The "short reciprocal division" procedure is similar to hand computed long division, and will be illustrated by a decimal example employing a 3×6 digit integer multiplier where the quotient is developed digit serially in the higher radix $10^2 = 100$.

Example 5.6.1 (Short Reciprocal Division)

Problem: Find the 6-digit integer quotient q and 6-digit integer non-negative remainder r with $0 \le r \le y - 1$ such that $x = q \times y + r$, where

$$\begin{array}{ll} x = 365748000000 & \text{(12 digit dividend)} \\ y = 784731 & \text{(6 digit divisor)} \end{array}$$

Solution: The result is determined digit serially as 3 radix 100 quotient digits in the redundant digit range [-100, 100], and then converted to standard decimal as follows. Note that the arithmetic employed here is sign-magnitude decimal.

Step 1: Determine the 3 digit short reciprocal

$$\overline{y} = \left\lceil \frac{10^8}{784731} \right\rceil = 128.$$

Step 2: Perform digit serial division radix 100. Digit selection is obtained iteratively by multiplying the 3-digit short reciprocal by the 6-digit remainder, with the initial quotient digit obtained by multiplying the short reciprocal by the leading 6 digits of the dividend, and then selecting the signed leading 3 digits of the 9-digit product as the next redundant radix 100 digit. The digit selection is underlined in the following, and each high radix digit is expressed in decimal, with negative digits overlined.

$$\begin{array}{rrll}
 & 46\ 61\ \overline{19}. & & \\
78\,47\,31 & \overline{\big\lceil\, 36\,57\,48\,00\,00\,00.} & & \\
128\times & 36\,57\,48 & = \underline{46}\,81\,57\,44 & \text{first digit selection} \\
46 \times 78\,47\,31 = & 36\,09\,76\,26 & & \\ \hline
128\times & 47\,71\,74 & = \underline{61}\,07\,82\,72 & \text{second digit selection} \\
61 \times 78\,47\,31 = & 47\,86\,85\,91 & & \\ \hline
128\times & -15\,11\,91 & = \underline{-19}\,35\,24\,48 & \text{third digit selection} \\
-19 \times 78\,47\,31 = & -14\,90\,98\,89 & & \\ \hline
 & -20\,92\,11 & &
\end{array}$$

Step 3: Determine the positive remainder: $r = 784731 - 209211 = 575520$. Decrement and convert the redundant quotient to standard decimal form:

$$q = 46\ 61\ \overline{19}_{100} - 1 = 466080. \qquad \square$$

The digit selection procedure illustrated in Step 2 of the example is justified as follows. In the first digit selection we seek to estimate a leading radix 100 digit (2 decimal digits) of $\frac{365748}{784731}$. Employing the exact divisor reciprocal $\frac{1}{784731} = 127.4322 \cdots \times 10^{-4}$, note that $(127.4322 \cdots \times 10^{-4}) \times 365748 = 46.60807 \cdots$, so "46" should be our leading radix 100 digit. Multiplying by the short reciprocal yields $128 \times 365748 = 046815744$, where the comparably normalized value is larger by less than 1% over the infinitely precise quotient. We select "46" knowing that it is either the correct radix 100 digit (leading to a positive