AN782

TC7660 Powers RS-232 Data Loop Low Cost Adapter

Author: Wes Freeman,
Microchip Technology, Inc.

INTRODUCTION

The introduction of single-voltage EPROMS and dynamic RAMs has permitted designers to produce complete digital systems powered by a single 5V supply. One area which has not yielded to single-supply operation, however, is the RS-232 interface. If a system must communicate with an RS-232 serial device, such as a printer or another computer, a separate power supply is required.

The circuit in Figure 1 provides an RS-232 driver without requiring a second power supply. Originally built for downloading files from an IBM PC to an IAM-65, the circuit is applicable to a wide variety of single-board computers as well as single chip microcontrollers such as Microchip's PIC16C745. In 100-piece quantities the component cost is less than $3, and pc board space is only a little more than is occupied by a 20-pin socket.Understanding the circuit's operation is easy. U1 is the CMOS TC7660 DC-to-DC converter. It contains an oscillator and matrix of switches which convert the +5V supply to –5V. The optoisolator converts the TTL-level input current into voltage which swings between the plus and minus supply rails, producing RS-232 compatible output levels.

Resistor R1 determines the RS-232 output voltage swing. R1's value is determined by the input specifications of the receiving device, current transfer ratio of the optoisolator, and the driving circuit's output current capability.

The RS-232 input voltage spec is ±3V. The minimum input resistance of the TC232, a typical RS-232 transceiver, is about 3kΩ. Therefore, 1mA of current must be supplied, and R1 must be:

$$R_1 = \frac{5V - 3V}{1mA} = 2k\Omega$$

For reliable operation the optoisolator should be biased to saturation, so:

$$I_{OPTO} = \frac{10k}{2k\Omega} + \frac{5V}{3k\Omega} = 2k\Omega$$

Since the optoisolator's current transfer ratio is only 20%, the LED current must be:

$$I_{LED} = \frac{6.6mA \cdot 100\%}{20\%} = 33mA$$

For interfacing to lower-power devices a higher gain optoisolator can be substituted. The 4N33 Darlington, for example, has a current transfer ratio of 500%, which reduces input drive current requirements to only 1.3mA.

For a cable length of six feet, the circuit operates properly up to 9600 baud. Unfortunately, high baud rates are not always useable. This is because many computer prototyping boards seem to have software serial-communications routines which are designed for 100 baud teleprinters. These routines do not make use of the handshakings signals which RS-232 provides. Unless the serial communications routines are rewritten, lower baud rates may be required for proper operation.

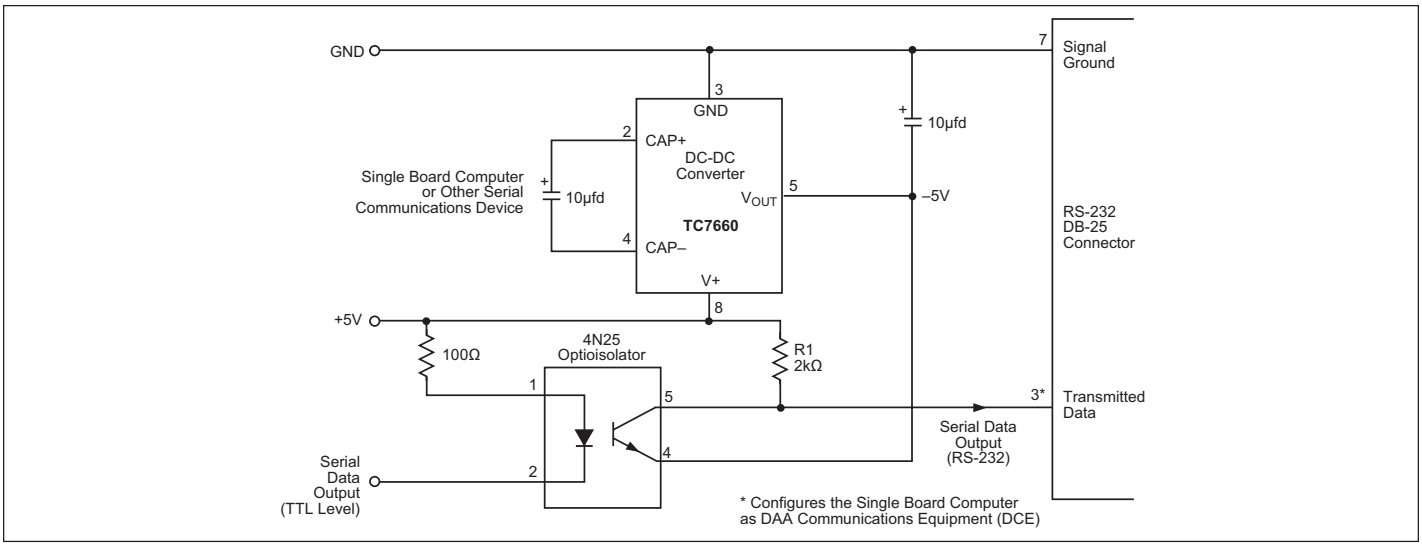
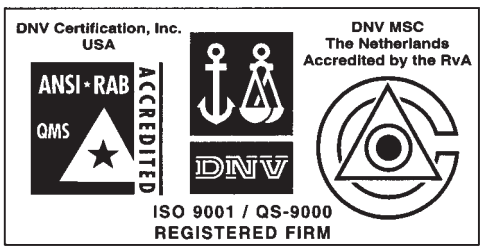


FIGURE 1: This low cost circuit converts TTL-level signals to an RS-232 level without the expense of a negative power supply. The TC7660's –5V output permits the optoisolator to swing to RS-232 levels at up to 9600 baud.

NOTES:



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2355 West Chandler Blvd.
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New York
150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose
Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto
6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia
Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing
Microchip Technology Consulting (Shanghai) Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu
Microchip Technology Consulting (Shanghai) Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-6766200 Fax: 86-28-6766599

China - Fuzhou
Microchip Technology Consulting (Shanghai) Co., Ltd., Fuzhou Liaison Office
Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506 Fax: 86-591-7503521

China - Shanghai
Microchip Technology Consulting (Shanghai) Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen
Microchip Technology Consulting (Shanghai) Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

Hong Kong
Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India
Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan
Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

Korea
Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore
Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-6334-8870 Fax: 65-6334-8850

Taiwan
Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark
Microchip Technology Nordic ApS
Regus Business Centre
Lautrup hoj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France
Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - ler Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany
Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy
Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom
Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

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