Life Is On | Foxboro by Schneider Electric

Technical Information 12.2003 TI EML0610 P(en)

144LD, 244LD Intelligent Buoyancy Transmitters Communication with PROFIBUS

The intelligent buoyancy transmitters 144LD and 244LD are designed to perform measurements for liquid level, interface and density of liquids based on the Archimedes buoyancy principle and are accessable via profibus communication according PROFIBUS-PA Profile V3.0 under the common device type 144LD.

FEATURES

- Communication PROFIBUS according Profile 3.0
- Display in % or physical units
- Power supply DC 12...30V
- Current Imax 150mA
- Measure temperature –196°C to +400°C
- Connection according IEC 1158-2

Contents

1 CONFIGURATION OF 144LD VIA PROFIBUS

1.1 General Description

Through the communication interface to PROFIBUS an operator is provided with extensive possibilities for the configuration and parameterization by using both the cyclic communication with the PROFIBUS Master Class 1 and the acyclic communication with the PROFIBUS Master Class 1 or Class 2. The general condition for the PROFIBUS master agrees with the condition instruction of this master.

1.2 First Operation via PROFIBUS

144LD is set in plant to default parameters. For its first operation, 144LD shall be given a bus address for the creation of the communication and furthermore be provided with some device specific data. If no device specific data are specified, the default parameter setting is used.

1.3 Bus Address Setting

The default bus address is 126 according PROFIBUS-PA Profile V3.0 [4]. Because this address is not allowed for cyclic communication, it must be set to other value for the first operation. This can be done via the profibus service DDLM_SET_SALVE_ADD or via the two display keys on the front side of the device. The setting of the bus address through the display keys is described in the MI-document for 144LD [5].

1.4 Configuration

144LD is configured and parametrized by accessing its parameters using the communication services mentioned in Section 1.1. The configured parameters remain unchanged in case of power-off and restart and keep so long until it is reset to the default values by writing 1 to the FACTORY_RESET parameter (see Section 3.1 and 3.2 in Chapter 3). It is the duty of the operator to use this setting carefully since all parameters configured by host may get lost. S

2. CYCLIC COMMUNICATION WITH MASTER CLASS 1

2.1 Device Data Base File (GSD)

The configuration and parametrization of PROFIBUS and PROFIBUS Master Class 1 is generally carried out through the use of the device database given in a so-called GSD file. The GSD file for 144LD is fox_d144.gsd, in which the identification number IDENT_NUMBER, i.e. 0xD140 is used for the identification of the device. This number should be provided by PNO after the acceptance of a submission.

Beside 0xD140, 144LD can also operate with another IDENT_NUMBER defined in Profile V3.0. This IDENT_ NUMBER is 0x9700 reserved by PNO for Transmitters.

In the GSD file for 144LD, beside the parameters necessary for bus operation there is also a parameter Module used to define the module of the Function Block application (see Section 2.3).

2.2 Cyclic Data

According Profile V3.0, PROFIBUS level transmitters support only one cyclic parameter called OUT. This parameter is indexed in the Function Block and delivers the process output to the master via cyclic communication. It has a length of 5 bytes with the following structure,

OUT:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
OUT_Value (float IEEE)				OUT_Status

where Out_Value is a floating value holding the process output; Out_Status is an one-byte data carrying the quality as well as the states of this value.

2.3 Cyclic Data Exchange

Before a cyclic data exchange begins the Function Block application of a device must be initialized, i.e. in terms of Profile V3.0 each Funccion Block has its own Identifier Byte, which express all of its parameters with the cyclic attribute. This Identifier Byte is defined in the GSD file using the Module parameter. In 144LD there is only one Function Block of type Analog Input. Therefore there is only one module to be defined for the Function Block application of 144LD, which is given in two formats, i.e.

- Normal Identifier Format: “Analog Input (AI) short” 0x94
- Extended Identifier Format: “Analog Input (AI) long” 0x42, 0x84, 0x08, 0x05

For identifying the AI Function Block in 144LD one of these two formats must be selected for the DDLM_CHK_CFG service. With this module, the master simply reads back the process output from the AI Function Block through accessing the cyclic parameter OUT.

2.4 Coding Status

The Status byte described in Section 2.2 for OUT provides information about the quality and state of the output value. Profile V3.0 defines a coding of this byte, which is applied for 144LD as below.

Status

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quality		Quality Substatus				Limits	

2.4.1 Quality

7	6	5	4	3	2	1	0	
Quality		Substatus				Limits		
0	0							Bad
0	1							Uncertain
1	0							Good (Non Cascade)
1	1							Not used

2.4.2 Substatus

The coding of Substatus depends on the coding of Quality.

