                              | IntelliMAX™                                    | Saving our world, 1mW/W/kW at a time™                                             | TinyPWM™                                                                            |
| Current Transfer Logic™                                                           | ISOPLANAR™                                     | SignalWise™                                                                       | TinyWire™                                                                           |
| DEUXPEED®                                                                         | Making Small Speakers Sound Louder and Better™ | SmartMax™                                                                         | TranSIC™                                                                            |
| Dual Cool™                                                                        | MegaBuck™                                      | SMART START™                                                                      | TriFault Detect™                                                                    |
| EcoSPARK®                                                                         | MICROCOUPLER™                                  | Solutions for Your Success™                                                       | TRUECURRENT®*                                                                       |
| EfficientMax™                                                                     | MicroFET™                                      | SPM®                                                                              | µSerDes™                                                                            |
| ESBC™                                                                             | MicroPak™                                      | STEALTH™                                                                          |  |
|  | MicroPak2™                                     | SuperFET®                                                                         | UHC®                                                                                |
| Fairchild®                                                                        | MillerDrive™                                   | SuperSOT™-3                                                                       | Ultra FRFET™                                                                        |
| Fairchild Semiconductor®                                                          | MotionMax™                                     | SuperSOT™-6                                                                       | UniFET™                                                                             |
| FACT Quiet Series™                                                                | mWSaver™                                       | SuperSOT™-8                                                                       | VCX™                                                                                |
| FACT®                                                                             | OptoHi™                                        | SupreMOS®                                                                         | VisualMax™                                                                          |
| FAST®                                                                             | OPTOLOGIC®                                     | SyncFET™                                                                          | VoltagePlus™                                                                        |
| FastvCore™                                                                        | OPTOPLANAR®                                    | Sync-Lock™                                                                        | XS™                                                                                 |
| FETBench™                                                                         |                                                |  |                                                                                     |
| FlashWriter®*                                                                     |                                                |                                                                                   |                                                                                     |
| FPS™                                                                              |                                                |                                                                                   |                                                                                     |

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As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

#### ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

#### PRODUCT STATUS DEFINITIONS

##### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.                                               |
| Obsolete                 | Not In Production     | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.                                                    |

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