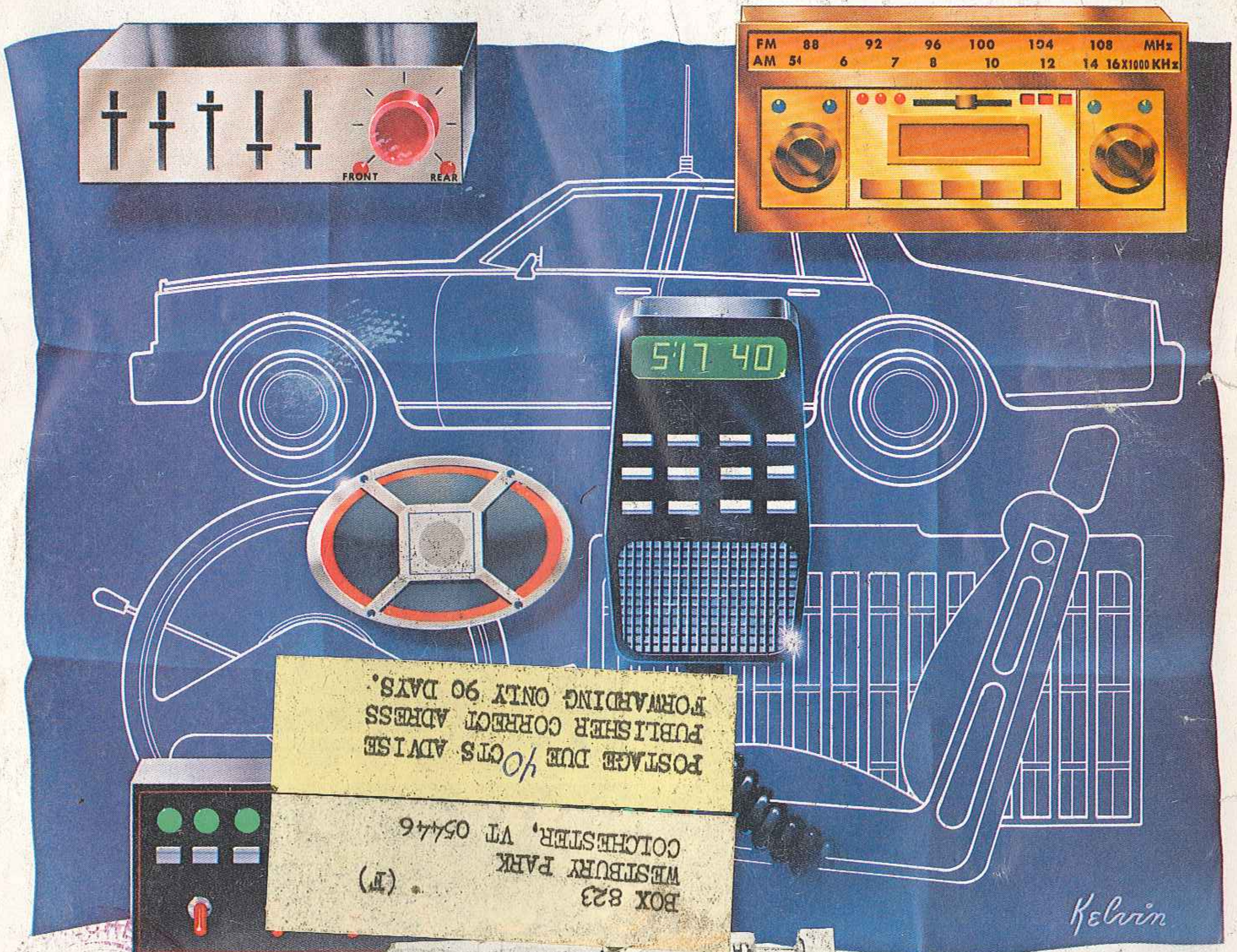
Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

JUNE 1979/$1.25

Pulse-Width Modulation Controls Motor Speed
A Simple, Adjustable Bench Power Supply
Electronically Simulated Ocean-Surf Sound

Special Focus on Car Stereo & CB Radio



Tested [illegible] Stereo Headphones
In This [illegible] f Speaker System
Issue [illegible] Stereo 150 Basic Power Amplifier

