You read what it can do last month, so why not build one!

Cassette Problems II

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In Part 1 of this series, we examined some of the problems encountered loading and running program tapes with the TRS-80 system. Part 2 shows you how you can eliminate these problems with the Data Dubber. It virtually eliminates the critical nature of CLOADing tapes by regenerating the original CSAVE pulses. You can run the CTR-41 volume up and down or flip the tone switch back and forth while CLOADing, and your TRS-80 will never blink an asterisk!

You can also use the Data Dubber to make copies of *any* tape, even those from vendors who say their tapes can't be copied. If cassettes are your principal storage media, you can probably save the cost of the Data Dubber in a month or two. If you have written some crafty programs, you can become an entrepreneur by duplicating and distributing your software. All it takes is a couple of CTR-41s from Radio Shack, the Data Dubber and a smidgen of operating capital.

How It Works

The schematic diagram is given in Fig. 1. Starting at the input plug (P1 from the cassette), there are several proprietary features that ensure loading and reproduction of poor-quality tapes. The input circuit, consisting of C1 and T1, forms a bandpass filter network to minimize hum modulation and noise on the tape. Furthermore, ground loop hum (a notorious problem with the CTR-41) is eliminated by floating the primary of the transformer. This isolates the CTR-41 from the TRS-80.

The full wave rectifier (D1-D4) ensures that all data pulses are positive going, regardless of whether positive or negative pulses predominate on the tape. These pulses turn on the data switch transistor, Q1.

The stream of data pulses feeds a series of Schmitt trigger stages in IC1, a CMOS-type 74C14. The time constant of each stage is chosen to produce pulses of exactly the same width as the TRS-80 supplies when CSAVEing a program. The pulses at pins 4 and 8 of IC1 are combined at P2 to provide an exact reproduction of the CSAVE pulses (see Fig. 2d). Pulses are also applied to Q3 and Q4 to drive the light-emitting diode (D10) that indicates the Data Dubber is operating. The pulses applied to this lamp are also differentiated by CB (.1 uF) and the 100 Ohm input impedance of the TRS-80 CLOAD circuit.

One of the craftiest features of the unit is the Q2 circuit. During the design phase of the

Duplicating tapes is easy with this setup. Pulses from the right cassette are regenerated by the Data Dubber. These replicas of the TRS-80 CSAVE pulses are recorded by the left cassette.

BA1	9 volt battery
C1	.47 uF, 50 volt disk ceramic capacitor
C8	Mfd, 50 volt disc ceremic
C2	4.7 uF tantalum capacitor
C3	100 uF, 16 V electrolytic capacitor
C4,C5,C6,C7	470 pF disk ceramic
C9	.01 uF Mylar capacitor
C1,C5,D7-D9	1N4148 silicon diode
D6	1N4001 silicon diode
D10	Light-emitting diode
IC1	Hex Schmitt Trigger-CMOS 74C14
J1	Jack, open circuit
P1,P2	Plug, molded with shield cable (Calrad 55-904)
Q1,Q3,Q4	MPS5172 NPN silicon (see text)
Q2	MPS3638 PNP silicon (see text)
R1,R8,R9	10k 1/4W resistor
R2	47k, 1/4W resistor
R3	47 Ohm, 1/4W resistor
R4,R7	1k, 1/4W resistor
R5	15 Ohm, 1/4W resistor
R6	470k, 1/4W resistor
R10,R11	270K, 1/4W resistor
R12,R13	4.7k, 1/4W resistor
R14,R15	270 Ohm, 1/4W resistor
R16	5.6k, 1/4W resistor
R17	2.7k, 1/4W resistor
T1	Transformer, 1k to 8 Ohms (reverse connected)