Quality = Bad (00):

7	6	5	4	3	2	1	0	
Quality		Substatus				Limits		
0	0	0	0	0	0			Non-specific
0	0	0	0	1	1			Device Failure
0	0	0	1	0	0			Sensor Failure
0	0	0	1	1	1			Out of Service

Quality = Uncertain (01):

7	6	5	4	3	2	1	0	
Quality		Substatus				Limits		
0	1	0	0	0	1			Last Usable Value
0	1	0	0	1	0			Substitute Value
0	1	0	0	1	1			Initial Value
0	1	0	1	0	0			Sensor Conversion not Accurate
0	1	0	1	0	1			Engineering Unit Range Violation
0	1	0	1	1	1			Configuration Error
0	1	1	0	0	0			Simulated Value

Quality = Good (Non Cascade) (10):

7	6	5	4	3	2	1	0	
Quality		Substatus				Limits		
1	0	0	0	0	0			Ok
1	0	0	0	0	1			Active Update Event
1	0	0	0	1	0			Active Advisory Alarm (Priority < 8)
1	0	0	0	1	1			Active Critical Alarm (Priority > 8)

2.4.3 Limits

The Limits bits indicate if the output value is in a valid area, is constant or crosses already the alarm boundary.

Limits:

7	6	5	4	3	2	1	0	
Quality		Substatus				Limits		
						0	0	Ok
						0	1	Low Limit acceded
						1	0	High Limit acceded
						1	1	Constant

2.5 Operation Mode Function Block AI

The Function Block of 144LD supports three operation modes, i.e. Out of Service (S/O), Automatic (AUTO) and Manual (MAN). The desired mode for operation can be set via accessing the parameter TARGET_MODE. Without a pre-setting, the default value for TARGET_MODE is AUTO, i.e. the device aims to switch the Function Block to AUTO mode. The actual operation mode during the operation can be acquired from reading the element “Actual-Mode” within the MODE_BLK parameter.

The meaning of the various operation modes and their important crossings will be discussed in the following subsections. A detailed description of all possible crossings can be found in Profile V3.0.

2.5.1 Automatic (AUTO)

This mode is the default operation mode of the Function Block (i.e. default value for TARGET_MODE). In this mode, the Function Block receives value from the Transducer Block, processes this value and outputs it to the OUT parameter. The Function Block changes to AUTO when the device is ready to work and TARGET_MODE is set to AUTO.

2.5.2 Out of Service (O/S)

This mode means that the Function Block and hence the functionality of the device is out of service. This may take place, e.g. when the device is in OFFLINE state where configuration parameters are sending to the device or in a state where local operation such as menu configuration through the two display keys on the front side of the device is just in progress. After the configuration, the operation mode will go back to AUTO if TARGET_MODE has been set to AUTO.

Manual (MAN)

During device operation, this mode can be achieved after TARGET_MODE has been set to MAN. This mode enables another two functions of the Function Block, i.e. simulation and override of the output. In the case of simulation, MAN mode is set and the Function Block and Transducer Block are disconnected, i.e. instead of receiving value from the Transducer Block the Function Block gets its input from the SIMULATE parameter in which both Value and Status are provided. Using SIMULATE as input, the Function Block performs a simulation and delivers the simulated output to OUT.

In the case of override, MAN mode is set and OUT is disconnected from the Function Block algorithm part, i.e. OUT is written directly by the operator. With this mode, the master can write a value to the device output and read back this value afterwards.

2.6 Slave Diagnosis

For being conform to Profile V3.0, 144LD responses to the PROFIBUS service DDLM_SLAVE_DIAG with 14 bytes that are coded as below.

Byte	Name	Value / Information
1 – 6	DIAG_STATUS	6 byte standard PROFIBUS-DP status information
7	Header	Length of status data followed DIAG_STATUS. For 144LD this is equal to 8 bytes.
8	Status_Type	0xFE (not used in future)
9	Slot_Number	Slot number of the Physical Block: 0x0
10	Specifier	= 0x01: Status in Diagnosis appears = 0x02: Status in Diagnosis disappears. = 0x03: Old status disappears and new status appears.
11 –14	Diagnosis	Diagnosis identical to that hold in the DIAGNOSIS parameter of the Physical Block.

2.6.1 DIAG_STATUS

The following 6 bytes for DIAG_STATUS are defined in [2], Section 8.3.

Byte 1:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diag.Master_Lock	Diag.Prm_Fault	Diag.Invalid_Slave_Response	Diag.Not_Supported	Diag.Ext_Diag	Diag.Cfg_Fault	Diag.Station_Not_Ready	Diag.Station_Non_Existent

Bit 7 Diag.Master_Lock: The DP-Slave will be parametrized by another master. This bit is set by DP- Master (Class 1) if the address in Byte 4 is neither equal to 255 nor equal to its own one. The DP-Slave sets this bit always to 0.

Bit 6 Diag.Prm_Fault: This bit will be set by DP-Slave if the last parametrization telegram was fault, e.g. due to invalid data length, invalid data or invalid IDENT_NUMBER etc.

Bit 5 Diag.Invalid_Slave_Response: For DP-Slaves this is always 0.

