

# Converting Existing MLT Programs to X-STREAM XE PLC Format

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## Overview

Emerson's MLT process gas analyzer includes an internal programmable logic controller (PLC) capability that much of the MLT installed base uses in the operation of their MLT analyzers. A significant amount of work, time, and knowledge can be invested into the programming of MLT PLCs. Converting the existing MLT PLC programs into the X-STREAM PLC language is simple, and allows users to take advantage of the power and usability of the X-STREAM XE without losing their significant investment in time and engineering of MLT PLC programming.

The X-STREAM XE PLC is part of an optional software package offered with the X-STREAM process gas analyzer. An unlock code is required with the purchase of the X-STREAM process gas analyzer, and must be purchased separately. The unlock code will be entered into the X-STREAM XE's purchased separately and entered into the related section of either the analyzer's LOI or the web-browser interface.

```
Step (1) -9
Step (2) 65
Step (3) -5
Step (4) 31
Step (5) -9
Step (6) 31
Step (7) -5
Step (8) 32
Step (9) -1
Step (10) -1
Step (11) -9
Step (12) 65
Step (13) -3
Step (14) 31
Step (15) 32
```



```
# This PLC program implements 3-stream switching
# with a X-STREAM XE analyzer
# Timer setup
TMR_MODE 1 REPPULSE;
TMR_DURATION 1 1;
TMR_PERIOD_CNT 1 3;
TMR_MODE 2 OFFDELAY;
TMR_DURATION 2 1;

# Connect Sample Gas Valve and Timers
LOAD S21; Load state of V1 into register
STO T1I1; Store content of register as Timer 1 Input 1 signal
LOAD T1; Load state of Timer 1 output into register
STO T2I1; Store content of register as Timer 2 Input 1 signal
```

# X-STREAM XE

X-STREAM XE PLC provides:

- Up to 22 digital relay outputs
- Up to 14 digital inputs
- Support for internal SHS
- 8 timers
- More than 100 digital output functions
- More than 35 actions
- 9 operators
- 10 results registers

## Programming the X-STREAM XE PLC

X-STREAM XE PLC programs are to be edited as simple text files on a separate computer, and then uploaded into the analyzer via the USB port or web browser. This makes it easier to setup, update, and extend a program, or to correct failures.

Also the language is now more comfortable, as it is comparable to other software languages: terms are easy to read and understand, with the ability to add comments and ensure that the program can be read, even if years have passed since the last modification.

## Structure of a Valid X-STREAM XE PLC Text File

The syntax structure to be used is

- lines starting with # are comment lines
- command lines start with a valid command (see overview)
- command lines must end with a “;”
- comments may be added to command lines after the “;”



X-STREAM XE timers are setup in the first section of the text file, followed by all other sections, while MLT timers are setup in LOI software menus.

## Converting MLT PLC to X-STREAM PLC

In the following sections, you will find the MLT Code in the 1st column, followed by an explanation in the 2nd. The 3rd & 4th columns show the related X-STREAM XE syntax and again explanatory descriptions.

To convert an existing MLT program, simply locate the related code within the left columns of these tables and write down the code of the associated right column. An example later in this document (page 11) in detail shows how this is done.

MLT		X-STREAM XE	
-1	no operation (placeholder)	--	n.a.
-2	OR combine the input signals with following ID; store to IR	OR	Logical OR of register and <read operands>
-3	AND combine the input signals with following ID; store to IR	AND	Logical AND of register and <read operands>
-4	invert the IR	NEG	Negate register
-5	set/clear the output signal with the following ID according IR	STO	Store register to <write operands>
-6	clear the IR	CLR	Set register to FALSE
-7	end of program	END	End of program
-8	set the IR	SET	Set register to TRUE
-9	load IR according input signal with following ID;	LOAD	load register with state of <read operands>
-10	if IR = True then IR = input signal with 1st following ID else IR = input signal with 2nd following ID	IF	if register = TRUE then load register with state of first <read operand> else load register with state of second <read operand>
-11	actions call according IR by using following ID of actions pool	CALL	if register = TRUE then call <call operand>

