Advance Data Sheet
January 1994

AT&T Microelectronics

ATT1800AT1
ATT1800AAB1

Optically Coupled High-Speed MOSFET Driver

Features

- Fast turn on
- Fast turn off
- Rise times typically 500 ns
- Fall times typically 300 ns
- 3750 Vrms I/O isolation voltage
- Zener diode protection for external MOSFET
- High output breakdown voltage (300 V)

Applications

- High-speed solid-state relays
- Switch mode power supplies
- dc motor control
- Industrial controls
- ATE
- Isolated switching

Description

The ATT1800 device is an optically coupled, photovoltaic generator with integrated switching speed enhancement circuitry. It provides a floating supply voltage capable of driving high-capacitive loads such as the gate of a power MOSFET transistor. The ATT1800 device is constructed by using a GaAlAs LED for actuation control and a monolithic output control die containing a photodiode array (PDA), high-speed turn-on/turn-off circuitry, and a robust ESD protection zener diode.

The device is packaged in a 6-pin, plastic DIP (ATT1800AT1) or in a surface-mount gull-wing configuration (ATT1800AAB1). The surface-mount gull-wing devices are available in sticks or on tape and reel.

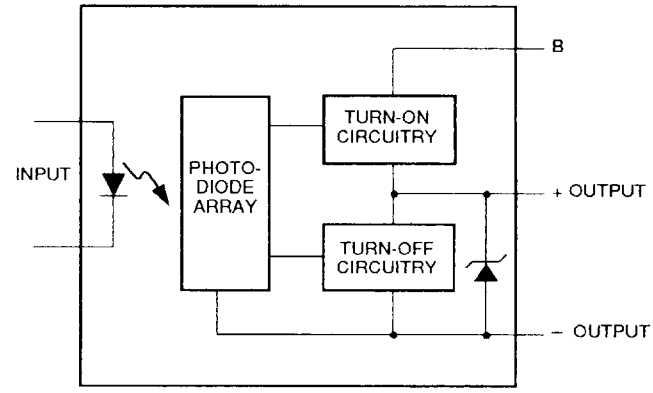


Figure 1. Functional Diagram

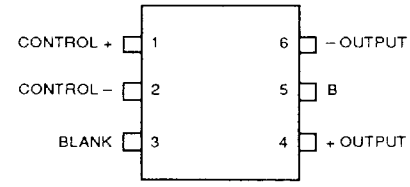


Figure 2. Pin Diagram

Functional Description

The ATT1800 device can be used with or without an external speed-up capacitor for turn-on. For basic operation without this capacitor, the current through the input LED illuminates the photodiode array, generating a voltage. This voltage is typically 10 V. The PDA supplies microamps of current to drive an external MOSFET. The positive output is connected to the MOSFET gate, and the negative output is connected to the MOSFET source.

For operation with fast turn-on, a voltage on input B of approximately 20 V or more is required. This voltage can be applied by using a capacitive bootstrapping technique. For fast turn-on configurations, refer to the application diagrams (Figures 5 and 6). When the MOSFET(s) is off, C1 charges up to the load voltage value through D1. With LED turn-on, the photodiode array actuates the turn-on circuitry. The turn-on circuit allows the charge from C1 to flow into the gate of the external MOSFET. Now, milliamps of current will turn on the MOSFET rapidly.

The turn-off circuitry operates whether a speed-up capacitor is used or not. During turn-off, the external MOSFET gate charge is quickly shunted to its source via this circuit.

The ATT1800 device also provides protection for the gates of the external MOSFETs via an integrated zener diode between the output pins 4 and 6.

Absolute Maximum Ratings At 25 °C, unless otherwise specified.

Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to maximum rating conditions for extended periods can adversely affect device reliability.