Parts List

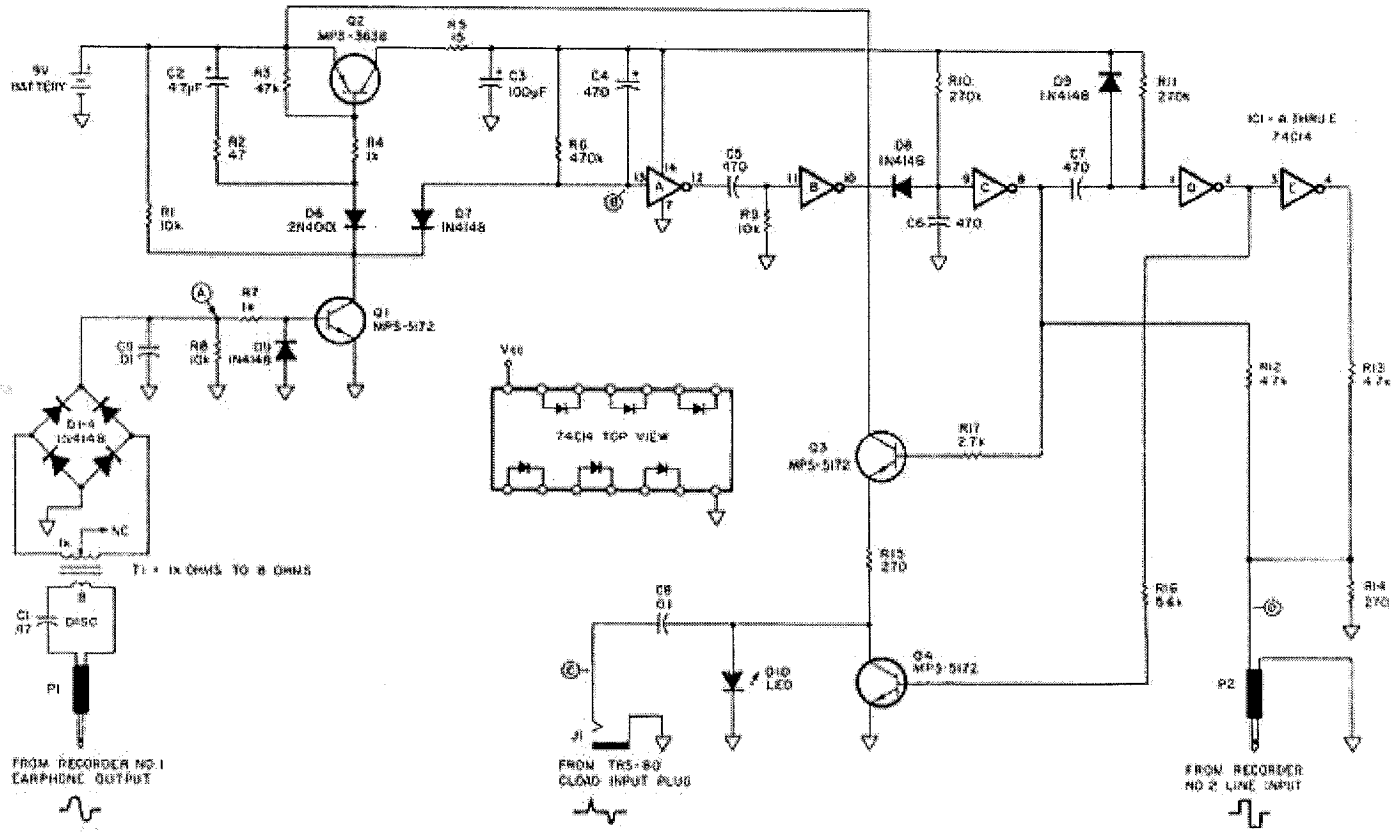


Fig. 1. Schematic diagram for the Data Dubber. Transistor Q2 is the electronic switch that turns the unit on.

Data Dubber, someone was always forgetting to switch the contraption off. A 9 volt battery was usually needed at the worst possible time (after the Radio Shack store closed), and the local drug store wouldn't accept a Radio Shack battery card! Thus, an electronic switch was added to the Data Dubber. As long as there is no signal input, the Dubber contentedly draws a fraction of a microampere from the 9 volt battery. However, as soon as there is a signal input (the beginning of the leader), the electronic switch springs to life and connects the battery to R15. The battery consumption is 7-10 milliamperes while data is coming in. As soon as the input ceases, the Data Dubber turns off automatically and goes back to sleep.

Thus, there are no controls to set or switches to throw. In fact, the only indication that the Dubber is working is the light-emitting diode on the front panel. It illuminates whenever data comes in from the cassette.

Construction

Probably the easiest way for the home constructor to duplicate the project is to build it on a piece of perfboard. The layout is totally noncritical, although you should observe the usual good construction practice of short leads.

The transistors used were selected because they were locally available at low cost, but any general-purpose PNP silicon transistor can be used for Q2. The other transistors are general-purpose NPN silicon. Use good-quality, 470 pF capacitors, since these determine the pulse width. Electrolytic capacitors should *not* be used for C1 and C8, although they are less expensive than the disk capacitors. Capacitor C2 (4.7 uF) must be a tantalum type for low leakage. The diodes are also not critical. The 1N4148 specified is a common type, but most low-leakage computer-grade silicon diodes will work. Note, however, that D6 is a 1N4001 power diode.

There is one assembly precaution regarding the integrated circuit. Since this is a CMOS type, it is subject to damage from static electricity. It is a good idea to use a socket and only insert the IC after wiring is complete. Also, don't touch the IC after you scrape across the carpet unless you touch a grounded object first.