**Input Signals Pool (Read Only)**

MLT		X-STREAM XE	
1	PLC Result 1	R1	PLC Result1
2	PLC Result 2	R2	PLC Result2
3	PLC Result 3	R3	PLC Result3
..		..	
10	PLC Result 10	R10	PLC Result10
11	PLC Result 11	--	n.a.
..		..	
15	PLC Result 15	--	n.a.
16	PLC Memory 1	M1	PLC Memory 1
17	PLC Memory 2	M2	PLC Memory 2
..		..	
30	PLC Memory 15	M15	PLC Memory 15
31	PLC Timer1 Out	T1	PLC Timer1 Out
32	PLC Timer 2 Out	T2	PLC Timer2 Out
..		..	
38	PLC Timer8 Out	T8	PLC Timer8 Out
39	Reserved	--	
40	Reserved	--	
41	System-DIO-Board 1 Input1	DI1	Digital I/O Board 1, Input 1
42	System-DIO-Board 1 Input 2	DI2	Digital I/O Board 1, Input 2
..		..	
47	System-DIO-Board 1 Input 7	DI7	Digital I/O Board 1, Input 7
48	System-DIO-Board 1 Input 8	--	n.a.
49	System-DIO-Board 2 Input1	DI8	Digital I/O Board 2, Input 1
50	System-DIO-Board 2 Input 2	DI9	Digital I/O Board 2, Input 2
..		..	
55	System-DIO-Board 2 Input 7	DI14	Digital I/O Board 2, Input 7
56	System-DIO-Board 2 Input 8	--	n.a.
57	System-Pump 1	PU1	Pump 1 State
58	System-Pump 2	PU2	Pump 2 State
..		..	
62	Reserved	--	n.a.
63	On-Signal	TRU	Logical TRUE Operand
64	Off-Signal	FALSE	Logical FALSE Operand

## Input Signals Pool (programmable)

MLT PLC with command codes 65 ... 128 supports variable, programmable commands, as listed in the following tables.

X-STREAM XE PLC does not support such variable assignment, so provides fixed codes for comparable functions.

## Control Module Functions

MLT		X-STREAM XE	
freely assignable to any code from 65 to 128	Any Function Control	S07	Any Function Check
	Any Maintenance Request	S06	Any Maintenance Request
	Any Failure	S04	Any Failure
	Any Cal. in Progress	S08	Any Calibrating
	Any Zero in Progress	S09	Any Zeroing
	Any Span in Progress	S10	Any Spanning
	Any Zero Failed	S11	Any Zero Failed
	Any Span Failed	S12	Any Span Failed
	Any Range Low	S13	Any Range Low
	Any Range High	S14	Any Range High
	Any Flow Low	S19	Any Flow Alarm
	Any Flow High		
	Any Conc. Low-Low	S15	Any Concentration Alarm
	Any Conc. Low		
	Any Conc. High		
	Any Conc. High-High		
	SYS:Valve-1	S21	Valve V1
	..	..	..
	SYS:Valve-20	S40	Valve V20
	SYS:Valve-21	--	n.a.
	..	..	
	SYS:Valve-32	--	n.a.
	Ext.Switch-1	S43	Ext Alarm1
	Ext.Switch-2	S44	Ext Alarm2
	..	..	
	Ext.Switch-8	S50	Ext Alarm8
	System Pump 1	S41	Pump1
	System Pump 2	S42	Pump2
	PLC-Result 1	S51	PLC Result1
	PLC-Result 2	S52	PLC Result2
..	..		
PLC-Result 10	S60	PLC Result10	
PLC-Result 11	--	n.a.	
..	..		
PLC-Result 15	--	n.a.	

**Analyzer Module Functions**

For X-STREAM, the codes for these functions are channel specific, so replace the 'x' within the com-

mand code by the number of the channel of interest, e. g. S107 gives the function

