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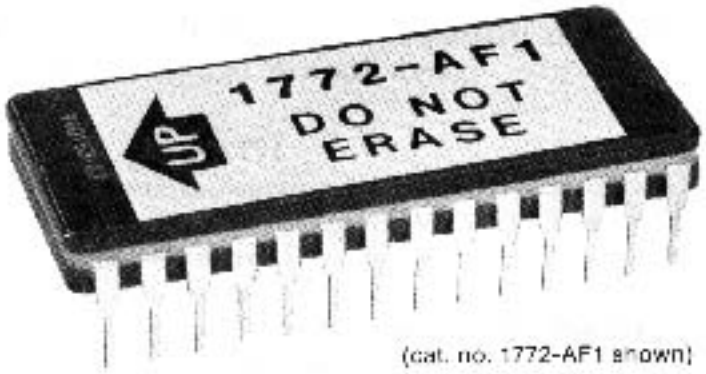
Allen-Bradley
Mini-PLC-2/15 Auxiliary Function PROMs

(Cat. No. 1772-AF1, -AF3, and -AF4)

Product Data



(cat. no. 1772-AF1 shown)

Introduction

Installation of one of the Auxiliary Function (AF) PROMs in your Mini-PLC-2/15 controller lets you expand its mathematical or diagnostic capabilities.

For simplification we refer to the three Auxiliary Function PROMs, cat. no. 1772-AF1, 1772-AF3, and 1772-AF4 as the AF1, AF3, and AF4, respectively.

Each of the three PROMs can only be used with the series A Mini-PLC-2/15 processor module (cat. no. 1772-LV), firmware revision 11 or later, or series B Mini-PLC-2/15 processor, firmware revision 4 or later. Programming the PROM functions with either series Mini-PLC-2/15 processor module requires the Industrial Terminal (cat. no. 1770-T3).

Each PROM has a 2K (16 bit) word section to which you can transfer your program (for backup memory) and a 2K word section for auxiliary functions. You can transfer your program into an AF PROM only with the series B Mini-PLC-2/15 controller. With the series A Mini-PLC-2/15 controller, program transfer to the PROMs is not possible. Backup user programs stored in the AF PROMs can be transferred into the controller's memory with either the series A or series B processors.

Related Publications

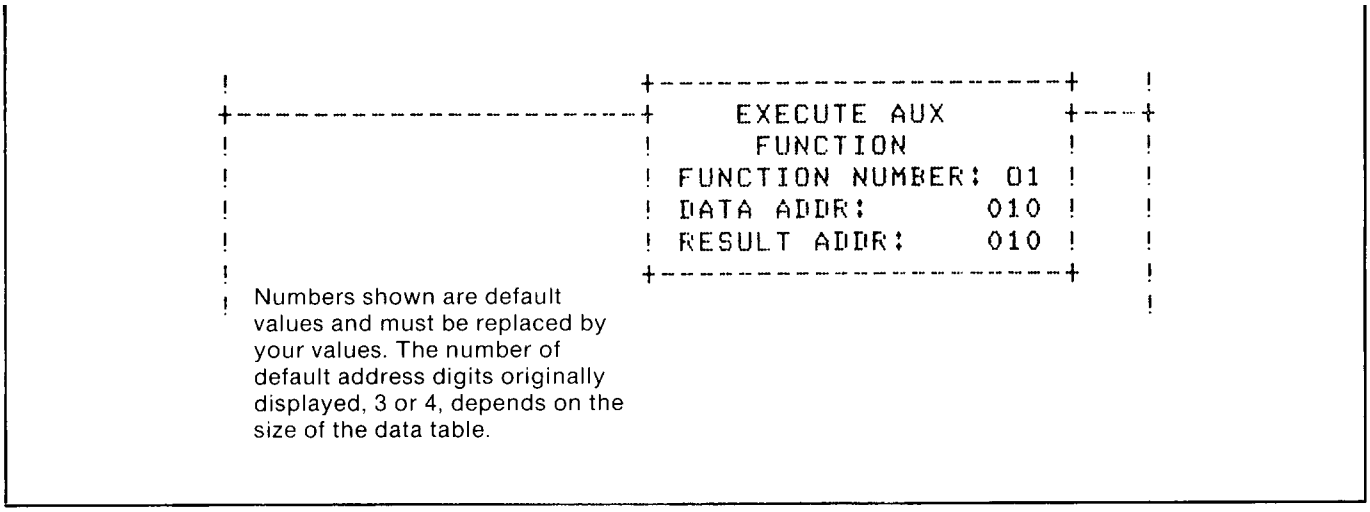
If you need additional information on these PROMs, refer to the appropriate publication:

