Each codeword satisfies the input constraint:

$$\frac{1}{n} \sum_{i=1}^{n} \kappa(x_i(w)) \leq P \quad \text{for } 1 \leq w \leq M.$$

Therefore

$$\frac{1}{n} \sum_{i=1}^{n} \kappa(X_i) \leq P$$

with probability 1.