Bit 4 Diag.Not_Supported: This bit will be set by DP-Slave if a service that is not supported by the DP-Slave is being required.

Bit 3 Diag.Ext_Diag: This bit will be set by DP-Slave if there exists any diagnosis within the DIAGNOSIS parameter supported by the DP-Slave.

Bit 2 Diag.Cfg_Fault: This bit will be set by DP-Slave as soon as he receives a configuration that is not identical to what he just operates with.

Bit 1 Diag.Station_Not_Ready: This bit will be set by DP-Slave if the DP-Slave is still not ready for cyclic data exchange.

Bit 0 Diag.Station_Non_Existent: For DP-Slaves this always 0.

Byte 2:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diag.Deactivated	Reserved	Diag.Sync_Mode	Diag.Freeze_Mode	Diag.WD_On	Always 1	Diag.Stat_Diag	Diag.Prm_Req

Bit 7 Diag.Deactivated: For DP-Slaves this is always 0. Bit 6 Reserved.

Bit 5 Diag.Sync_Mode: For 144LD this is always 0. Bit 4 Diag.Freeze_Mode: For 144LD this is always 0.

Bit 3 Diag.WD_On: This bit will be set by DP-Slave as soon as the Profibus-Watchdog is switched on.

Bit 2 Always set to 1

Bit 1 Diag.Stat_Diag: If the DP-Slave sets this bit the DP-Master should fetch DIAGNOSIS data until this bit is reset to 0, e.g. when the DP-Slave is not able to deliver valid data anymore.

Bit 0 Diag.Prm_Req: This bit will be set by DP-Slave to show that he is waiting for a parametrization and configuration until the parametrization and configuration operation is finished. Afterwards this bit is set back by the DP-Slave.

Byte 3:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diag.Ext_Diag_Overflow	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Bit 7 Diag.Ext_Diag_Overflow: For 144LD this bit is always 0. Bit 0-6 Reserved.

Byte 4: (= Diag.Master_Add)

Byte 4 holds the address of the PROFIBUS Master (Class 1) who parametrizes the DP_Slave. If the DP-Slave is not parametrized Diag.Master_Add holds the address 255.

Byte 5-6: (= IDENT_NUMBER)

Byte 5 and 6 hold the identification number of the device (DP-Slave). For the level transmitter 144LD this number depends on the parameter “IDENT_NUMBER_SELECTOR” of the Physical Block. In default case, the identification number is registered as 0xD140. Alternatively, by switching IDENT_NUMBER_SELECTOR, the profile identification number 0x9700 can be used for the registration.

Diagnosis

The DIAGNOSIS parameter from the Physical Block consists of 4 byte diagnosis information of the device. Each byte of DIAGNOSIS is bit-coded and each bit corresponds to one specific condition. The active bits will be set so long as the corresponding conditions are satisfied. If a condition disappears, the corresponding bit is reset to 0. Following is the coding of the 4 diagnosis bytes for 144LD.

Byte 1:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Reserved	Meas. Fail	Mem chksum	Temp. high	Reserved	Reserved	HW Fail

Bit 7 Reserved
Bit 6 Reserved
Bit 5 DIA_MEASUREMENT: Measurement failed Bit 4 DIA_MEM_CHECKSUM: Memory error
Bit 3 DIA_TEMP_ELECTR: Electronic temperature too high Bit 2 Reserved
Bit 1 Reserved
Bit 0 DIA_HW_ELECTR: HW Failure of the electronics

Byte 2:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IDENT_ NUM violation	Reserved	Reserved	Coldstart	Warmstart	Conf. invalid	Supply Fail	Zero Point Error

Bit 7 Ident_Number Violation: Set to 1 if the IDENT_NUMBER of the running cyclic data transfer and the IDENT_NUMBER selected from IDENT_NUMBER_SELECTOR are different.
Bit 6 Reserved
Bit 5 Reserved
Bit 4 DIA_COLDSTART: Cold start-up carried out
Bit 3 DIA_WARMSTART: Warm start-up carried out (restart)
Bit 2 DIA_CONF_INVAL: Configuration not valid
Bit 1 DIA_SUPPLY: Power supply failed (electrical)
Bit 0 DIA_ZERO_ERR Zero point error (limit position)

Byte 3: All bits are reserved for use within the PNO.

Byte 4:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Extension Avail.	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Bit 7 Extension Available: This bit is set to 1 if more diagnosis information is available in the DIAGNOSIS_EXTENSION parameter of the Physical Block.
Bit 0-6 Reserved

3. Acyclic Communication With Master Class 1 Or Master Class 2

Acyclic communication with the level transmitter 144LD is possible for Master Class 1 as well as for Master Class 2 specified in Profile V3.0.

Master Class 2 can read and write the parameters supported by 144LD by using the PROFIBUS services MSAC2_ READ and MSAC2_WRITE. Also, the Master Class 1 can do the same thing by using the PROFIBUS services MSAC1_READ and MSAC1_WRITE specified in DPV1 [3].

