PSK modulator resolves phase shifts to 22.5°

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Requiring little more hardware than the circuit proposed by Chawdhury and Das[1] and eliminating the software entirely, this phase-shift-keyed modulator offers an even more versatile and less expensive solution to sending binary data over long distances. One of its great advantages is that carrier phase shifts can be resolved to 16 bits—22.5°.

Only three low-cost chips and a means for generating four-input binary data are required, as shown. The carrier signal is first divided by 16 and applied to the CD4015 eight-stage shift register. Because the register is clocked by the carrier at a rate 16 times that of the signal to be shifted, a discrete eight-phase version of the carrier appears at the output of the register, each shifted by 360/16 = 22.5° from its neighboring stage. These signals are then introduced to the CD4051 multiplexer.

The first 3 bits of each of the modulating data inputs, A–D, address the CD4051 also. Thus any desired phase shift from 0° to 157.5° may be selected (see large table). The eight remaining values, from 180° to 337.5°, may be selected with the aid of the D input, which at the output of the last stage of the register inverts the phase of the signals that have already been generated.

There may be instances where it is desirable to transmit fewer than 16 levels. The small table summarizes the A–D states required to achieve this. □

References
1. F. B. Chawdhury and J. Das, "8085 performs PSK modulation for data-line transmission," *Electronics*, Jan. 31, 1980, p. 108.

DATA				ϕ
D	C	B	A	
0	0	0	0	0°
0	0	0	1	22.5°
0	0	1	0	45°
0	0	1	1	67.5°
0	1	0	0	90°
0	1	0	1	112.5°
0	1	1	0	135°
0	1	1	1	157.5°
1	0	0	0	180°
1	0	0	1	202.5°
1	0	1	0	225°
1	0	1	1	247.5°
1	1	0	0	270°
1	1	0	1	292.5°
1	1	1	0	315°
1	1	1	1	337.5°

NUMBER OF PHASE LEVELS	A	B	C	D
2 ϕ	0	0	0	DATA
4 ϕ	0	0	DATA	DATA
8 ϕ	0	DATA	DATA	DATA
16 ϕ	DATA	DATA	DATA	DATA

Multiphase. Three-chip circuit performs PSK modulation on square-wave input, resolving carrier shifts to 22.5°. First three bits of modulating data inputs select shifts from 0° to 157.5°, with D input required for higher values. Truth tables summarize operation.