

Square Root Functions

SQRT S12

DESCRIPTION

The SQRT special function calculates the square root of a numeric value and scales the result by a gain factor you can define.

It provides a simple means of linearizing variables with square law characteristics, e.g. flow measurements from differential pressure.

On GEM80 Controllers that have floating point facilities, SQRT can accept either an integer or floating point rung input.

FEATURES

- High accuracy.
- User programmable gain factor.
- Automatic limiting at full scale output.

SPECIFICATION

Control language:-

- (a) Fixes gain factor N:

```

      SQRT
X-----SPEC-----VALUE-----Q
      S12          N
  
```

- (a) Variable gain factor (location Zm contains gain factor N):

```

      SQRT
X-----SPEC-----VALUE-----Q
      S12          Zm
  
```

On Controllers that accept floating point numbers, the rung input X and rung output Q will always be of the same type, either both integer or both floating point. The gain factor N, however, must be integer, and Zm must therefore not be a Q-table location.

Equation:

$Q = N\sqrt{X}$ when X is positive

$Q = N\sqrt{-X}$ when X is negative integer only

where the positive value of the square root is taken; that is:

$Q = N\sqrt{|X|}$

In other words, the sign of Q is the same as the sign of NX .

Accuracy:

For an integer rung input X , the rung output calculation gives a result rounded to the nearest integer whose accuracy is better than 1 in 1000.

For a floating point rung input X , the rung output calculation gives a floating point result that is as accurate as can be represented in floating point format.

Table 1 Program rung & value data

Sym	Location	Use	Range
X	Rung Input	Input variable	In the range -32768 to + 32767 if integer, or approx. $\pm 10^{38}$ if floating point.
Q	Rung Output	Result (integer if X integer, floating point is X floating point)	Limited at ± 32767 if integer, or approx $\pm 10^{38}$ if floating point.
Zm	Value location	Location for gain factor	Any integer table usable by special functions
N	Value or contents of Zm	Gain factor	± 32767 (integer only)

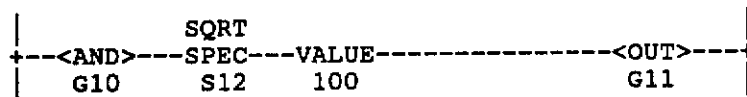
Table 2 Fault Conditions

Condition	Result
PROGRAMMING ERRORS	
No VALUE after SPEC	$Q = 0$
VALUE location Zm in table not usable by Special Functions	$Q = 0$
VALUE location Zm defines a floating point table	$Q = 0$

APPLICATION NOTES

1. Program Example

Suppose you want to calculate $Q = 100\sqrt{X}$, where the rung input X comes from table location G10. You want the result to be stored in table location G11. To do this, use the following rung:



2. Accuracy Limitations in Integer

If your controller does not have floating point facilities, or if you are using SQRT with an integer input, then SQRT produces an integer output that has a high accuracy provided that:

- the result is a reasonably large numeric value
- the result does not exceed the ± 32767 limits.

For most applications, a gain factor of the order of 100 (say between 50 and 180) satisfies both these criteria. See paragraph 3 below for examples.

3. Typical Results in Integer

Input (X)	Gain (N)	Output (Q)	
+10000	+100	+10000	
+3600	+100	+6000	
+64	+100	+800	
-3600	+100	-6000	
+3600	-100	-6000	
-3600	-100	+6000	
+49	+1	+7	These examples show the worst case effect of accuracy and rounding.
+49	10	+70	
+49	+100	+699	
+49	+1000	+6999	



Kidsgrove, Stoke-on-Trent, ST7 1TW, England
Tel: (0782) 783511 Fax: (0782) 776329

Note: The Company's policy is one of continuous development. Products supplied may differ from those described herein