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POLYPHASE CODE SEQUENCES WITH OPTIMAL AUTOCORRELATION FUNCTION

A phase-shift keyed (PSK) signal is a sequence of N rectangular radio pulses of the same duration and amplitude. The law of change of the initial phase φ of each partial radio pulse determines the shape of the autocorrelation function (ACF) of the PSK-signal and the structure of its compression filter. Changing the initial phase φ according to the Barker code by 180° determines the optimal ACF with a simple matches filter structure. Though Barker codes are known only for unique phase sequences of 3, 4, 5, 7, 11 and 13 pulses. For the remaining N values, no signal structure consistent with the structure of the Barker filter has been found.

An alternative to finding pseudo-noise sequences with optimal ACF is to switch to other values of the initial phase shift. In this case, the coherent accumulation of the main lobe of the compressed signal will be possible only by complicating the matched filter, in which the weights will be not ± 1 , but a complex conjugate harmonic function.

Table 1 shows the new phase sequences φ_i and the levels of the ACF lobes y_i . The known 180°-phase Barker sequences, which can also be compressed by a complex matched filter, are not listed here.

Table 1 – Phase sequences φ_i and the levels of the ACF lobes y_i

Code No	N	φ_1	φ_2	φ_3	φ_4	φ_5	φ_6	φ_7	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8	y_9	y_{10}	y_{11}	y_{12}	y_{13}	
3-2-1	3	120	0	0					-1	1	3	1	-1									
3-3-1	3	0	60	0					1	1	3	1	1									
3-3-2	3	0	90	0					1	0	3	0	1									
3-3-3	3	0	120	0					1	1	3	1	1									
4-3-1	4	0	120	0	0				1	1	0	4	0	1	1							
4-6-1	4	0	90	90	0				1	0	1	4	1	0	1							
4-6-2	4	0	120	120	0				1	1	0	4	0	1	1							
5-10-1	5	0	120	120	120	0			1	1	0	1	5	1	0	1	1					
7-23	7	0	120	0	120	120	0	0	1	1	0	1	1	0	7	0	1	1	0	1	1	1

On the basis of research of statistical parameters and characteristics of detection of the synthesized phase sequences the conclusion on possibility of expansion of an ensemble of PSK-signals with optimum ACF from 7 pieces is made (Barker codes) up to 16 pieces (see table).

The expansion of the ensemble of phase-code-manipulated signals has become possible due to the transition to the use of phase change from 0° to an angle of 60°, 90°, 120° or 180° depending on the sequence.