

Embedded system paranoia: TI OMAP (ARM9)

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1 Output results

Data kindly supplied by Vibin Viswanbharan of Visteon India.

OMAP Bootloader V1.0

COMMENT: =====

COMMENT: Welcome to ESP - Embedded System Paranoia

COMMENT: Please let me know your experiences

COMMENT: and suggestions at lesh@oakcomp.co.uk or

COMMENT: L.Hatton@kent.ac.uk

COMMENT:

COMMENT: \$Revision: 1.5 \$ \$Date: 2003/09/26 13:23:47 \$

COMMENT: Modification by VVIBIN (Visteon India) to test the

COMMENT: floating point arithmetic of TCompiler/OMAP (ARM9)

COMMENT: This version will attempt divide by zero.

COMMENT: This version uses internal numeric

COMMENT: conversion functions which cannot

COMMENT: distinguish Inf and Nan.

COMMENT: This version uses double precision.

COMMENT: =====

-----> Diagnosis resuming after Milestone 0, Page 1

COMMENT: -1, 0, 1/2, 1, 2, 3, 4, 5, 9, 27, 32 & 240

PASSED : small integer tests are all OK.

COMMENT: Searching for Radix and Precision.

COMMENT: Radix = .19999999999999984E+1

COMMENT: Closest relative separation found is U1 = .11102230246251563E-15

COMMENT: Recalculating radix and precision

COMMENT: confirms closest relative separation U1.

COMMENT: Radix confirmed.

-----> Diagnosis resuming after Milestone 10, Page 2

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-----> Diagnosis resuming after Milestone 20, Page 3
COMMENT: The number of significant digits of the
COMMENT: Radix is .52999999999999962E+2

-----> Diagnosis resuming after Milestone 25, Page 4

-----> Diagnosis resuming after Milestone 30, Page 5
COMMENT: Subtraction appears to be normalized, as it should be.
COMMENT: Checking for guard digit in *, / and -.
PASSED : *, /, and - appear to have guard digits, as they should.

-----> Diagnosis resuming after Milestone 35, Page 6
COMMENT: Checking rounding on multiply, divide and add/subtract.
PASSED : Multiplication appears to round correctly.

-----> Diagnosis resuming after Milestone 40, Page 7
FLAW : Division neither chopped nor correctly rounded.

-----> Diagnosis resuming after Milestone 45, Page 8
COMMENT: Addition/Subtraction neither rounds nor chops.
COMMENT: Sticky bit used incorrectly or not at all.
FLAW : Flaws are present due to lack of guard digits or round/chop failures

-----> Diagnosis resuming after Milestone 50, Page 9
COMMENT: Testing multiplicative commutation
COMMENT: with random pairs, trials = 20
PASSED : No failures found during these trials.

-----> Diagnosis resuming after Milestone 60, Page 10
COMMENT: Running test of square root(x).
COMMENT: Testing integer X, $\text{sqrt}(X * X) = X$, trials = 20
DEFECT :

COMMENT: $\text{sqrt}(X * X) - X = -.71054273576010000E-14$ rather than 0.
COMMENT: Test for sqrt monotonicity.
PASSED : sqrt has passed a test for Monotonicity.

-----> Diagnosis resuming after Milestone 70, Page 11
COMMENT: Running test of difference of two squares).
COMMENT: integer X, $(X**2 - Y**2) - (X - Y)(X + Y)$ trials = 20

-----> Diagnosis resuming after Milestone 75, Page 12

-----> Diagnosis resuming after Milestone 80, Page 13
COMMENT: Testing whether sqrt is rounded or chopped.
FLAW : Square root is neither chopped nor correctly rounded.
COMMENT: Observed errors run from
COMMENT: $-.99999999999999928E+0$ to $.39506171580368265E+0$ ulps.

-----> Diagnosis resuming after Milestone 85, Page 14

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-----> Diagnosis resuming after Milestone 90, Page 15
COMMENT: Testing powers  $Z^i$  for small Integers Z and i.
COMMENT: Power function
COMMENT: .0000000000000000E-306 ^ .0000000000000000E-306 = .0000000000000000E-306
COMMENT: which differs from correct value by  $-.9999999999999928E+0$ 
COMMENT: Number of similar discrepancies = 1
DEFECT : Power function
COMMENT: .1999999999999984E+1 ^ .2999999999999978E+1 = .7999999999999928E+1
COMMENT: which differs from correct value by  $-.17763568394002500E-14$ 

-----> Diagnosis resuming after Milestone 91, Page 16
COMMENT: Errors like this may invalidate financial calculations
COMMENT: involving interest rates.
COMMENT: Number of similar discrepancies = 237

-----> Diagnosis resuming after Milestone 100, Page 17
COMMENT: Seeking Underflow thresholds UfThold and E0.

