CRAY-2 Floating Multiply Concepts (Reciprocal)

The CRAY-2 Floating Multiply Functional Unit provides the function of finding the approximate reciprocal of scalar or vector operands. This reciprocal can then be used as part of a divide sequence.

A divide operation is performed in a CRAY-2 by multiplying an operand by the reciprocal of a second operand. The divide sequence involves finding the approximate reciprocal of one of the operands and multiplying that result by the other operand. The sequence involves the use of the reciprocal approximation instructions and the multiply instructions.

Example: $6/2 = (6) \times (1/2) = 3$

When performing a reciprocal approximation the CRAY-2 hardware accesses a look-up table to obtain values for use in the approximation process. The value from the look-up table is a predetermined value which never changes. The value read depends upon the operand. A portion of the operand is used to address the table to read the value out. The look-up value is substituted into parts of the equation that is used to calculate reciprocals. The look-up value for reciprocal approximation is derived from a guess at the actual result. The value reflects the result of substituting the guess into the part of the reciprocal equation that pertains to the look-up value. The value comes in two parts from the table in a single 39-bit transfer. There is a 13-bit value which represents a number equal to two times the guess. There is a 26-bit value which represents a number equal to the square of the guess. These values are used as part of the reciprocal formula. The guess from the look-up table is very close. The guess is accurate to 13 places.

If a greater degree of accuracy is desired when finding the approximate reciprocal of an operand an iteration can be performed on the result of the reciprocal approximation instruction. A single iteration is allowed. The iteration process results in a correction factor which when multiplied by the original approximate reciprocal yields a more accurate approximate reciprocal.