LDE144PA supports all mandatory parameters as well as most of the optional parameters defined in Profile V3.0 for Transmitters [4]. Besides, some manufacturer specific parameters are also defined.

3.1 Parameter Table

144LD is a Simple/Compact Device [4] with one Function Block, one Transducer Block and one Physical Block. According to Profile [4] and Change Requests [6] all Function Block and Transducer Block parameters are managed to be located at slot 1 while all Physical Block parameters should be located at slot 0 in line with the DPV1 specification. The following table summaries all parameters of 144LD. The abbreviations in the table have the meaning:

A	Absolute Index in given slot
R	Relative Index
m/o/ms	mandatory/optional/manufacturer-specific
r	read access
w	write access

Index (A)	Index (R)	Parameter Name	m/o/ms	Size (Bytes)	Access	Range	Default Value
Directory (slot 1)							
0	0	DIRECTORY_OBJECT_ HEADER	m	12	r	-	-
1	1	COMPOSITE_LIST_ DIRECTORY_ENTRIES / COMPOSITE_DIRECTORY _ ENTRIES	m	24	r	-	-
2 - 15	2 - 15	Unused/Reserved	m	-	-	-	-
Function Block (slot 1)							
Standard Parameter							
16	0	BLOCK_OBJECT	m	20	r	-	-
17	1	ST_REV	m	2	r	-	0
18	2	TAG_DESC	m	32	r,w	-	-
19	3	STRATEGY	m	2	r,w	-	0
20	4	ALERT_KEY	m	1	r,w	-	0
21	5	TARGET_MODE	m	1	r,w	0x80 = O/S (OFFLINE) 0x10 = Manual 0x08 = AUTO (ONLINE)	AUTO
22	6	MODE_BLK	m	3	r	O/S, AUTO, MAN	-, 0x9A, 0x08
23	7	ALARM_SUM	m	8	r	X, 0, 0, 0, 0, 0, 0, 0	0, 0, 0, 0, 0, 0, 0, 0
24	8	BATCH	m	10	r,w	-	0 in each element
Additional Parameter for Analog Input Function Block							
25	9	Unused/Reserved	-	-	-	-	-
26	10	OUT	m	5	r,w	-	-
27	11	PV_SCALE	m	8	r,w	-	19.613, 0.0
28	12	OUT_SCALE	m	11	r,w	-	100.0, 0.0, 1342, 1
29	13	LIN_TYPE	m	1	r,w	0 = linear 1 = linearisation table 10 = square root	0

30	14	CHANNEL	m	2	r,w	-	-
31	15	Unused/Reserved	-	-	-	-	-
32	16	PV_FTIME	m	4	r,w	-	8.0
33	17	FSAFE_TYPE	o	1	r,w	0 = FS value for OUT 1 = Last usable value 2 = As calculated (OUT)	0
34	18	FSAFE_VALUE	o	4	r,w	-	0.0
35	19	ALARM_HYS	m	4	r,w	-	0.5 (0.5% of meas. range)
36	20	Unused/Reserved	-	-		-	-
37	21	HI_HI_LIM	m	4	r,w	-	110.0
38	22	Unused/Reserved	-	-	-	-	-
39	23	HI_LIM	m	4	r,w	-	100.0
40	24	Unused/Reserved	-	-	-	-	-
41	25	LO_LIM	m	4	r,w	-	0.0
42	26	Unused/Reserved	-	-	-	-	-
43	27	LO_LO_LIM	m	4	r,w	-	-10.0
44 - 49	28 - 33	Unused/Reserved	-	-	-	-	-
50	34	SIMULATE	m	6	r,w	Enabled: 0 = disable 1 = enable	disable
51	35	Unused/Reserved	-	-	-	-	-
52 - 60	36 - 44	Reserved by PNO	-	-	-	-	-
Additional Parameter for Analog Input Function Block defined by Foxboro Eckardt							
61	45	FSAFE_CFG	ms	1	r,w	Bit0 = Calibration failed Bit1 = PV out of range Bit2 = wr. EEPROM imp. Bit3 = Zero pos. invalid Bit4 = OUT out of range Bit5 = Sensor temp OOL Bit6 = Board temp OOL Bit7 = Meas. Range inval	0x8F
62 - 70	46 - 54	Unused/Reserved	-	-	-	-	-
71	55	VIEW1_FB	m	18	r	-	-
72 - 75	56 – 59	Unused/Reserved	-	-	-	-	-
Transducer Block (slot 1)							
Standard Parameter							
76	0	BLOCK_OBJECT	m	20	r	-	-
77	1	ST_REV	m	2	r	-	0
78	2	TAG_DESC	m	32	r,w	-	-
79	3	STRATEGY	m	2	r,w	-	-
80	4	ALERT_KEY	m	1	r,w	-	-
81	5	TARGET_MODE	m	1	r,w	0x08 = AUTO (ONLINE)	AUTO
82	6	MODE_BLK	m	3	r	-	0x08, 0x08, 0x08
83	7	ALARM_SUM	m	8	r	X, 0, 0, 0, 0, 0, 0, 0	0, 0, 0, 0, 0, 0, 0, 0
Additional Parameter for Transducer Block defined by Profile							
84	8	PRIMARY_VALUE	m	5	r	-	-
85	9	PRIMARY_VALUE_UNIT	m	2	r,w	-	N
86	10	LEVEL	m	4	r	-	-
87	11	LEVEL_UNIT	m	2	r,w	-	%
88	12	SENSOR_VALUE	m	4	r	-	-
89	13	SENSOR_UNIT	m	2	r,w	-	N
90 - 93	14 - 17	Unused/Reserved	-	-	-	-	-
94	18	SENSOR_OFFSET	m	4	r,w	-	0.0
95	19	CAL_TYPE	m	1	r,w	0 = dry 1 = online	1
96	20	CAL_POINT_LO	m	4	r,w	-	0.0
97	21	CAL_POINT_HI	m	4	r,w	-	100.0
98	22	LEVEL_LO	m	4	r,w	-	0.0
99	23	LEVEL_HI	m	4	r,w	-	100.0
100	24	LEVEL_OFFSET	m	4	r,w	-	0.0
101	25	LIN_TYPE	m	1	r,w	0 = linear 1 = linearisation table 10 = square root	0