Parameter	Symbol	Value	Unit
Ambient Operating Temperature Range	T_A	–55 to +100	°C
Storage Temperature Range	T_{stg}	–55 to +150	°C
Pin Soldering Temperature (t = 10 s max.)	T_S	260	°C
Input/Output Isolation Voltage	V_{ISO}	3750	Vrms
Insulation Resistance (V_{ISO} = 500 V)			
T_A = 25 °C	R_{ins}	>10	GΩ
T_A = 100 °C	R_{ins}	>0.1	GΩ
LED Input Ratings:			
Reverse Voltage ($I_R \leq 10$ µA)	V_R	6	V
Continuous Forward Current	I_F	60	mA
Peak Forward Current	I_{Fpeak}	600	mA
Power Dissipation	P_{DISS}	100	mW
MOSFET Driver Output Ratings:			
Bias Voltage (pin 5 to 6)	V_B	300	V
Leakage Current (pin 5 to 6) (V_R = 100 V)	—	200	nA
Peak Input Current (pin 5 to 4)	—	50	mA
Power Dissipation	P_{DISS}	150	mW

Electrical Characteristics T_A = 25 °C

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information purposes only and are not part of the testing requirements.

Table 1. Common Electrical Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
LED Forward Voltage	V_F	I_F = 10 mA	0.9	1.26	1.5	V
LED Junction Capacitance	C_J	V_R = 0 V, f = 1 MHz	—	25	—	pF
Zener Voltage (pin 4 to 6)	V_Z	I_{ZT} = 10 µA	—	13	—	V

Electrical Characteristics T_A = 25 °C (continued)

Table 2. MOSFET Driver Electrical Characteristics WITH External Biasing (See Figure 3.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Dynamic Output Voltage (Pin 4 to 6)	V_{OUT}	C_L = 2000 pF, V_B = 20 V, I_F = 10 mA	9	11	—	V
Dynamic Output Current (Pin 4 to 6)	I_{OUT}	C_L = 2000 pF, V_B = 20 V I_F = 10 mA I_F = 40 mA	 — —	 5 15	 — —	 mA mA
Dynamic Output Resistance Sourcing (Pin 4) Sinking (Pin 4)	R_{OUT}	I_F = 10 mA	 — —	 300 20	 — —	 Ω Ω
Turn-on Time	t_{on}	C_L = 2000 pF, Measure at V_{OUT} = 5 V V_B = 20 V, I_F = 40 mA	—	3.5	5	µs
Turn-off Time	t_{off}	C_L = 2000 pF, Measure at V_{OUT} = 2 V V_B = 20 V, I_F = 40 mA	—	3.5	5	µs

Table 3. MOSFET Driver Electrical Characteristics WITHOUT External Biasing (See Figure 4.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Open-circuit Voltage (Pin 4 to 6)	V_{OC}	I_F = 10 mA	8	10	—	V
Output Short-circuit Current (Pin 4 to 6)	I_{SC}	 I_F = 10 mA I_F = 40 mA	 2.5 10	 4 16	 — —	 µA µA
Dynamic Output Resistance Sinking (Pin 4)	R_{OUT}	I_F = 10 mA	—	20	—	Ω
Turn-on Time	t_{on}	C_L = 2000 pF, Measure at V_{OUT} = 5 V I_F = 40 mA	—	650	1000	µs
Turn-off Time	t_{off}	C_L = 2000 pF, Measure at V_{OUT} = 2 V I_F = 40 mA	—	3	5	µs

Table 4. MOSFET Driver Electrical Characteristics in High-Speed Relay Configuration (See Figure 5.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Rise Time	t_r	M1 C_{gs} = 2000 pF V+ = 50 V Measure at 90%—10% M1 V_{DS}	—	500	—	ns
Turn-on Time	t_{on}		—	3.5	—	µs
Fall Time	t_f	M1 C_{gs} = 2000 pF V+ = 50 V Measure at 10%—90% M1 V_{DS}	—	300	—	ns
Turn-off Time	t_{off}		—	3.5	—	µs