MLT		X-STREAM XE	
freely assignable to any code from 65 to 128	Function control	Sx07	Function Check
	Maintenance request	Sx06	Maintenance Request
	Failure	Sx04	Failure
	Cal. in progress	Sx08	Calibrating
	Zero in progress	Sx09	Zeroing
	Zero failed	Sx10	Spanning
	Span failed	Sx11	Zero Failed
	Range Low	Sx12	Span Failed
	Range High	Sx13	Range Underflow
	Flow Low	Sx14	Range Overflow
	Flow High	Sx36	Flow Lo
	Conc. Low-Low	Sx19	Conc. LoLo
	Conc. Low	Sx20	Conc. Lo
	Conc. High	Sx21	Conc. Hi
	Conc. High-High	Sx22	Conc. HiHi
	Range 1	Sx15	Range1
	Range 2	Sx16	Range2
	Range 3	Sx17	Range3
	Range 4	Sx18	Range4
	Sample gas	--	n.a.
	Zero gas	--	n.a.
	Span gas	--	n.a.
	Span gas-1	--	n.a.
	Span gas-2	--	n.a.
	Span gas-3	--	n.a.
	Span gas-4	--	n.a.
	Purge gas	--	n.a.
	Test gas	--	n.a.
	Linearizer gas	--	n.a.
	Average Low-Low	Sx23	Average LoLo
	Average Low	Sx24	Average Lo
	Average High	Sx25	Average Hi
	Average High-High	Sx26	Average HiHi
	Flow Low-Low	Sx35	Flow LoLo
Flow Low	Sx36	FlowLo	
Flow High	Sx37	FlowHi	
Flow High-High	Sx38	FlowHiHi	
Temp. Low-Low	Sx27	Temperature LoLo	
Temp. Low	Sx28	Temperature Lo	
Temp. High	Sx29	Temperature Hi	
Temp. High-High	Sx30	Temperature HiHi	

## Output Signals Pool (programmable)

MLT		X-STREAM XE		
1	PLC Result 1	R1	PLC Result1	
2	PLC Result 2	R2	PLC Result2	
3	PLC Result 3	R3	PLC Result3	
..		..		
10	PLC-Result 10	R10	PLC Result10	
11	PLC-Result 11	--	n.a.	
..		..		
15	PLC Result 15	--	n.a.	
16	Memory 1	M1	Memory 1	
17	Memory 2	M2	Memory 2	
..		..		
29	Memory 14	M14	Memory 14	
30	Memory 15	M15	Memory 15	
31	Timer 1 Input1	T1I1	Timer 1 Input1	
32	Timer 2 Input1	T2I1	Timer 2 Input1	
33	Timer 3 Input1	T3I1	Timer 3 Input1	
34	Timer 4 Input1	T4I1	Timer 4 Input1	
35	Timer 5 Input1	T5I1	Timer 5 Input1	
36	Timer 6 Input1	T6I1	Timer 6 Input1	
37	Timer 7 Input1	T7I1	Timer 7 Input1	
38	Timer 8 Input1	T8I1	Timer 8 Input1	
39	Reserved	--	n.a.	
40	Reserved	--	n.a.	
41	Timer 1 Input2	T1I2	Timer 1 Input2	
42	Timer 2 Input2	T2I2	Timer 2 Input2	
43	Timer 3 Input2	T3I2	Timer 3 Input2	
44	Timer 4 Input2	T4I2	Timer 4 Input2	
45	Timer 5 Input2	T5I2	Timer 5 Input2	
46	Timer 6 Input2	T6I2	Timer 6 Input2	
47	Timer 7 Input2	T7I2	Timer 7 Input2	
48	Timer 8 Input2	T8I2	Timer 8 Input2	
49	Reserved	--	n.a.	
..		..		
56	Reserved	--	n.a.	
57	System-Pump 1	A14	Pump1	Differing from the MLT, the XE requires a CALL function for these signals.
58	System-Pump 2	A15	Pump2	
59	Reserved	--	n.a.	
..		..		
70	Reserved	--	n.a.	

**Action**

*Control Module Actions*

MLT		X-STREAM XE	
no separate code	SYS:Zero-Cal	A02	Zero All
	SYS:Zero/Span-Cal	A04	Zero&Spanall
	SYS:Program-Cal	A06	Program Sequence
	SYS:Cancel-Cal	A05	Cancel All
	SYS:CAL-Test-Mode	A08	CalCheckMod
	External function control	A13	FctCheck
	AM: Hold Outputs	--	n.a.
	External failure	A10	Failure
	External maintenance	A12	MaintRequ

## Analyzer Module Functions

For X-STREAM the codes for these functions are channel specific, so replace the 'x' within the com-

mand code by the number of the channel of interest, e.g. S107 gives the function check status for channel 1