102-103	26 - 27	Unused/Reserved	-	-	-	-	-
104	28	SENSOR_HIGH_LIMIT	o	4	r	-	150.0
105	29	SENSOR_LOW_LIMIT	o	4	r	-	-150.0
106	30	MAX_SENSOR_VALUE	o	4	r,w	-	-
107	31	MIN_SENSOR_VALUE	o	4	r,w	-	-
108	32	TEMPERATURE	o	4	r	-	-
109	33	TEMPERATURE_UNIT	o	2	r,w	-	°C
110	34	MAX_TEMPERATURE	o	4	r,w	-	-
111	35	MIN_TEMPERATURE	o	4	r,w	-	-
112	36	TAB_ENTRY	o	1	r,w	1 to 32	1
113	37	TAB_X_Y_VALUE	o	8	r,w	-	-
114	38	TAB_MIN_NUMBER	o	1	r	2	2
115	39	TAB_MAX_NUMBER	o	1	r	32	32
116	40	TAB_OP_CODE	o	1	r,w	0 = Not initialized 1 = New characteristic 2 = Reserved 3 = Last value, check … 4 = Delete point 5 = Insert point 6 = Replace point	0
117	41	TAB_STATUS	o	1	r	0 = Not initialized 1 = Good 2 = Not monotonous 4 = Not enough values 5 = Too many values 8 = Tab. Currently loaded	0
118	42	TAB_ACTUAL_NUMBER	o	1	r,w	2 to 32	2
119-128	43 - 52	Reserved by PNO	-	-	-	-	-
Additional Parameter for Transducer Block defined by Foxboro Eckardt							
129	53	LEVEL_SCALE	ms	8	r,w	-	100.0, 0.0
130	54	SENSOR_SCALE	ms	8	r,w	-	19.613, 0.0
131	55	PRIMARY_VALUE_RANGE	ms	8	r,w	-	19.613, 0.0
132-140	56 - 64	Unused/Reserved	-	-	-	-	-
141	65	VIEW1_TB	m	22	r	-	-
142-202	66 - 126	Unused/Reserved	-	-	-	-	-
203	127	PB_COMMAND	ms	7 - 32	w	-	-
204	128	PB_RESPONSE	ms	6 - 31	r	-	-
Physical Block (slot 0)							
Standard Parameter							
0 - 15	0 - 15	Unused/Reserved	-	-	-	-	-
16	0	BLOCK_OBJECT	m	20	r	-	-
17	1	ST_REV	m	2	r	-	0
18	2	TAG_DESC	m	32	r,w	-	-
19	3	STRATEGY	m	2	r,w	-	-
20	4	ALERT_KEY	m	1	r,w	-	-
21	5	TARGET_MODE	m	1	r,w	0x08 = AUTO (ONLINE)	AUTO
22	6	MODE_BLK	m	3	r	-	0x08, 0x08, 0x08
23	7	ALARM_SUM	m	8	r	X, 0, 0, 0, 0, 0, 0, 0	0, 0, 0, 0, 0, 0, 0, 0
Additional Parameter for Physical Block defined by Profile							
24	8	SOFTWARE_REVISION	m	16	r	Format: xx.yy	“2.yy”
25	9	HARDWARE_REVISION	m	16	r	Format: xx	“2”
26	10	DEVICE_MAN_ID	m	2	r	-	0x003F
27	11	DEVICE_ID	m	16	r	Format xxxxxxx	“xxxxxxx”
28	12	DEVICE_SER_NUM	m	16	r	Format xx/yyyyyy	“xx/yyyyyy”
29	13	DIAGNOSIS	m	4	r	-	-
30	14	DIAGNOSIS_EXT	o	6	r	-	-
31	15	DIAGNOSIS_MASK	m	4	r	-	0x39, 0x9E, 0x00, 0x80
32	16	DIAGNOSIS_EXT_MASK	o	6	r	-	0xFB, 0x3F, 0x73, 0x7F, 0x00, 0x00
33	17	Unused/Reserved	-	-	-	-	-
34	18	WRITE_LOCKING	o	2	r,w	0 = Protected 2457 = Not protected	Not protected
35	19	FACTORY_RESET	o	2	r,w	1 = Restore without addr.	0

