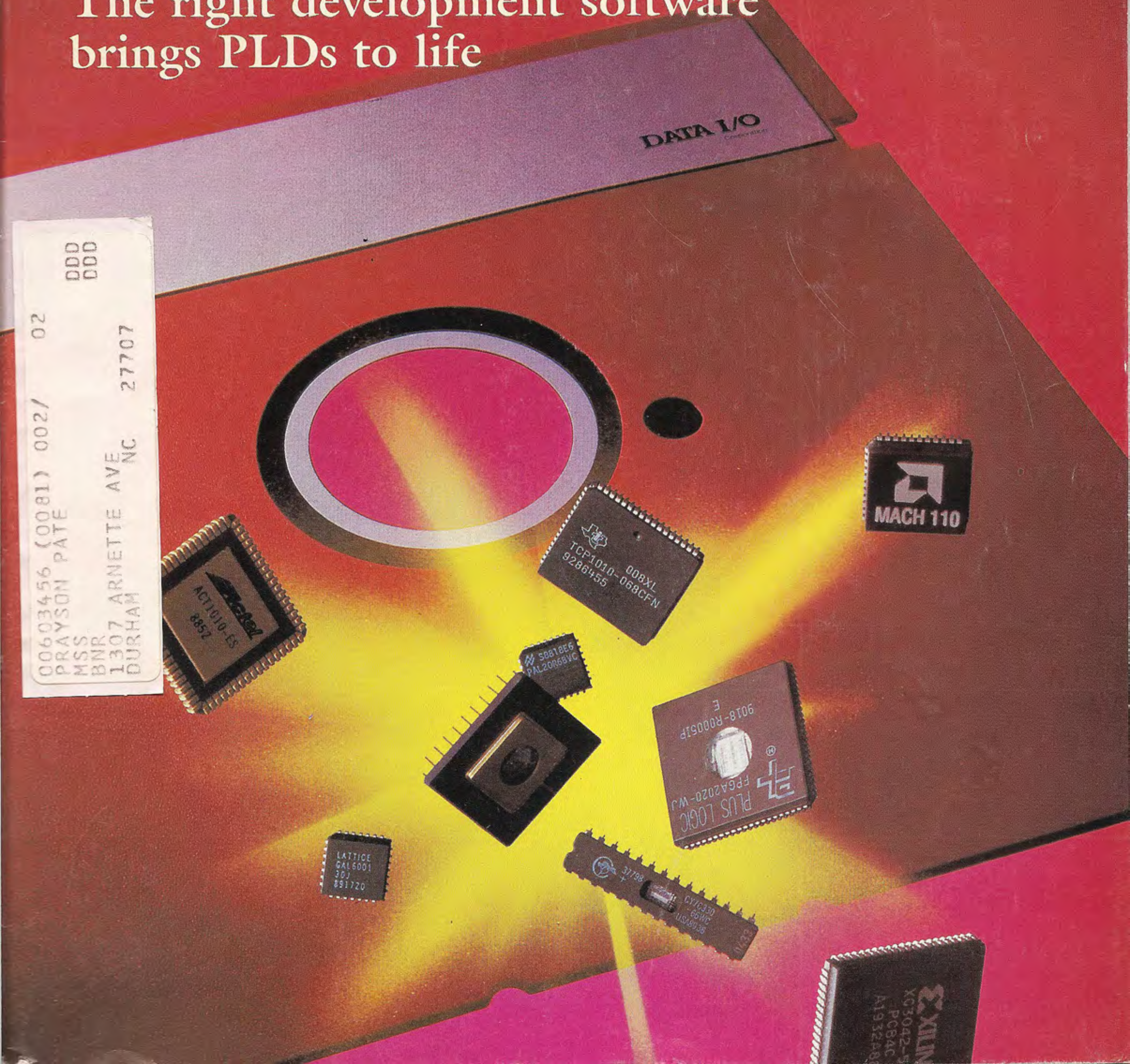
A CAHNERS PUBLICATION

AUGUST 2, 1990

EDN®

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

Special Report:
The right development software brings PLDs to life



EDITED BY CHARLES H SMALL

Passive network is totally resistive

Prayson Pate
BNR, Research Triangle Park, NC

The circuit in **Fig 1a** looks trivial, but it isn't. It can provide a resistive termination to a transmission line over a wide bandwidth—much wider than you can achieve with op amps. Further, you can extend the circuit to make multipole lowpass, highpass, and bandpass filters. Note that although the circuit resembles a tank circuit, it doesn't ring. In fact, ringing arising from component mismatch is small for reasonable component tolerances.

