

FGEN Functions

FGEN S30

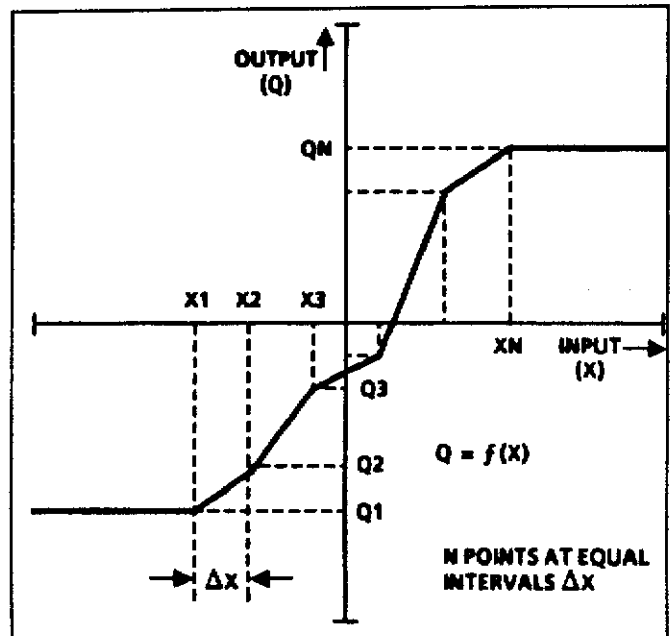
DESCRIPTION

The FGEN function may be used to generate an approximate representation for any continuous function of the form $Q = f(X)$.

It provides linear interpolation between points tabulated by the user.

FEATURES

- Full four quadrant operation.
- User chosen quantity of tabulated points.
- User chosen interval between points.



SPECIFICATION

Control language:-

```

      FGEN
X-----SPEC-----VALUE-----Q
      S30           Zm
  
```

Function:

Linear interpolation between N tabulated points (X_1 to X_N at equal intervals ΔX).

$Q = Q_1$ for $X \leq X_1$
 $Q = Q_N$ for $X \geq X_N$

Accuracy:

Calculation in floating point arithmetic introduces small error (± 1 in 10^7). Result truncated to form integer. Answer can be as much as one too small.

Table 1 Program rung data

Sym	Location	Use	Range
X	Rung Input	Input variable	± 32767
Zm	Value location	Start of data list tabulating function (N+4 locations)	Any table usable by special functions
Q	Rung output	Calculated result	± 32767

Table 2 Value data

Sym	Location	Use	Range
F	Zm	Fault code. Suppressed if Zm in write protected table	See table 3. (Zero for no fault)
X1*	Zm + 1	Lowest value of X for which Q is tabulated	± 32767
ΔX^*	Zm + 2	Interval between points	1 to 32767
N*	Zm + 3	Number of tabulated points	1 to 32763
Q1*	Zm + 4	Tabulated value for X1	± 32767
*			
QN*	Zm + 3 + N	Tabulated value for XN	± 32767

* Data set up by user

Restrictions:-

- (a) $X - X1 \leq 32767$ i.e. positive range of X must be limited if $X1 < 0$.
- (b) $XN - X1 \leq 32767$ i.e. tabulated function cannot exceed $\frac{1}{2}$ total range of X.

Table 3 Fault conditions

Condition	Result (Q)	Code in Zm	
		Numeric Value	States ON
Programming error No VALUE ater SPEC.	Q = 0	-	-
Programming error VALUE location invalid e.g. (a) Number instead of address. (b) Table not usable by special functions.	Q = 0	-	-
Programming error or number (N) of tabulated points too large. Zm + 3 + N beyond end of data tables memory area.	Q = 0	3	0 & 1
Number of tabulated points (N)<1.	Q = 0	5	0 & 2
Interval between points (ΔX)<1.	Q = 0	9	0 & 3
(X-X1)>32767.	Q = 0	17*	0 & 4
[X1 + (N-1) ΔX] >32767. Detected only when X between X(N-1) and XN. This condition means that tabulated function exceeds $\frac{1}{2}$ total range of X.	Q = 0	33*	0 & 5

Note: If Zm is in write protected memory then fault code is suppressed, but FGEN operates normally in other respects.

* Not produced on 16 bit controllers.

APPLICATION NOTES

1. Write protected value location

For many special functions it is usual to enter preset 'value' data in the write protected P table and arrange copying on start up into a working value W table used for the special function value location. Whilst this arrangement is perfectly suitable for FGEN it is extravagant in the use of data table space, because the fault code is the only variable data. the user can save table space by placing Zm in a write protected P table, in which case the fault code output is automatically suppressed. Fault diagnosis becomes slightly more difficult, but the condition Q = 0 can be used to detect a fault condition provided that the user can distinguish from a normal output Q = 0.

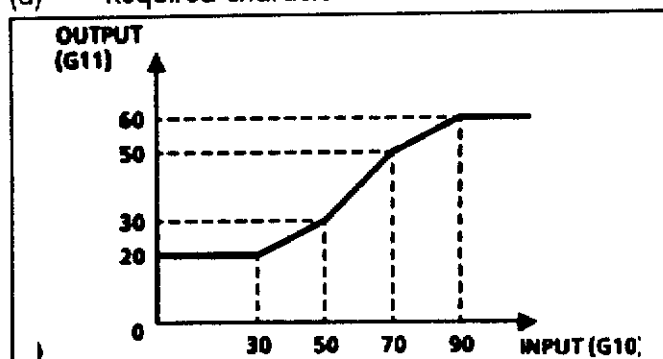
2. Choice of ΔX and N

The accuracy with which FGEN approximates to a required continuous function depends on the quantity and spacing of tabulated points. Each FGEN function consists of equal width segments. For the most critical applications it may be appropriate to divide a curve into sections so that some parts can be

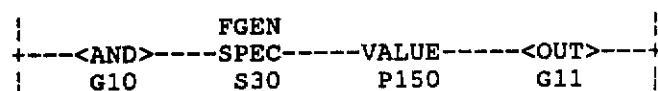
represented by closely spaced segments without having to tabulate enormous numbers of points on nearly linear parts. The complication of having several FGEN functions would have to be balanced against the saving in data table space.

3. Example

(a) Required characteristic



(b) Program rung



(c) Value data

P150	0	Fault code suppressed if P table write protected
P151	30	Lowest tabulated input (X1)
P152	20	Interval between points (ΔX)
P153	4	No. of tabulated points (N)
P154	20	1st tabulated point (Q1)
P155	30	2nd tabulated point (Q2)
P156	50	3rd tabulated point (Q3)
P157	60	4th tabulated point (Q4)



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