						2506 = Warm reset 2712 = Reset bus addr. 32768= Reset hist. Status 32769= Restore full 32770= Create Fac. Setting	
36	20	DESCRIPTOR	o	32	r,w	-	" " - Tag number
37	21	MESSAGE	o	32	r,w	-	" " - Device message
38	22	Unused/Reserved	-	-	-	-	-
39	23	LOCAL_OP_ENA	o	1	r,w	1 = enable 0 = disable	enable
40	24	IDENT_NUMBER_SELECTOR	m	1	r,w	0 = Profile IDENT_NUM. 1 = 144LD IDENT_NUM.	144LD IDENT_NUM.
41	25	HW_WRITE_PROTECTION	o	1	r	0 = Not protected 1 = Protected	Not protected
42 - 48	26 - 32	Reserved by PNO	-	-	-	-	-
Additional Parameter for Physical Block defined by Foxboro Eckardt							
49 - 60	33 - 44	Unused/Reserved	-	-	-	-	-
61	45	VIEW1_PB	m	17	r	-	-
62 - 72	46 - 56	Unused/Reserved	-	-	-	-	-

3.2 Description of Parameters

The parameters listed in the table of last section are described below

Parameter Name	Description
Directory	
DIRECTORY_OBJECT_HEADER	This parameter contains a directory description that defines the block structures determined according Profile V3.0 (see [4], General Requirements, Section 3.6.2.2 and Mapping of the Profile to PROFIBUS-DP, Section 2.4.3).
COMPOSITE_LIST_DIRECTORY_ENTRIES / COMPOSITE_DIRECTORY_ENTRIES	This parameter gives a detailed definition of the individual block of the device, i.e. the slot number, the start index and the number of parameters in the block. See also Profile V3.0 [4], General Requirements, Section 3.6.2.2 and the example in Mapping of the Profile to PROFIBUS-DP, Section 2.4.3 for detailed information.
Standard Parameter for FB, TB and PB	
BLOCK_OBJECT	This parameter contains the characteristics of the blocks.
ST_REV	A block has static block parameters that are not changed by process. Values are assigned to this parameter during the configuration or optimization. The value of ST_REV must increase by 1 after every change of a static block parameter. This provides a check of the parameter revision. Since 144LD is a Simple/Compact Device one FB, one TB and one PB the ST_REV parameter for all three Blocks is the same, i.e. uses the same memory place.
TAG_DESC	Every block can be assigned a textual TAG description. The TAG_DESC must be unambiguous and unique in the fieldbus system. As for ST_REV, 144LD uses one memory place for the TAG_DESC parameter of all three blocks.
STRATEGY	Grouping of Function Block. The STRATEGY field can be used to group blocks. This parameter uses one memory place for all three blocks in 144LD.
ALERT_KEY	This parameter contains the identification number of the plant unit. It helps to identify the location (plant unit) of an event. Also 144LD uses one memory place for this parameter of all three blocks.
TARGET_MODE	The TARGET_MODE parameter contains desired mode normally set by a control application or an operator. The modes are valid alternatively only, i.e. only one mode can be set at one time. A write access to this parameter with