MLT		X-STREAM XE	
no separate code	AK-Error#8	--	n.a.
	AM:Range-1	Ax06	Range1
	AM:Range-2	Ax07	Range2
	AM:Range-3	Ax08	Range3
	AM:Range-4	Ax09	Range4
	AM:Span-Cal	Ax03	Span Calibration
	AM:Zero-Cal	Ax02	Zero Calibration
	All Zero+SpanCal	--	n.a.
	All purge gas	--	n.a.
	All sample gas	--	n.a.
	All span gas	--	n.a.
	All zero gas	--	n.a.
	ExtStatus1	--	n.a.
	..	..	
	ExtStatus5	--	n.a.
	FunctionControl	Ax13	FctCheck
	HoldAnalogOutput	--	n.a.
	ResetMaxMeas	--	n.a.
	ResetMinMeas	--	n.a.
	SYS:AM-Span-Gas1	Ax16	
	SYS:AM-Span-Gas2	Ax17	
	SYS:AM-Span-Gas3	Ax18	
	SYS:AM-Span-Gas4	Ax19	
	SYS:AM-Zero-Gas	Ax15	
	SYS:AM-closed-valves	Ax20	
	SYS-Blowback	Ax21	
	Span gas-1	--	n.a.
	Span gas-2	--	n.a.
	Span gas-3	--	n.a.
	Span gas-4	--	n.a.

**Example of a Converted MLT PLC Program**

**Brief description of the application:**

Three sample gas lines are sequentially connected to a gas analyzers sample gas inlet, while the sample gas valve of the analyzer's internal valve block is open.

(For a more detailed description, and how to find the right logic diagrams, see Technical Guide 51A-HASXEE-PPG)

**Preparation:**

The program is established on the following specifications (see Figure 1):

**MLT**

Sample gas valve = V1:

Input-ID 65 = Control Module: Sys.-Valve1

**X-STREAM XE**

Internal sample gas valve = V3 (factory default setting)

**Both**

PLC Result1 = Stream 1 valve control signal

PLC Result2 = Stream 2 valve control signal

PLC Result3 = Stream 3 valve control signal

Stream switching is active while the sample valve is open

Two timers are used to control the procedure:

First timer is of type 'Repeated Pulse',

Second timer is of type 'Off-Delay'

Duration is 60 s

Period is 180 s (3x 60 s)

Sample gas valve and timer signals are connected as shown (Figure 3):

These are the logic diagrams for the three streams (Figure 4):

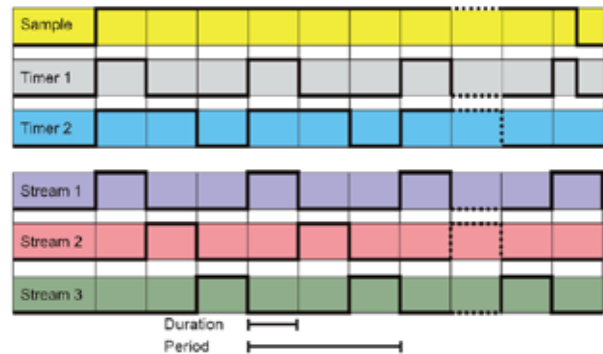
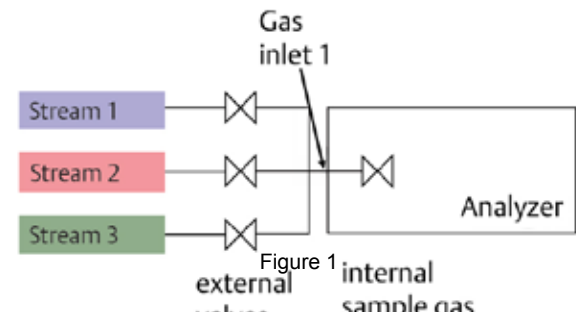


Figure 2

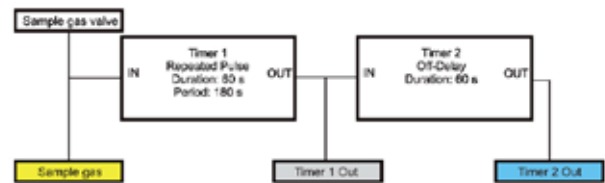


Figure 3

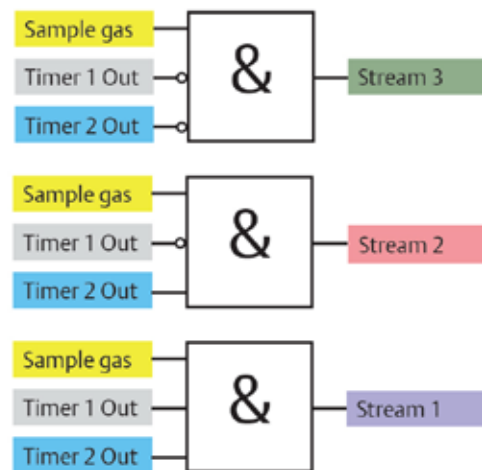


Figure 4

# X-STREAM XE

## Timer Setup

MLT requires to setup timers in separate software menus, but not in the PLC program.