Test Circuits

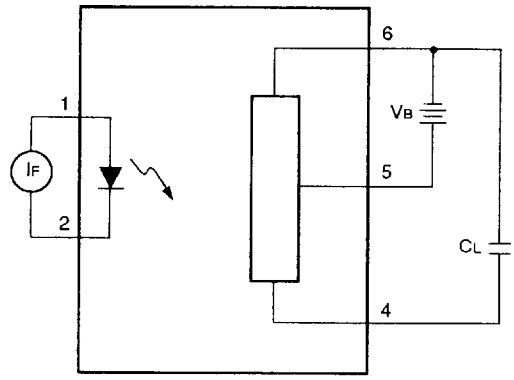


Figure 3. ATT1800 Test Circuit With External Biasing

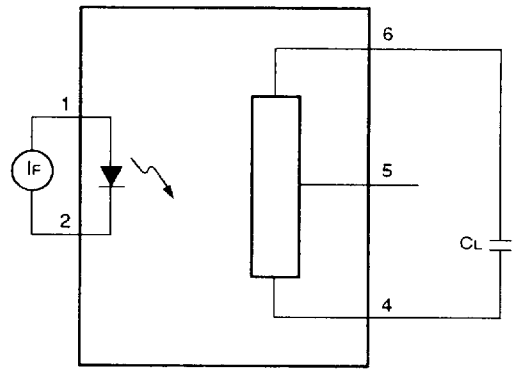


Figure 4. ATT1800 Test Circuit Without External Biasing

Application

The ATT1800 device can be used in low-side or high-side drive applications. Figure 5 depicts a low-side drive application using a single MOSFET for dc switching. Figure 6 depicts a high-side drive application using two source-coupled MOSFETs in series. This configuration allows bidirectional ac (or dc) switching and blocking capability.

The ATT1800 device is capable of handling a load voltage of 300 V when operated in the high-speed mode (pin 5 connected). External components D1, C1, and M1 must be rated at a voltage greater than the supply voltage. To minimize voltage droop, the rated value of C1 should be equal to or greater than the gate-to-source capacitance of M1.

An external MOSFET gate protection zener is not required since one is provided within the ATT1800 device.