	more than one mode is out of the range of the parameter and has to be refused.
MODE_BLK	This parameter is a data structure of type DS-37 (see [4], General Requirements) and contains the current mode, the permitted mode and the normal mode of the block.
ALARM_SUM	This parameter is a data structure of type DS-42 and contains the current states of the block alarms.
BATCH	This parameter is a data structure of type DS-67 and is used in Batch application in line with IEC 61512 Part 1. Note that *only Function Blocks carry this parameter*. There is no algorithm necessary within a Function Block. The BATCH parameter is necessary in a distributed fieldbus system to identify used and available channels, in addition to identify the current batch in case of alerts.
Function Block	
OUT	The Function Block parameter OUT is a data structure of type DS-33 and contains the current measurement value in a vendor specific or configuration adjusted engineering unit stored in OUT_SCALE and the belonging state in AUTO mode. If set in MAN mode, OUT contains the value and status set by an operator.
PV_SCALE	This parameter is a data structure containing two float values and is used for the conversion of the Process Variable into percent using the high and low scale values. The engineering unit PV_SCALE high and low scale values are direct related to the PRIMARY_VALUE_UNIT of the configured Transducer Block (configured via CHANNEL parameter). The PV_SCALE high and low scale values follow the changes of the PRIMARY_VALUE_UNIT of the related Transducer Block automatically, i.e. a change of the Transducer Block PRIMARY_VALUE_UNIT causes no bump at OUT from AI (Analog Input).
OUT_SCALE	This parameter is a data structure of type DS-36 and is used for the scale of the Process Variable. The function block parameter OUT_SCALE contains the values of the lower limit and higher limit effective range, the code number of the engineering unit of the Process Variable and the number of digits on the right hand side of the decimal point. In default, OUT_SCALE is set in the way that of OUT is shown in the range of 0% -- 100%. Besides %, 144LD supports also a lot of other units such m, ft etc.
LIN_TYPE	Type of linearisation. For details see LIN_TYPE in **Transducer Block**.
CHANNEL	Reference to the active Transducer Block that provides the measurement value to the Function Block. For more details see [4], General Requirement definitions. 144LD has only one Transducer Block, hence this parameter is not evaluated.
PV_FTIME	Filter time of the Process Variable. This parameter contains the time constant for the rise of the Function Block output up to a value of 63.21% resulted from a jump on the input. The engineering unit of the parameter is second.
FSAFE_TYPE	Defines reaction of device, if a fault is detected. The calculated ACTUAL MODE remains AUTO. 0 = value FSAFE_VALUE is used as OUT, Status – Uncertain_Substitute_Value 1 = use of stored last valid OUT value Status – Uncertain_Last_Usable_Value, If there is no valid value

	then Uncertain_Initial_Value, Out value = Initial Value 2 = OUT hat the wrong calculated value and status Status – Bad_xxx (xxx = as calculated)
FSAFE_VALUE	Default value for the OUT parameter, if sensor or sensor electronic fault is detected. The unit of this parameter is the same like the OUT one.
ALARM_HYS	Hysteresis Within the scope of PROFIBUS-PA specification for transmitters there are functions for the monitoring of limit violation (off-limit conditions) of adjustable limits. Maybe the value of one process variable is just the same as the value of a limit and the variable fluctuates around the limit it will occur a lot of limit violations. That triggers a lot of messages; so it must be possible to trigger message only after crossing an adjustable hysteresis. The sensitivity of triggering of the alarm messages is adjustable. The value of the hysteresis is fixed in ALARM_HYS and is the same for the parameters HI_HI_LIM, HI_LIM, LO_LIM, LO_LO_LIM. The hysteresis is expected as value below high limit and above low limit in the engineering unit of xxx_LIM.
HI_HI_LIM	Value for upper limit alarms Upper limit value for alarms with engineering unit of the OUT parameter. If the measured variable is equal to or higher than the upper limit value the State Bits in the State Byte of OUT and in the Function Block parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
HI_LIM	Value for upper limit warnings Upper limit value for warnings with engineering unit of the OUT parameter. If the measured variable is equal to or higher than the upper limit value the State Bits in the State Byte of OUT and in the Function Block parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
LO_LIM	Value for lower limit warnings Lower limit value for warnings with engineering unit of the OUT parameter. If the measured variable is equal or lower than the lower limit value the State Bits in the State Byte of OUT and in the Function Block parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
LO_LO_LIM	Value for lower limit alarms Lower limit value for alarms with engineering unit of the OUT parameter. If the measured variable is equal to or lower than the upper limit value the State Bits in the State Byte of OUT and in the Function Block parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
SIMULATE	Data structure of type DS-50 (see [4]). For commissioning and test purposes the input value from the TRANSDUCER Block in the Analog Input Function Block (AI-FB) can be modified. That means that the Transducer Block and AI-FB will be disconnected.
FSAFE_CFG	The FSAFE_CFG parameter is a manufacturer-specific parameter that is used to provide an user-desired failsafe condition configuration. Each bit in FSAFE_CFG corresponds to one failsafe condition and there are totally 8 failsafe conditions for 144LD (see Parameter Table in 3.1). Setting of one bit in FSAFE_CFG means that the corresponding condition will be considered for failsafe. The conditions for those bits not set in FSAFE_CFG will be ignored and no failsafe will be set although the corresponding conditions may actually exist.
VIEW1_FB	The VIEW1_FB parameter groups the following parameters of the Function Block according Profile V3.0 to be read with one read request. The total length