Testing

Before applying power to the circuit, you should make a couple of pretests. First, inspect your wiring to ensure there are no shorts or bad connections. Then, measure the resistance across C3. It should measure several hundred Ohms. Finally, connect a milliammeter in series with the positive terminal of the 9 volt battery and the battery clip. If the meter pointer moves visibly, it indicates something is wrong with the circuitry of Q2. There should be no leakage through this stage.

So far, so good? Connect the battery and apply data to P1. If the LED lights up, you have probably successfully completed the construction of the Data Dubber.

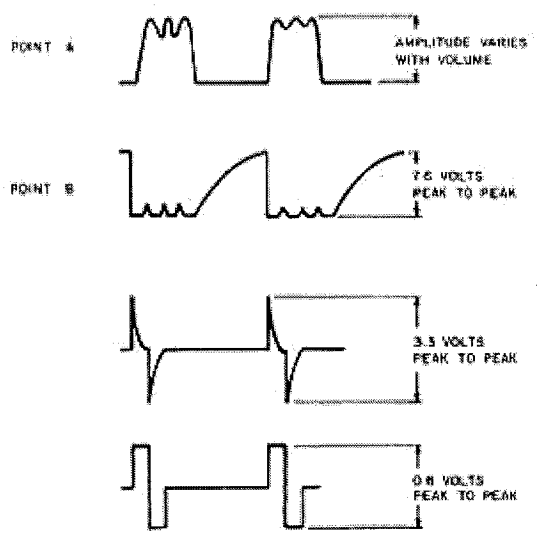


Fig. 2. Oscilloscope waveforms found in the Data Dubber. The number of glitches on A and B are determined by waveform distortion on the tape.