Enter

- SYSTEM CONFIGURATION AND DIAGNOSTICS...
- SYSTEM PROGRAMMABLE LOGIC CONTROL (PLC)...
- TIMERS..

to setup the timers:

X-STREAM PLC timers are configured within the PLC program:

**- Timers -**

**Timer number:** **1**

**Timer mode:** **Repeated Pulse**

**Duration:** **60 secs**

**Period / Counts:** **180 secs**

**Hours (0..23):**

**Minutes:**

**Month:**

**Day:**

**View... States...**

Code	Comment (optionally part of program)
TMR_MODE 1 REPPULSE;	The timer 1 mode is repeated pulse
TMR_DURATION 1 60;	the duration for Timer 1 is 60 s
TMR_PERIOD_CNT 1 180;	the period for Timer 1 is 180 s

**- Timers -**

**Timer number:** **2**

**Timer mode:** **Off-delay**

**Duration:** **60 secs**

**Period / Counts:**

**Hours (0..23):**

**Minutes:**

**Month:**

**Day:**

**View... States...**

Code	Comment (optionally part of program)
TMR_MODE 2 OFFDELAY;	Timer 2 is of type off-delay
TMR_DURATION 2 60;	the duration for Timer 2 is 60 s

**Program Code Conversion**

The following table's first two columns show the MLT PLC program code, while the 3rd and 4th columns show how this is done with X-STREAM XE code.

MLT		X-STREAM XE	
-9	LOAD	Load S23;	Load the state of valve V3 into register
65	Control-Module SYS:Valve-1 (=Input-Signal 65)		
-5	STORE to	STO T1I1;	Assign the register state as Input (trigger) for Timer 1
31	Timer1-Input1 (=Output-Signal31)		
-9	LOAD	LOAD T1;	Load the state of Timer 1 output into register
31	Timer1-Input1 (=Output-Signal31)		
-5	STORE to	STO T2I1;	Assign the register state as Input (trigger) for Timer 2
32	Timer2-Input1 (=Output-Signal 32)		
-1	placeholder	--	placeholders not required
-1	placeholder	--	placeholders not required
-9	LOAD	Load S23;	Load the state of valve V3 into register
65	Control-Module SYS:Valve-1 (=Input-Signal 65)		
-3	AND	AND T1, T2;	AND conjunct it with both Timers outputs
31	Timer1-Output		
32	Timer2-Output		
-5	STORE to	STO R1;	Store the AND gate output into PLC Result 1 register (=> Stream 1)
1	PLC-Result1 (=Output-Signal1) =>Stream 1		
-1	placeholder	--	placeholders not required
-1	placeholder	--	placeholders not required
-9	LOAD	LOAD T1;	Load the state of Timer 1 output into the register
31	Timer1-Output		
-4	INVERT	NEG;	Negate register
-3	AND	AND S23, T2;	AND conjunct it with valve V3 state and Timer 2 output
65	Control-Module SYS:Valve-1		
32	Timer2-Output		
-5	STORE to	STO R2;	Store the AND gate output into the PLC Result 2 register (=>Stream 2)
2	PLC-Result2 (=Output-Signal 2) =>Stream2		
-1	placeholder	--	placeholders not required
-1	placeholder	--	placeholders not required
-9	LOAD	LOAD T1;	Load the state of Timer 1 output into register
31	Timer1-Output		
-2	OR	OR T2;	OR conjunct Timer 2 output with register
32	Timer2-Output		
-4	INVERT (build: not Timer1-Output and not Timer2-Output)	NEG;	Negate register
-3	AND	AND S23;	AND conjunct the state of valve V3 with register
65	Control-Module SYS:Valve-1		
-5	STORE to	STO R3;	Store the AND gate output into PLC Result 3 register (=> Stream 3)
-7	End of program	END;	End of program

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