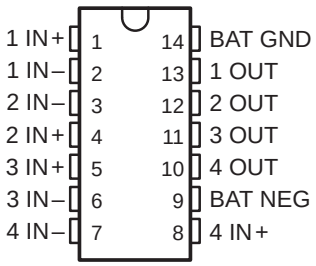
DS3680
QUAD TELEPHONE RELAY DRIVER

SLRS014C – MARCH 1986 – REVISED SEPTEMBER 1995

- **Designed for –52-V Battery Operation**
- **50-mA Output Current Capability**
- **Input Compatible With TTL and CMOS**
- **High Common-Mode Input Voltage Range**
- **Very Low Input Current**
- **Fail-Safe Disconnect Feature**
- **Built-in Output Clamp Diode**
- **Direct Replacement for National DS3680 and Fairchild μA3680**

D OR N PACKAGE
(TOP VIEW)

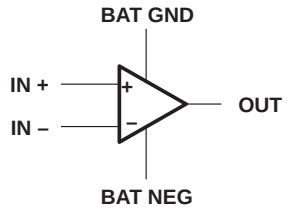


description

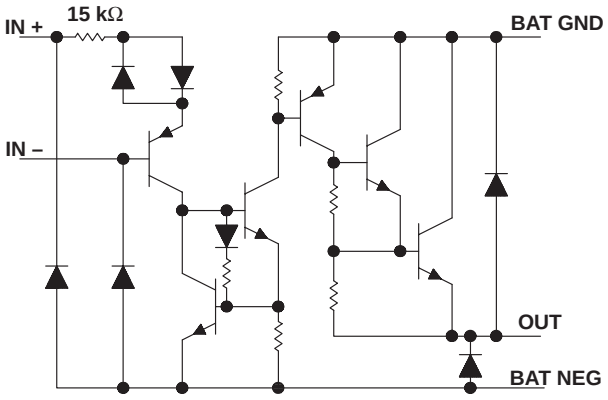
The DS3680 telephone relay driver is a monolithic integrated circuit designed to interface –48-V relay systems to TTL or other systems in telephone applications. It is capable of sourcing up to 50 mA from standard –52-V battery power. To reduce the effects of noise and IR drop between logic ground and battery ground, these drivers are designed to operate with a common-mode input range of ±20 V referenced to battery ground. The common-mode input voltages for the four drivers can be different, so a wide range of input elements can be accommodated. The high-impedance inputs are compatible with positive TTL and CMOS levels or negative logic levels. A clamp network is included in the driver outputs to limit high-voltage transients generated by the relay coil during switching. The complementary inputs ensure that the driver output is off as a fail-safe condition when either output is open.

The DS3680 is characterized for operation from 0°C to 70°C.

symbol (each driver)



schematic diagram (each driver)



All resistor values shown are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage range at BAT NEG, V_{BAT-} (see Note 1) . . . . . –70 V to 0.5 V
Input voltage range with respect to BAT GND . . . . . –70 V to 20 V
Input voltage range with respect to BAT NEG . . . . . –0.5 V to 70 V
Differential input voltage, V_{ID} (see Note 2) . . . . . ±20 V
Output current, I_O: Resistive load . . . . . –100 mA
Inductive load . . . . . –50 mA
Inductive output load . . . . . 5 H
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds . . . . . 260°C

NOTES: 1. All voltages are with respect to BAT GND, unless otherwise specified.
2. Differential input voltages are at the noninverting input terminal IN+ with respect to the inverting input terminal IN–.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING
D	950 mW	7.6 mW/°C	608 mW
N	1150 mW	9.2 mW/°C	736 mW

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{BAT-}	–10	–60	V
Input voltage, either input	–20†	20	V
High-level differential input voltage, V_{IDH}	2	20	V
Low-level differential input voltage, V_{IDL}	–20†	0.8	V
Operating free-air temperature, T_A	0	70	°C

† The algebraic convention, in which the less positive (more negative) limit is designated minimum, is used in this data sheet for input voltage levels.

electrical characteristics over recommended operating free-air temperature range, V_{BAT-} = –52 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP‡	MAX	UNIT
I_{IH}	High-level input current (into IN+)	V_{ID} = 2 V			40	100	µA
		V_{ID} = 7 V			375	1000	
I_{IL}	Low-level input current (into IN+)	V_{ID} = 0.4 V			0.01	5	µA
		V_{ID} = – 7 V			–1	–100	
$V_{O(on)}$	On-stage output voltage	I_O = 50 mA,	V_{ID} = 2 V		–1.6	–2.1	V
$I_{O(off)}$	Off-stage output current	$V_O = V_{BAT-}$	V_{ID} = 0.8 V		–2	–100	µA
			Inputs open		– 2	–100	
I_R	Clamp diode reverse current	V_O = 0			2	100	µA
V_{OK}	Output clamp voltage	I_O = 50 mA			0.9	1.2	V
		I_O = –50 mA,	V_{BAT-} = 0		–0.9	–1.2	
$I_{BAT(on)}$	On-state battery current	All drivers on			–2	–4.4	mA
$I_{BAT(off)}$	Off-state battery current	All drivers off			–1	–100	µA

‡ All typical values are at T_A = 25°C.

switching characteristics $V_{BAT–}$ = –52 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{on}	Turn-on time	V_{ID} = 3-V pulse, R_L = 1 kΩ, L = 1 H, See Figure 2		1	10	µs
t_{off}	Turn-off time			1	10	µs