Microcomputer I/O Board Buying Directory

Make & Model	Price[1] ($)	Power required[2] (mA)[2] +8V	+16V	−16V	Ports[3]	Serial: 20-mA? RS-232?[4]	Cassette Ports	Remarks
S-100								
Alpha Microsysts.								
AM-300	695				6S	R		Multi-level interrupt under program control.
Byte								
Byt-LIF	200	X			1P	no		For Okidata and similar parallel printers; 37-pin connector.
CGRS Microtech								
A Lot of I/O	170 (k) 220 (w)				2S, 4P			With ROM space, and connector for PerSci floppy controller card.
TIM I/O	40 (b) 140 (k) 170 (w)				2S, 3P			Memory-mapped; w. 320 bytes RAM; 1K TI F M, breadboard area for custom I/O.
Cromemco								
8PIO	195 (k) 295 (w)	1.5A			8Pb			
PRI	195 (w)	700			4P (1I, 1O), 1 control			For printers; supports 1 dot-matrix, 1 daisy-wheel.
Tu-Art	195 (k) 205 (w)	1A	80	40	2S, 2P	B		With interval timers, vectored interrupts.
Educational Data Systs. of Va.								
PK3	85	300			1S, 2P	B		Expandable; options include 8 interrupts, real-time clock, floating-point processor.
PK4	150	800			1S, 8P	B		
PK1	130	500			2P	opt.		
Fire Bird Sales								
1SIB4	214				S4	R		
1PIB4	268				P4			
Franklin Elect.								
I/O Interface	165 (k) 250 (w)	750	50	50	3S, 1P	B		LEDs for send, receive data.
IMSAI								
MIO	195 (k) 350 (w)				2P, 1S	B	1 Tarbell	Includes 1 control port.
PIO 4-1	93 (k) 140 (w)				1P			Status and indicator lights.
PIO 4-4	156 (k) 299 (w)				4P			As above.
PIOM	22 (k)				1P			Expansion kit for PIO4-1.
PIO 6-6	169 (k) 279 (w)				6P			
PIO 6-3	139 (k) 239 (w)				3P			Expandable to PIO 6-6.
PO6M	54 (k) 90 (w)				3P			Expansion module for PIO 6-3.
SIO 2-2	156 (k) 299 (w)				2S	B		
SIO 2-1	125 (k) 235 (w)				1S	B		Expandable to SIO 2-2.
SIOM	47 (k) 69 (w)				1S			Expansion kit for SIO 2-1.
SIOC	31 (k)							Serial I/O clock piggyback.
Infinite								
MFIO-1K	234	730	145	85	1P, 1S	B	see Remarks	Also has 2K EPROM, 128 bytes RAM; firmware avail.; cassette port for 300-baud K.C., 1200-baud Processor Tech, 600 & 2400 baud.
Jade Computer								
JG-PS-01	125 (k) 175 (w)	X	X	X	2S, 1P	B	1 KC	Crystal-controlled baud rate.
Morrow's Microstuff								
Speakeasy	120	700			1S, 1Pb	B	3 KC	512 bytes ROM and RAM; cassete stop/start relays.
National Multiplex								
2SIO	190	600			2S, ½P	B	RS-232	For terminal & digital tape.
PUCI	235	600			3S, 1P	B	RS-232	For term., tape & printer.
Parasitic								
Speakeasy	150 (k) 185 (w)	900	40	60	1S, 1Pb	B	3 KC	Baud rate software-selectable.
Pickles & Trout								
P&T-488	250 (k) 325 (2)	X			1 IEEE 8Pb		1 KC	S-100 to IEEE-488 software on KC cassette.
BDIO	165 (w)							8 bidirectional data lines with 3 control, 3 port-select, 3 filtered interrupt lines; for up to 6 devices on one cable.
Processor Tech.								
3P+S	149 (k) 199 (w)				2Pb, 1S	B	no	1 serial, 2 parallel, 1 control port.
Solid State Music								
IO-2	55 (k)	300			1P			Experimenters' card with 1 port, spare IC patterns for serial port or PROM.
IO-4	150 (k)				2P, 2S	B	no	With 6 ribbon cables.
Space-Time Prod.								
Master I/O	48 (b) 369 (w)	1A	200	200	1S, 6P	TTL		With 3K ROM, 1K RAM, 3 counter-timers.
Vector Graphic								
Bit-Streamer	195 (w)				1S, 2P	B		Can be software-configured for 5-8 data bits.
Wameco								
SIO-1	30 (b)				2S, 2P	1 KC		
Xecon Micro								
Smart Controller	205 (w)	800	X		1S	B	mod. KC	On-board ROM with file-formatting tape OS; KC @ 1200-4800.
Xitan								
SMB-2	395 (w)		170	170	2S, 1P	B*	1*	*One RS-232 configurable as 20-mA; cassette interface 1200/2400 baud; parallel port has 8 bits + 2 control lines; board has socket for 2K RAM, 4K EPROM, ZAPPLE monitor in 12K ROM; see main listing.