To calcuate the circuit's impedance, first let $Z_1 = R \parallel L$ and $Z_2 = R \parallel C$. If $\omega_1 = R/L$ and $\omega_2 = 1/RC$, then

$$Z_1 = R/(1 + \omega/j\omega_1)$$

and

$$Z_2 = R/(1 + j\omega_2/\omega).$$

Thus the circuit's input impedance equals $Z_1 + Z_2$, or

$$Z_{IN} = R(1 + (j\omega/\omega_2 + \omega_1/j\omega) + 1)/(1 + j\omega/\omega_2 + \omega_1/j\omega + \omega_1/\omega_2).$$

This expression reduces to simply R if $\omega_1 = \omega_2 = \omega_0$. You can calculate values for L and C simply:

$$L = \omega_0/R = 2\pi/F_0$$

and

$$C = 1/\omega_0 R = 1/2\pi F_0.$$

The circuit's transfer function is then:

$$H(j\omega) = Z_2/Z_{IN} = 1/(1 + j\omega/\omega_0),$$

which is the same transfer function as a simple LC lowpass filter.

You can realize more elaborate circuits by various combinations of the RL and RC subcircuits. Swapping the subcircuits in the circuit in **Fig 1a** yields a highpass circuit with the same pole. **Fig 1b** shows a 2-pole lowpass filter, and **Fig 1c** shows a bandpass filter. In **Figs 1b** and **1c**, the resistive input impedance of the second filter stage acts as the parallel resistor for the first stage. You can repeat this arrangement many times. The bandpass filter in **Fig 1c** does have the disadvantage of a 3-dB loss in its passband. EDN