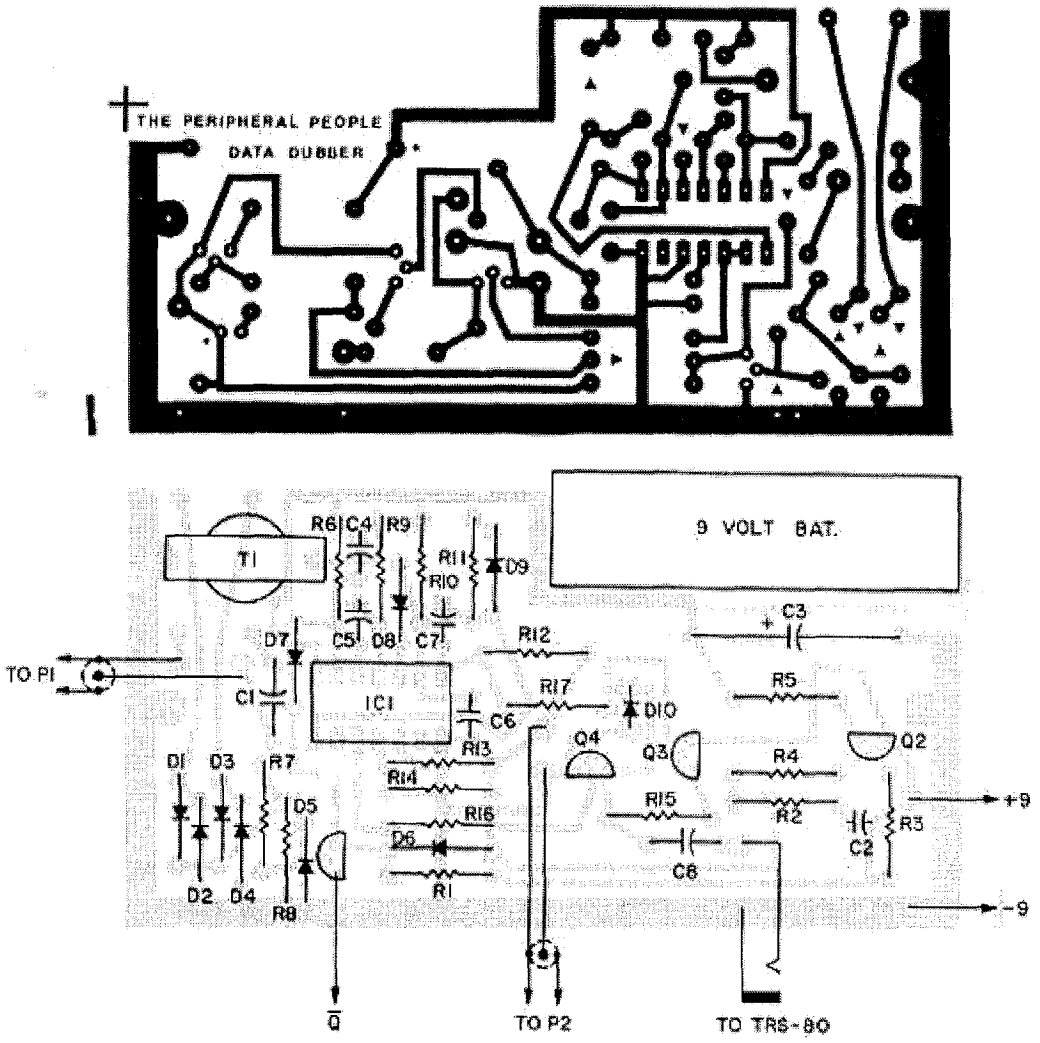


Fig. 3. Artwork and component layout for the circuit board. Note—this drawing is actual size.

If you have an oscilloscope, you should check the waveforms at points A, B, C and D in Fig. 1. The waveform at point B is particularly critical. If the glitches along the bottom of the waveform stick up past the center, they can cause double triggering of the output signal. Note that as you run the level higher, the glitches are more suppressed.

Using the Data Dubber

While the Data Dubber can be a godsend to the TRS-80 owner, it cannot resurrect life. If you have a tape that has never been loadable under any circumstances, there is a good chance you won't be able to load it with the Dubber either. Very likely, pulses are missing, and it will never load.

However, if one of your tapes loads after much fiddling with the volume and tone, it will likely load the first time with the Data Dubber. Normally, you will set the volume somewhere between 4 and 6 for a good-quality tape. Particularly troublesome tapes may require a volume setting between 6 and 10 to get a load.

Most of the time, advancing the volume until a good load is obtained should prove satisfactory. However, some tapes may have garbage on the baseline that is increased when the volume is advanced. In this case, a compromise setting of the volume might be required.

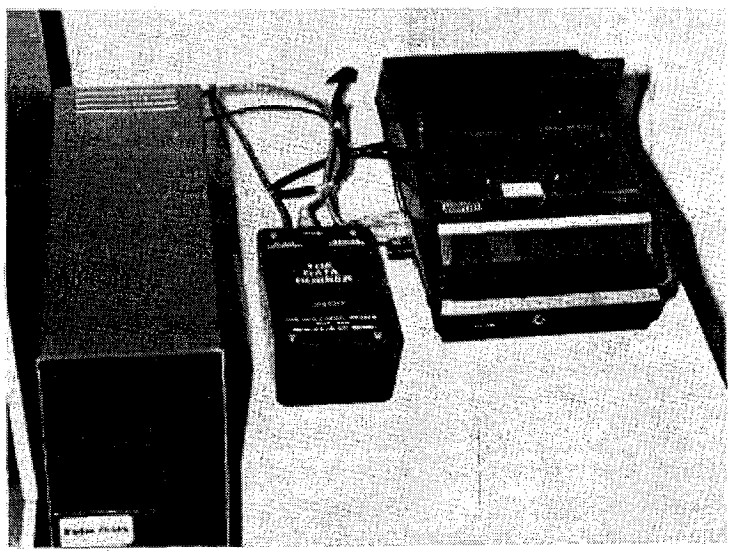
In testing more than 100 tapes, we have never found one that would load directly into the TRS-80, but not through the Data Dubber. However, since the forms of distortion added by duplication can be varied and fiendish, it is conceivable that this situation could occur. We would like to obtain such a tape for testing and design improvement of the Data Dubber.

The LED can be used as a level indicator. A good data stream is indicated by a steady light on the leader and a barely perceptible flicker when data is coming in. As you advance the volume from zero, the light will suddenly come on. Keep advancing the level two numbers on the volume knob. The optimum point for the volume seems to be slightly above the point where illumination occurs.

Once you have successfully loaded a troublesome tape, you can copy it one of two ways. Probably the easiest route is to simply CSAVE the program on a new cassette. However, if it is a machine-language program, connect a second recorder (slave) to the Data Dubber and use the same volume level (master) that produced the successful load. The duplicated tape from the slave recorder should load perfectly with or without the Data Dubber.

For those of you who despise building electronic gadgets, the wired and tested Data Dubber is available from The Peripheral People, Box 524, Mercer Island WA 98040, for $49.95 postage paid. For those of you who despise buying wired and tested electronic gadgets, the circuit board or a kit of parts is also available for $4.95 and $24.95, respectively.

Readers of *80 Microcomputing* are welcome to construct the Data Dubber for their own personal use. However, any duplication of the Data Dubber or conceptual variation for commercial sale is expressly prohibited by law. Not only is it uncouth, legally uncool and morally reprehensible, but our ill-tempered attorney is gonna getcha! ■



The Data Dubber can be connected in line between the cassette recorder and the TRS-80 CLOAD input.