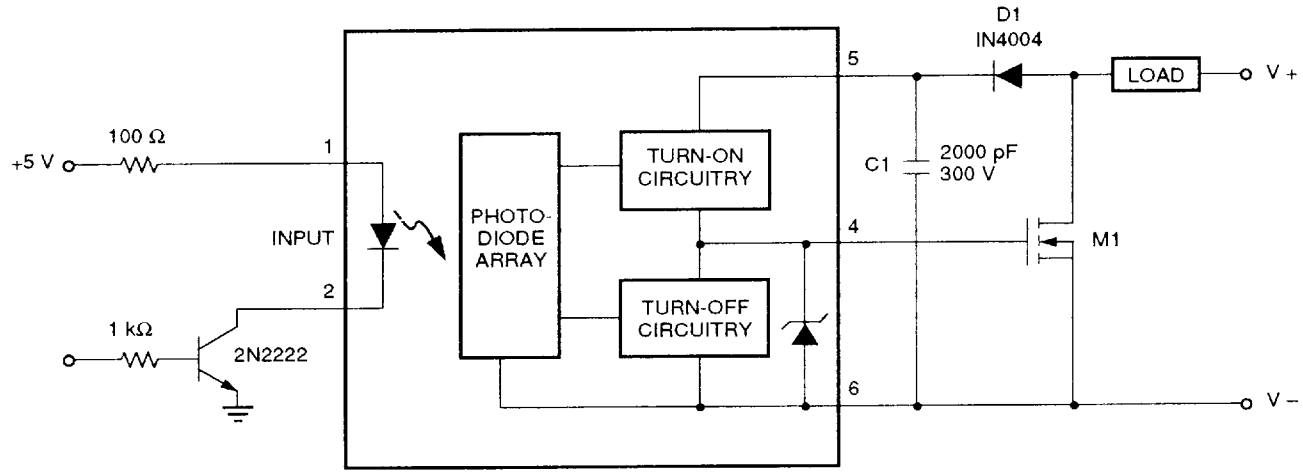


Figure 5. High-Speed dc Relay in Low-Side Drive Configuration

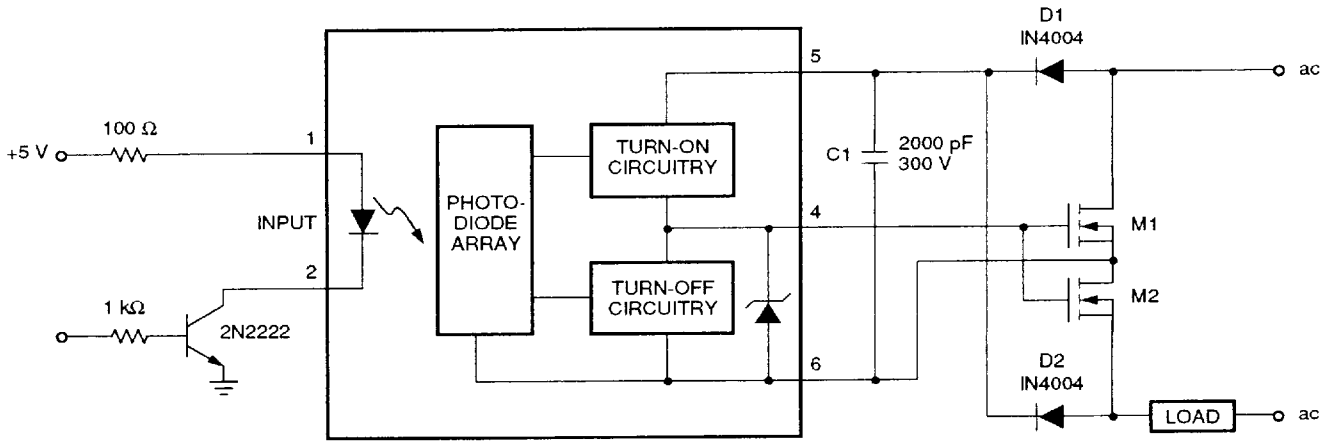
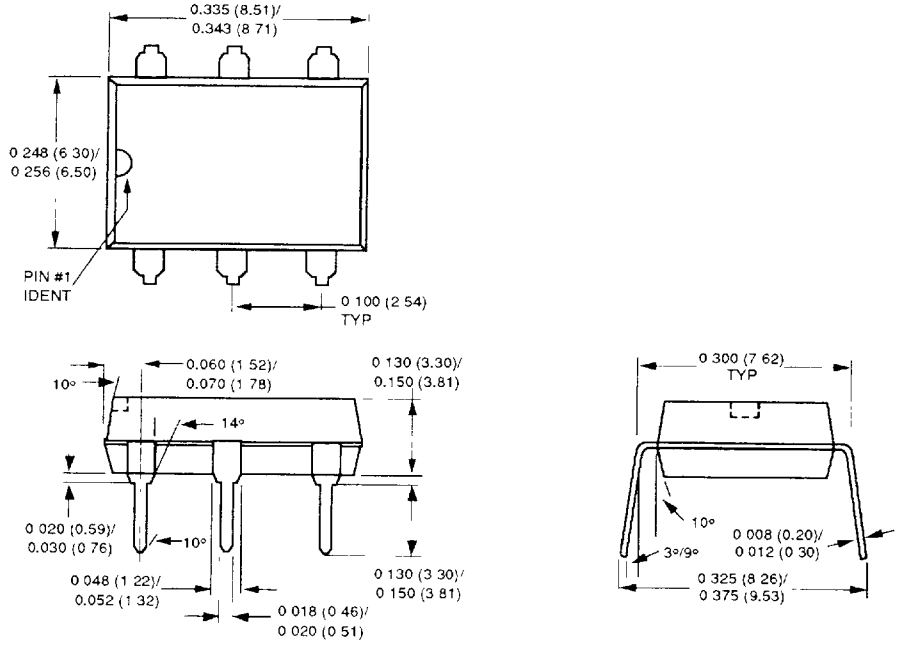


Figure 6. High-Speed ac/dc Relay in High-Side Drive Configuration

Outline Drawings

6-Pin, Plastic DIP (ATT1800AT1)

Dimensions are in inches and (millimeters).



6-Pin, Surface-Mount Gull Wing (ATT1800AAB1)