Make & Model	Price[1] ($)	Power required[2] (mA) +5V	+12V	−12V	Ports[3]	Serial: 20-mA? RS-232?[4]	Cassette Ports	Remarks
SS-50								
F&D Associates								
VPI-1*	33 (b)				5P	no	no	36 bidirectional lines, 4 inept only; configurable as four 8-bit ports with 1 I/O and 1 input handshake line; can run Selectric; can replace 2 SWTP MP-L.
Gimix								
1 ACIA	99 (w)	X	X	X	1S	B	no	
2 PIA	98 (w)	X			2P			
4 ACIA	198 (w)	X	X	X	4S	B	no	Real-time clock for 1-sec. and 1-min. interrupts.
8 PIA	198 (w)	X			8P (5b)			
Midwest Scientific								
PIA-1	50 (k) 65 (w)				1P			
SI-1	58 (k)				2SI, 2SO	B		

Make & Model	Price[1] ($)	Power required[2] (mA) +5V	+12V	−12V	Ports[3]	Serial: 20-mA?	Cassette Ports	Remarks
National Multiplex 2SIO (R)	190	500			2S, 1P	B	RS-232	For terminal & tape; OS in ROM.
SDS Tech. Devices MP-S	35 (k)	200			1S	B	2 SWTP AC-30	
Southwest Tech. MP-S	10 (b) 35 (k)	200			1S	B		110-9600 baud.
MP-C	10 (b)				1S	B		110-300 baud; serial & control board.
MP-LA	35 (k)	300			2P			

NOTES:
[1](b)=bare board; (k)=kit, (w)=wired. Prices shown may not include cables.
[2]In amperes where indicated by "A."
[3]S=serial, P=parallel; I=input only, O=output only, b=bidirectional.
Types of parallel port given only if specified by manufacturer. Some manufacturers count 8 I/O lines as one port, others count each line separately.
[4]R=RS-232, T=20 mA (TTT), B=both.

BUILD A PAIR OF "LAZY-LEADS"

BY GENE FRANCISCO

Eliminate switching leads when testing semiconductors

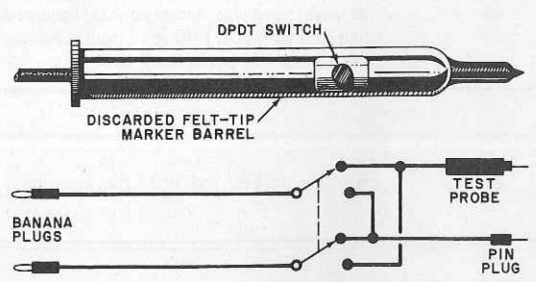
If you have ever tested a batch of semiconductors with an ohmmeter, you know that continually transposing test leads results in tired hands and tangled leads. Presented here is a simple probe called "Lazy Leads" which eliminates the need to transpose leads thanks to a built-in dpdt switch. It can be assembled from odd parts in a few moments.

Construction of the Lazy Leads is very simple. Locate a used felt-tip marker whose barrel sits comfortably in your hand. Also, select a subminiature dpdt switch. The switch must be small enough to fit inside the marker barrel. (Alternatively, choose a marker whose barrel is large enough to accommodate a small dpdt switch.) Other required items include a pin-tipped test probe, a pin plug, a length of three-conductor flexible cable and a pair of plugs compatible with your meter.

Remove the sealing plug from the top of the marker barrel and discard the spent ink reservoir and tip. Thoroughly clean the barrel with rubbing alcohol. Next, cut an opening in the barrel near the tip to accommodate the dpdt switch. Drill a hole in the sealing plug large enough to allow the three-conductor cable to run through it. Pass a length of the cable somewhat longer than the barrel through the hole and then tie a knot in the cable on the inner side of the seal.