To Vote For This Design, Circle No. 746

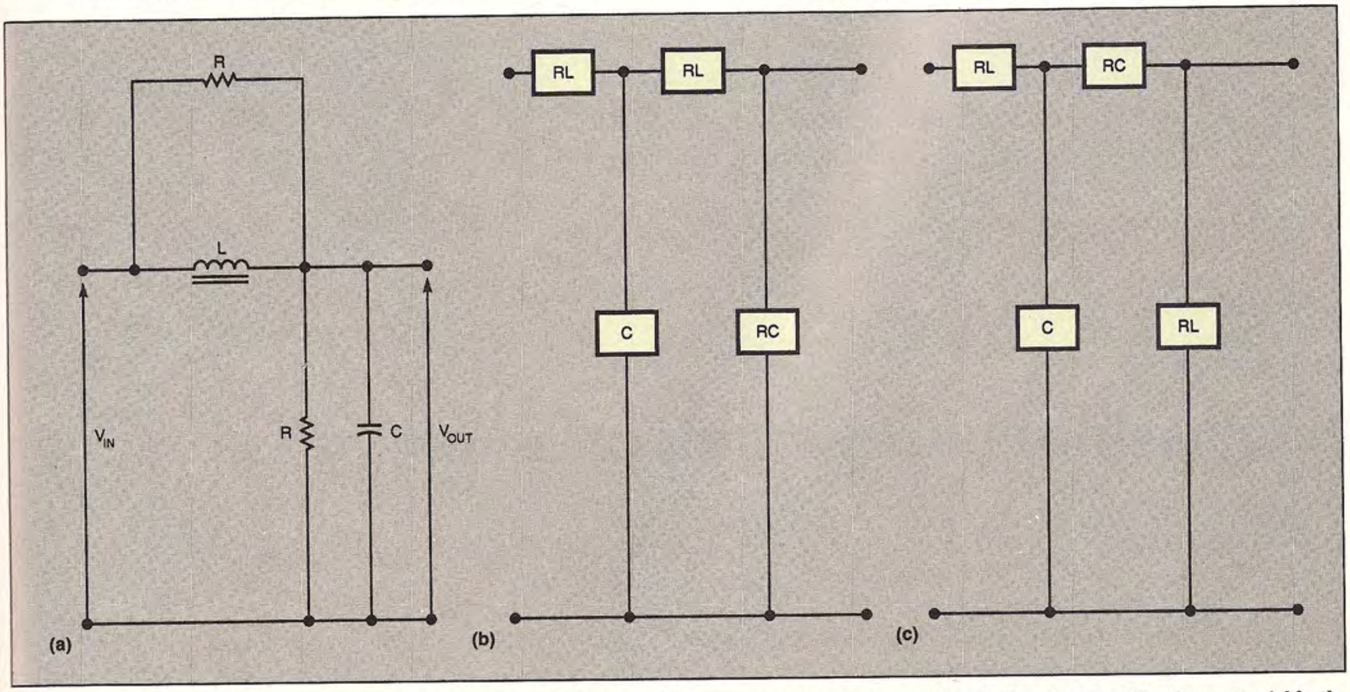


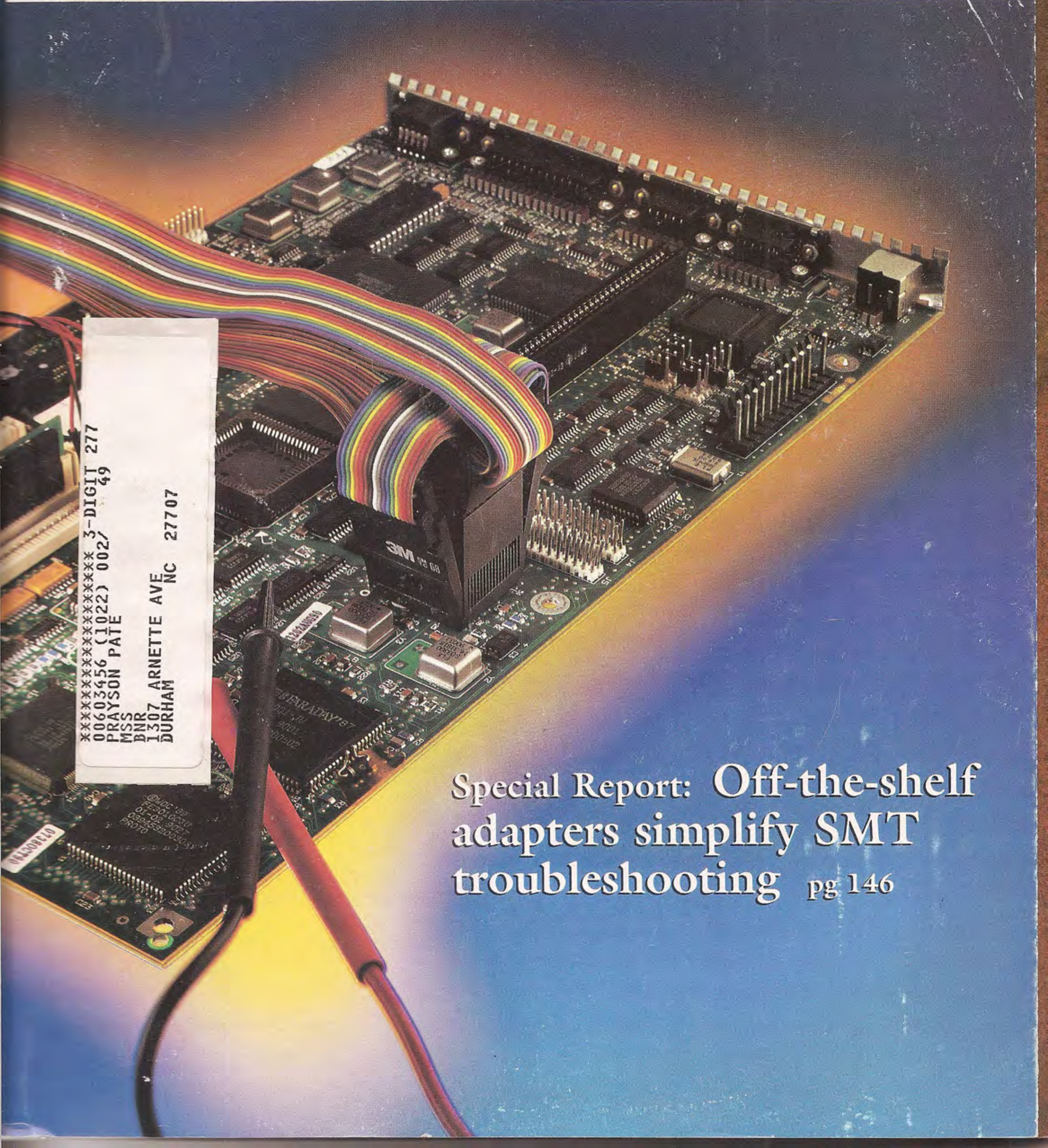
*Fig 1—**The simple circuit in a** provides resistive termination at all frequencies. Combining and swapping the circuit's elements yields the 2-pole lowpass filter in **b** and the bandpass filter in **c**.*