PARAMETER MEASUREMENT INFORMATION

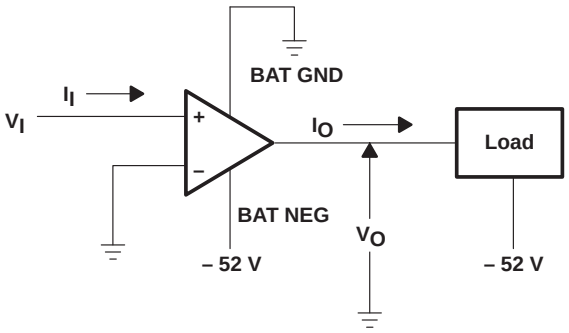


Figure 1. Generalized Test Circuit, Each Driver

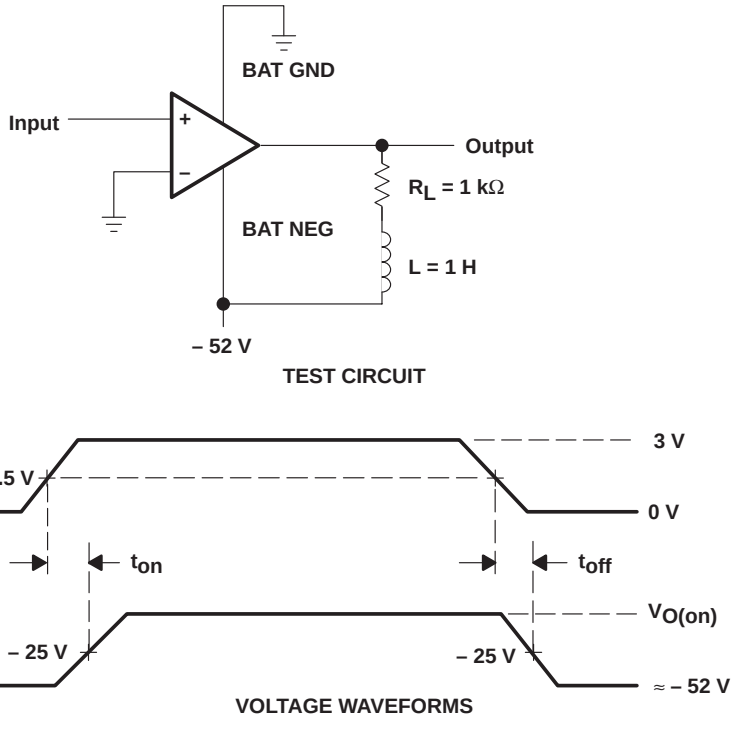


Figure 2. Test Circuit and Voltage Waveforms, Each Driver

APPLICATION INFORMATION

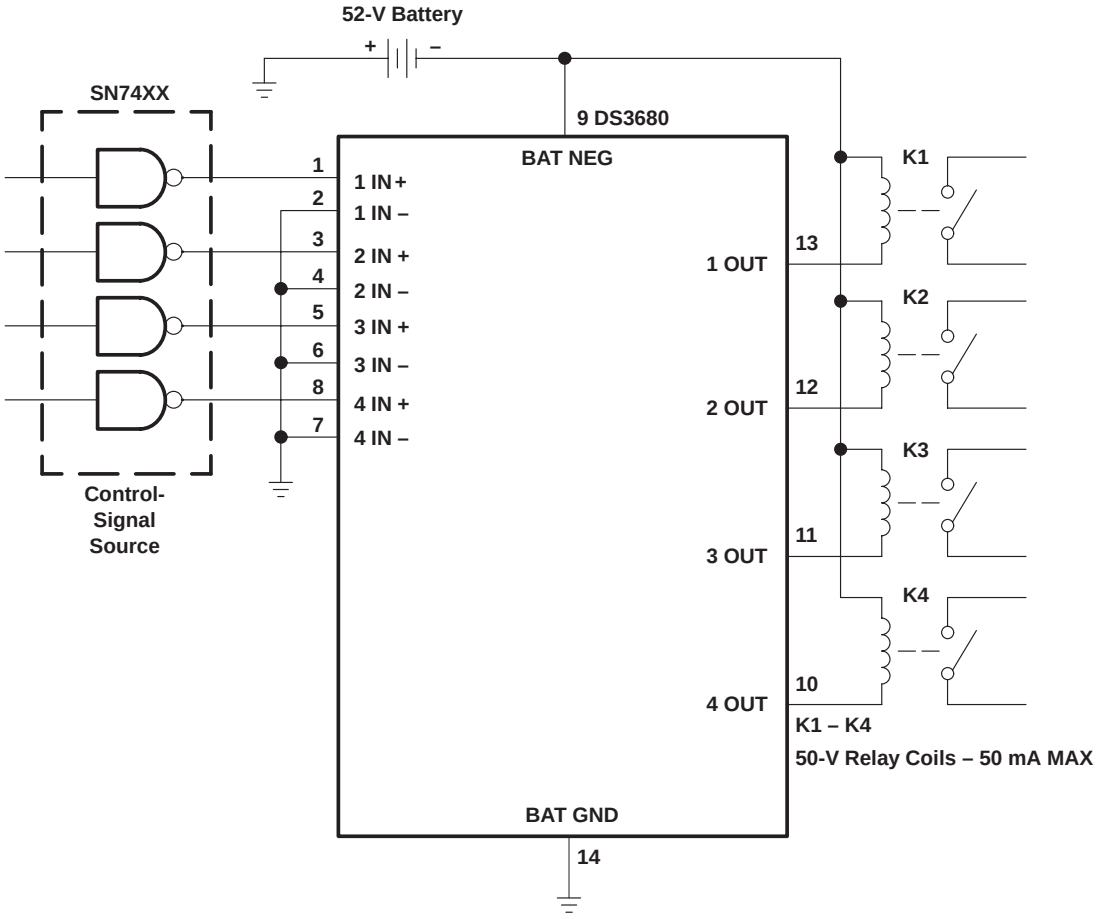


Figure 3. Relay Driver

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.