PROM	Publication	Title
1771-AF1	1772-825	Auxiliary Function PROM (cat. no. 1772-AF1) for the Mini-PLC-2/15 Controller
1772-AF3	1772-827	Auxiliary Function PROM (cat. no. 1772-AF3) for the Mini-PLC-2/15 Controller
1772-AF4	1772-828	Auxiliary Function PROM (cat. no. 1772-AF4) for the Mini-PLC-2/15 Controller

Auxiliary Function Call-up

After you've installed the PROM and connected your industrial terminal, you request a PROM function by pressing keys [SHIFT][EAF] or [SHIFT][SCT] on the keyboard of your industrial terminal. The display shown in figure 1 appears on the CRT. The instruction is an output instruction and may be preceded on a rung by condition instructions. To program a specific PROM function you enter the function number assigned to the particular function.

Figure 1
Auxiliary Function Format



Arithmetic Functions

Since the AF1 and AF4 are arithmetic function PROMs, we describe their specific functions and characteristics together. Tables A and B present the function capabilities of the AF1 and AF4 respectively.

Table A
AF1 Characteristics

Function	Format	Function No.	Execution Time [1]		Number [3] of scans
			Avg. ms	Worst ms	
Add	(± XXX XXX.) + (± XXX XXX.) = ± XXX XXX.	01	1.22	1.27	1
Subtract	(± XXX XXX.) – (± XXX XXX.) = ± XXX XXX.	02	1.22	1.27	1
Multiply	(± XXX XXX.) x (± XXX XXX.) = ± XXX XXX XXX XXX.	03	4.49	5.28	1
Divide	(± XXX XXX.) ÷ (± XXX XXX.) = ± XXX XXX.XXX XXX	04	16.17	21.76	4
Square Root	$\pm XXX.^{1/2} = \pm XX.XX$	05	6.08	7.11	2
Averaging	(XXX. + XXX. +---XXX.) ÷ N = XXX.XXX	06	12.33 +0.29 per year	12.33 +0.32 per value	$4+N/4^2$
Standard Deviation	LOG XXX. = X.XX XXX	07	94.16 +2.09 per value	94.16 +2.27 per value	$20+5N/4^2$
BCD to Binary	0 to 4095 → 12 Bit Binary	13	0.89	0.89	1
Binary to BCD	12 Bit Binary → 0 to 4095 BCD	14	0.84	0.84	1

1 These times are calculated for a single AF function Overhead for AF interlocking and multiple runs through the ladder program to complete some function are included.

2 N = number of values whose average or standard deviation is sought

3 This is the number of program scans required to complete the functions.

AF1, AF4 Applications

The arithmetic functions provided by the AF1 and AF4 have applications in various industries such as food processing, machine tool work, and material handling. Applications in these industries could be weighing, blending, batch processing, scaling, positioning, operating test stands, and heat treating. The square root function is frequently used for flow measurement. The average function can be used for averaging thermocouple inputs or other process variables. Standard deviation and averaging have applications in trend analysis, inline gauging, and report generation.

Automatic AF1, AF4 checks

To guard against improper program execution, automatic check routines are incorporated in the AF1 and AF4. The processor uses these routines to prevent the following:

- Executing functions having invalid function addresses
- Excessive time processing functions that the controller neglects its main program and I/O scans

Table B
AF1 Characteristics

Function	Format	Function No.	Execution Time [1]		Number [2] of scans
			Avg. ms	Worst ms	
Add	(±XXX XXX.) + (±XXX XXX.) = ±XXX XXX.	01	1.22	1.27	1
Subtract	(±XXX XXX.) – (±XXX XXX.) -- XXX XXX.	02	1.22	1.27	1
Multiply	(±XXX XXX.) x (±XXX XXX.) = ±XXX XXX XXX XXX.	03	449	5.28	1
Divide	(±XXX XXX.) ÷ (±XXX XXX.) = ±XXX XXX.XXX XXX	04	16.17	21.76	4
BCD to Binary	0 to 4095 → 12 Bit Binary	13	0.89	0.89	1
Binary to BCD	12 Bit Binary → 0 to 4095 BCD	14	0.84	0.84	1
Log to Base 10	LOG XXX. = X.XX XXX	30	2.28	4.21	1
Log to Base e	LN XXX. =X.XX XXX	31	8.17	8.49	2
Exponential, e^x	$e^{\pm xxx} = r(10)^{\pm s}$, r=X.XX, s=±X.	32	15.53	20.97	5
Power, $Y^{\pm x}$	$XXX.^{\pm xx.x}=r(10)^{\pm s}$, r=X.XX, s=±XX.	33	17.10	23.65	5
Reciprocal, 1/X	1/±XXX XXX. = ±.XXX XXX	34	19.08	23.11	4
Sine X	SIN XXX.= ±X.XX XXX	35	1.00	1.00	1
Cosine X	COS XXX. = ±X.XX XXX	36	1.00	1.00	1
Square Root	$XXX.^{1/2}=r(10)^{\pm s}$, r=X.XX, s=X.	37	16.23	19/64	5