-----> Diagnosis resuming after Milestone 110, Page 18
COMMENT: Smallest strictly positive number found
COMMENT: is E0 = .02225073858507210E-306
COMMENT: Since comparison denies  $Z = 0$ , evaluating
COMMENT:  $(Z + Z) / Z$  should be safe.
COMMENT:  $(Z+Z)/Z$  is OK but this installation cannot
COMMENT: signal any Over/Underflow.

-----> Diagnosis resuming after Milestone 120, Page 19
FLAW :
COMMENT:  $X \neq Z$  but  $X - Z = \text{Zero}$ 
COMMENT:  $X = .03059476555447414E-306$ ,  $Z = .02225073858507210E-306$ 
COMMENT: This is OK only if underflow signalled.
COMMENT:  $X / Z = 1 + .3749999999999977E+0$ 
COMMENT: The Underflow threshold is .02225073858507210E-306
COMMENT: Below this, a calculation may suffer larger Relative
COMMENT: error than merely roundoff.

-----> Diagnosis resuming after Milestone 121, Page 20
COMMENT: Since underflow occurs below the threshold
COMMENT: UfThold = .1999999999999984E+1 ^  $-.1021999999999993E+4$ 
COMMENT: only underflow could affect this expression.
COMMENT: calculating yields: .0000000000000000E-306
PASSED : This computed value is O.K.

-----> Diagnosis resuming after Milestone 130, Page 21
COMMENT: As  $X \rightarrow 1$ , Testing  $X^{((X + 1) / (X - 1))}$  against  $\exp(2)$ .
COMMENT:  $\exp(2) = .73890560989306468E+1$ 
PASSED : Accuracy seems adequate.

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-----> Diagnosis resuming after Milestone 140, Page 22
COMMENT: Testing powers Z^Q at four nearly extreme values.

DEFECT : Power function
COMMENT: $.1999999999999984E+1 \wedge .9539999999999938E+3 = .15227053142811799E+288$
COMMENT: which differs from correct value by $-.61704801236645403E+274$
COMMENT: Number of similar discrepancies = 4

-----> Diagnosis resuming after Milestone 150, Page 23

-----> Diagnosis resuming after Milestone 160, Page 24
COMMENT: Searching for Overflow threshold:
COMMENT: This may generate an error.
COMMENT: Can 'Z = -Y' overflow?
COMMENT: Trying it on $Y = -\text{Inf}$ or NaN
PASSED : Seems O.K.
COMMENT: Overflow threshold is $V = \text{Inf}$ or NaN
COMMENT: Overflow saturates at $V0 = \text{Inf}$ or NaN
COMMENT: No overflow should be signalled for $V*1 = \text{Inf}$ or NaN
COMMENT: No overflow should be signalled for $V/1 = \text{Inf}$ or NaN
COMMENT: Any overflow separating $V*1$ from
COMMENT: V above is a DEFECT.

-----> Diagnosis resuming after Milestone 161, Page 25

-----> Diagnosis resuming after Milestone 170, Page 26
DEFECT :
COMMENT: Comparison alleges that what prints as $Z = .02225073858507210E-306$
COMMENT: is too far from $.16239104138107872E-305$
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-----> Diagnosis resuming after Milestone 175, Page 27

DEFECT :
COMMENT: Comparison alleges that $Z = \text{Inf}$ or NaN
COMMENT: is too far from $\text{sqrt}(Z) \wedge 2 = \text{Inf}$ or NaN

-----> Diagnosis resuming after Milestone 180, Page 28

-----> Diagnosis resuming after Milestone 190, Page 29

-----> Diagnosis resuming after Milestone 191, Page 30

-----> Diagnosis resuming after Milestone 200, Page 31
COMMENT: Trying to compute $1/0$ gives $.0000000000000000E-306$
COMMENT: Trying to compute $0/0$ gives $.0000000000000000E-306$

-----> Diagnosis resuming after Milestone 210, Page 32
COMMENT: =====

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COMMENT:      Embedded System Paranoia SUMMARY
COMMENT:
COMMENT: Number of FAILURES encountered = 0
COMMENT: Number of SERIOUS DEFECTs discovered = 0
COMMENT: Number of DEFECTs discovered = 6
COMMENT: Number of FLAWs discovered = 4
COMMENT:
COMMENT: The arithmetic diagnosed may be Acceptable
COMMENT: despite inconvenient DEFECT.
COMMENT:
COMMENT: Rating ...
COMMENT:
          Excellent
          Very good
          Good
        =====> Acceptable
          Unacceptable
          Broken
COMMENT: Total floating point exceptions registered = 1
COMMENT:
COMMENT: END OF TEST.
COMMENT: =====
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