Separate one of the conductors on the *outer* side of the sealing plug and solder it to a test probe. Solder banana plugs to the two remaining conductors. Then feed the three-conductor cable down the barrel and through the hole cut for the switch. Solder the conductors to the switch contacts according to the schematic shown in the figure. Also, solder one end of a short length of hookup wire to a pin plug and the other end of the remaining switch contacts. Screw the pin plug into the tip end of the marker, replace the sealing plug and secure the switch in place with cement or suitable hardware.

The Lazy Leads are now ready for use. You will be able to change the polarity of the leads merely by throwing the dpdt switch. This will greatly simplify semiconductor tests with an ohmmeter or voltage or current tests with a multimeter lacking an autopolarity function. ◇



The Lazy Leads are made by inserting probe tips and a subminiature switch in the barrel of a felt-tip marker.

Calculating Capacitive Reactance Made Easy

BY ARTHUR F. BLOCK

THERE ARE a number of shortcuts to simplifying problem solving in electronics. In problems involving capacitive reactance, for instance, a useful procedure is to use the "magic" number of 160,000. This process may lead to errors of less than 1% in comparison to using standard textbook methods, but the components involved have 10% to 50% tolerances anyway.

Using the magic number in solving capacitance problems lets you deal with the basic units instead of the units involved in traditional formulas.

The Magic Formula. When dealing with capacitance in a problem, two of three variables are given. The traditional textbook formula for calculating capacitive reactance is: $X_C = 1/(2\pi FC)$, where X_C is in ohms, π is equal to 3.14159296, f is frequency in hertz, and C is capacitance in farads. (F). As you can see, this formula can be cumbersome to work with, especially if the frequency is in kilo- or megahertz and/or the capacitance is in micro- or picofarads. The problem can be greatly simplified as: $X_C fC = 160{,}000$ with C in microfarads.

To solve for X_C, f, or C, you simply transfer the two known values to the right side of the equals sign, where they become the divisor for the 160,000 constant. Hence, $f = 160{,}000/X_C C$ and $C = 160{,}000/fX_C$. The following examples will illustrate the relationship.

1. What is the equivalent reactance of a 0.01-μF capacitor at 1600 Hz? First, write down the formula $X_C = 160{,}000/fC$. Next, fill in the values of f and C: $X_C = 160{,}000/(1600 \times 0.01) = 160{,}000/16 = 10{,}000$ ohms.

2. A crossover point is the frequency at which a capacitor and resistor have equal reactance. Hence, it is sometimes necessary to calculate the capacitance value required for a given X_C and f in order to match a given resistance. What value capacitor is required to provide a crossover at 800 Hz with a 100,000-ohm resistor? First write down the formula: $C = 160{,}000/(800 \times 100{,}000) = 160{,}000/80{,}000{,}000 = 0.002$ μF.

3. Now, let us determine the low-frequency cutoff of a 10-μF capacitor across a 100-ohm resistance: $f = 160{,}000/CX_C = 160{,}000/(10 \times 100) = 160{,}000/1000 = 160$ Hz.

4. Finally, how large a coupling-capacitor value is required to provide signals down to 20 Hz into a 500-ohm load? Write the problem: $C = 160{,}000/fX_C = 160{,}000/(20 \times 500) = 16$ μF.

Now we can expand the usefulness of the basic relationship further. If you wish to work in megahertz, change the capacitance from microfarads to picofarads. In this manner, the frequency and capacitance are changed by a 1,000,000:1 ratio and results are read out directly in megahertz, ohms, or picofarads.

Going Further. Resistance-capacitance (RC) combinations exhibit what is known as a "time constant." The formula for determining the time constant is: $T = RC$, where T is the time in seconds, R is the resistance in ohms, and C is the capacitance in farads. Microfarads and ohms yield time constants in microseconds. Using picofarads and megohms, you also obtain results in microseconds.

As an example of how to use our "magic" number here, consider the 75-μs deemphasis used in FM radio. Since microseconds can be represented by ohms and microfarads, dividing 160,000 by 75 yields a crossover frequency of 2133 Hz for the deemphasis. Generally, however, you will be more interested in what component to use to obtain the 75-μs deemphasis.

To determine the component values required, just remember that any RC combination that yields a product of 75 (μs) can be used. For example, if you wish to use a 100,000-ohm resistor, the first thing to do is translate this value into 0.1 megohm. Then, using the formula, you will find that a 750-pF capacitor will provide the proper deemphasis.

Keep the R and C values within reason and consistent with the circuitry in which the network is to be used. You would not, for example, use a 750-μF capacitor because it would require a 0.1-ohm resistor to provide the proper deemphasis. ◇