A CAHNERS PUBLICATION

FEBRUARY 18, 1991

EDN®

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS



Special Report: Off-the-shelf adapters simplify SMT troubleshooting

pg 146

Design Entry Blank

$100 Cash Award for all entries selected by editors. An additional $100 Cash Award for the winning design of each issue, determined by vote of readers. Additional $1500 Cash Award for annual Grand Prize Design, selected among biweekly winners by vote of editors.

To: Design Ideas Editor, EDN Magazine
Cahners Publishing Co
275 Washington St, Newton, MA 02158

I hereby submit my Design Ideas entry.

Name ____________________

Title ____________ Phone ________

Company ____________________

Division (if any) ____________________

Street ____________________

City ____________ State ________

Country ____________ Zip ________

Design Title ____________________

Home Address ____________________

____

Social Security Number ____________
(Must accompany all Design Ideas submitted by US authors)

Entry blank must accompany all entries. Design entered must be submitted exclusively to EDN, must not be patented, and must have no patent pending. Design must be original with author(s), must not have been previously published (limited-distribution house organs excepted), and must have been constructed and tested.

Exclusive publishing rights remain with Cahners Publishing Co unless entry is returned to author or editor gives written permission for publication elsewhere.

In submitting my entry, I agree to abide by the rules of the Design Ideas Program.

Signed ____________________

Date ____________________

Your vote determines this issue's winner. All designs published win $100 cash. All issue winners receive an additional $100 and become eligible for the annual $1500 Grand Prize. **Vote now,** by circling the appropriate number on the reader inquiry card.

FEEDBACK AND AMPLIFICATION

on the common pin. Also, parts cost drops from $3.50 (1000) to $1 (100) if you use a generic 74HC5043 triple dpst switch rather than a quad switch. **Fig 1** shows my suggested redesign.

Lastly, Tian Jin Qin's "Inverters mimic interlocked switches" on pg 132 also has problems. First, the circuit won't always switch. If you use CMOS logic, the worst-case current through B_1, C, R_3, S, and D_{1B} available to a switch, assuming a 5V ±10% supply, is 5.5 mA. For the circuit to work correctly, this current should be larger than the maximum inverter sink current, or at least 20 mA. Next, the circuit has an indeterminate state at power-on. Lastly, you could inadvertently turn on multiple outputs by pressing more than one button simultaneously. **Fig 2** shows my suggested revision.

Larry K Baxter, VP Engineering
Echolab Inc
175 Bedford Rd
Burlington, MA 01803
(617) 273-1512

Author corrects equations

The Design Idea I contributed, "Passive network is totally resistive" (EDN, August 2, 1990, pg 135), contains two errors. The equation for L should be

$$L=\frac{R}{\omega_0}=\frac{R}{2\pi F_0},$$

and the equation for C should be

$$C=\frac{1}{\omega_0 R}=\frac{1}{2\pi F_0 R}.$$

Prayson Pate
BNR
Research Triangle Park, NC

EDN's bulletin board is on line

Call EDN's free bulletin board service (BBS) at (617) 558-4241 (2400,N,E,1) and select /DI_SIG to get additional information or to comment on these Design Ideas.