1 These times are calculated for a single AF function. Overhead for AF interlocking and multiple runs through the ladder program to complete some functions are included

2 This is the number of program scans required to complete the functions

To avoid excessive execution times, the AF1 and AF4 have an interlock system. This system automatically checks and does the following:

- Permits no AF1 or AF4 function to run longer than 6ms
- During program scan each true function rung which can be completed in a single scan will be completed as it is encountered. However, upon encountering a true function rung which requires multiple program scans to complete, all other true function rungs will be “locked out” until sufficient program scans complete the active function rung.
- Once started, it completes a function prior to starting the next function encountered in the user program which has a true rung condition.
- Limits the number of enabled functions in a program to 50.You may include more functions but you must ensure that no more than 50 are enabled at one time. This requirement only applies where you have programmed a function that requires more than one scan to complete.

AF3 Functions

The AF3 performs the following functions:

- File Search — This instruction locates all words in a file with data identical to the data of a specified word.
- File Diagnostic — This instruction locates discrepancies between actual and desired states of I/O or data table words on a bit-by-bit basis.

The function numbers for the file search and file diagnostic functions are 21 and 20 respectively.

AF3 File Search Instruction

The file search instruction is an output instruction. It searches a file looking for a match of data in a file word with data of a specified match word. The instruction starts at the beginning of the file and searches from lowest to highest word address. When the instruction finds a match, it stores the position of the file word and sets the true bit. The true bit signals that the instruction found a match. Your program logic can detect when the true bit is set and perform the application logic associated with the match.

AF3 File Search Execution Time

The search of a file containing several consecutive match words takes less time per match than a file search containing no match words. The scan of a 100 word file with no match words takes approximately 5.5ms.

AF3 Diagnostic Instruction

The file diagnostic instruction is an output instruction. It compares data in a file of actual values with another file of user-entered reference values, word-by-word and bit-by-bit. The instruction starts at the beginning of the files and searches from lowest to highest word address and from lowest to highest bit number. When the instruction finds a mismatch, it stops at the word containing the mismatch. The instruction sets the true bit to signal that a new mismatch was found. Then, in the same scan, it temporarily stores the following information:

- Word address and bit number found mismatched in the file of actual values
- Number of mismatched values found to that point in the file
- Status of the bit in the file of actual values that did not match the reference bit

The instruction stores the above information in a 3-word result file. Your program logic can detect when the true bit is set, and perform the application logic associated with the mismatch. On the next execution of the instruction, the search continues from the word/bit address where the previous mismatch was found.

AF3 File diagnostic Execution Time

File comparison takes less time when the instruction finds several consecutive mismatches. Comparison of two 50 word files with no mismatches takes approximately 5.0ms.

AF3 Applications

The AF3 is intended for use in programs for machine diagnostics.

There are several methods commonly used to implement machine diagnostics. One method is extended data comparison (EDC). This method is a useful technique for automatically detecting an out-of-sequence or faulted I/O device. EDC can be summarized as follows: At each step in a particular sequence or operation, a word containing the actual I/O status is compared to a desired or standard I/O status word. If the machine or process is operating properly, the bit pattern of the actual I/O word matches the bit pattern of the desired I/O status word.

Should an input fail, or be out of sequence, the bit patterns would differ, and your program would initiate a routine to determine which bit of the input word represented a faulted input. The basic EDC concept is normally expanded to include a group or file of input words and a corresponding file of desired standard words. By comparison with a standard, each input is checked for its proper bit status at a particular step or operation.

Program routines for EDC are very similar to a sequencer instruction that compares a file of input words with a file of standard words for a desired status at each particular step. Therefore, the routine should only be implemented on a sequential machine or operation. Keep in mind that the I/O must be at a static stage for the comparison to be valid. Dynamic I/O or asynchronous machining operations would result in invalid I/O fault detection.

NOTE: The AF PROMs are sensitive to ultraviolet light, therefore when exposed to UV light, both the program and the axuliary functions are erased. The PROMs' transparent window is covered with the product label to avoid accidental alteration of memory from UV light sources. Do not remove

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