Several types of transducer, such as electromagnetic acoustic transducers (EMATs), piezoelectric paints or air-coupled transducers, produce weak signals that can be below the noise threshold at the receiver. In such scenarios averaging or pulse-compression is employed to increase the signal-to-noise ratio (SNR). This paper explores quantisation strategies for these weak signals. It is shown that when the SNR is low, binary (one-bit) quantisation can be used without experiencing significant losses compared to analog-to-digital converters (ADCs). Binary quantizers are simple analog comparators, which make the electronics faster, cheaper, more compact and energy efficient than ADCs. This is especially important when arrays with many channels are used or many devices are produced. An advantage of comparators over ADCs is that the sampling rate can always be as high as the system clock. We review the theory of binary quantisation, and investigate the conditions under which binary quantisation is of practical interest for ultrasound applications. The main finding is that when the input SNR is in the order of 8 dB or less then, in most cases, binary quantisation results in small/negligible errors. This is an important finding because such low input SNRs are being reported for some NDE applications and the use of ADCs in these applications is inefficient.