POUGHKEEPSIE
Department 539
South Road Laboratory

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FILE MEMO

SUBJECT: True Zero Handling

1. Floating point numbers with exponents ≤ -1024 and zero fraction may be considered true zeros. These numbers are contrasted with floating point numbers with zero fraction and exponent > -1024, which represent an order of magnitude. Exponents ≤ -1024 should not be used with non-zero fractions.

2. a. The action of the computer is such that consistent results are obtained when true zeros are used as operands in floating point operations, as follows:

(1) Loading or storing of a true zero operand yields a true zero result.

(2) Addition of a true zero operand to a non-true zero operand yields the non-true zero operand as a result. Addition of two true zero operands yields a true zero result.

(3) In comparison, the magnitude of a true zero operand is considered smaller than the magnitude of a non-true zero operand. The signs of the operands are inspected in the normal manner to yield a high or low indication. Two true zero operands are considered equal.

(4) Multiplication by a true zero factor yields a true zero result.

(5) A true zero dividend yields a true zero quotient and remainder. A true zero divisor gives a program alert.

(6) The square root of a true zero is a true zero.

(7) Operations on parts of floating point words, such as exponent addition or fraction shifts, ignore the true zero definition.

b. In order to obtain the proper action, operands are tested for exponent ≤ -1024 prior to the operation.

(1) If any operand, except a divisor, has exponent ≤ -1024, the exponent of the result is made ≤ -1024 in the operations: MPY, MPYD, DIV, RDIV, DIVD (quotient and remainder), SRT and SLO.

(2) If multiplier or multiplicand in CMPY have exponent ≤ -1024, the exponent of the product developed in that operation is made ≤ -1024.

(3) If both operands have exponent ≤ -1024, the result of a comparison is considered equal.

(4) If a divisor has exponent ≤ -1024, the indicator ZD, Zero Divisor, is turned on.

3. The program is alerted by indicators for all results which have exponent ≤ -1024 which are not derived from operands with exponents ≤ -1024, as follows:

a. The indicators XPN, XPU and RU will be turned on for the proper result exponent range, provided none of the operands of the operation are ≤ -1024.

The indicators can be used in reconstructing the proper exponent result. The programmer may use the results as true zero operands in subsequent operations by making the fractions equal to zero.

4. Results which are derived from operands with exponents ≤ -1024 will not alert the program.

a. The indicators XPN, XPU, RU, and PSH are not set to one if any operand has exponent ≤ -1024.

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