	is 18. ST_REV (2 bytes) MODE_BLK (3 bytes) ALARM_SUM (8 bytes) OUT (5 bytes)
Transducer Block	
PRIMARY_VALUE	PRIMARY_VALUE is a data structure of type DS-33. It contains the process value and the status of the Transducer Block and is the input for the AI Function Block. PRIMARY_VALUE contains the same value as LEVEL when LIN_TYPE = 0. The unit is defined in PRIMARY_VALUE_UNIT.
PRIMARY_VALUE_ UNIT	Selected unit code for PRIMARY_VALUE. Mandatory: %, m, ft. 144LD supports more than these units.
LEVEL	LEVEL derives directly from SENSOR_VALUE by a linear transformation using LEVEL_HI, LEVEL_LO, CAL_POINT_HI, CAL_POINT_LO and SENSOR_OFFSET. The unit is defined in LEVEL_UNIT.
LEVEL_UNIT	Selected unit code for LEVEL, LEVEL_HI and LEVEL_LO. Mandatory: %, m, ft.
SENSOR_VALUE	SENSOR_VALUE is the physical value of the sensor.
SENSOR_UNIT	Unit for SENSOR_VALUE, SENSOR_LOW_LIMIT, SENSOR_HIGH_LIMIT, CAL_POINT_HI, CAL_POINT_LO, MAX_SENSOR_VALUE and MIN_SENSOR_VALUE. Mandatory for distance: m, ft. 144LD supports much more than these units.
SENSOR_OFFSET	SENSOR_OFFSET is a constant offset that is added to the SENSOR_VALUE. The unit is defined in SENSOR_UNIT.
CAL_TYPE	Defines type of calibration. CAL_TYPE = 0 : Dry – no influence of sensor value on level calibration. Mandatory for Radar Devices. CAL_TYPE = 1 : Online – current sensor value determines level calibration.
CAL_POINT_LO	CAL_POINT_LO is the lower calibrated point of the SENSOR_VALUE. It refers to LEVEL_LO. The unit is defined in SENSOR_UNIT.
CAL_POINT_HI	CAL_POINT_HI is the upper calibrated point of the SENSOR_VALUE. It refers to LEVEL_HI. The unit is defined in SENSOR_UNIT.
LEVEL_LO	LEVEL_LO is the value of LEVEL at CAL_POINT_LO. The unit is defined in LEVEL_UNIT. When writing LEVEL_LO and CAL_TYPE = 1, the CAL_POINT_LO is automatically set to SENSOR_VALUE.
LEVEL_HI	LEVEL_HI is the value of LEVEL at CAL_POINT_HI. The unit is defined in LEVEL_UNIT. When writing LEVEL_HI and CAL_TYPE = 1, the CAL_POINT_HI is automatically set to SENSOR_VALUE.
LEVEL_OFFSET	LEVEL_OFFSET is a constant offset added after the transfer function of level calibration. The unit is defined in LEVEL_UNIT.
SENSOR_HIGH_ LIMIT	Upper process limit of the sensor in SENSOR_UNIT.
SENSOR_LOW_ LIMIT	Lower process limit of the sensor in SENSOR_UNIT.
MAX_SENSOR_ VALUE	Holds the maximum process SENSOR_VALUE. The unit is defined in SENSOR_UNIT.
MIN_SENSOR_ VALUE	Holds the minimum process SENSOR_VALUE. The unit is defined in SENSOR_UNIT.

TEMPERATURE	Process temperature.
TEMPERATURE_ UNIT	TEMPERATURE_UNIT selects the unit of TEMPERATURE, MAX_TEMPERATURE and MIN_TEMPERATURE.
MAX_TEMPERATUR E	Holds the maximum process temperature.
MIN_TEMPERATUR E	Holds the minimum process temperature.
LIN_TYPE	Type of linearisation. 144LD supports the following options: 0 = no linearisation 1 = linearisation table (customer table) 10 = square root
TAB_ENTRY	The TAB_ENTRY parameter identifies which element of the linearisation table is in the TAB_X_Y_VALUE parameter currently.
TAB_X_Y_VALUE	The TAB_X_Y_VALUE parameter contains one value couple of the table.
TAB_MIN_NUMBER	For device internal reasons (e.g. calculation), sometimes it is necessary to use a certain number of table values in minimum. This number is provided in the TAB_MIN_NUMBER parameter and is equal to 2 for 144LD.
TAB_MAX_NUMBER	TAB_MAX_NUMBER is the maximum size (number of TAB_X_Y_VALUE) of the table in the device and is equal to 32 for 144LD.
TAB_STATUS	It is common to provide a plausibility check in the device. The result of this check is indicated in the TAB_STATUS parameter. 144LD supports the following check variants: 0 : not initialized 1 : good (new table is valid) 2 : not monotonous increasing (old table is valid) 4 : not enough values transmitted (old table is valid) 8 : table is currently loaded, set after TAB_OP_CODE = 1 and before TAB_OP_CODE = 3 (additional access to table not valid, old values are valid)
TAB_OP_CODE	The modification of a table in a device influences the measurement or actuation algorithms of the device. Therefore an indication of a starting and an end point is necessary. The TAB_OP_CODE controls the transaction of the table. For 144LD the following transactions are supported: 0 : not initialized 1 : new operation characteristic, first value (TAB_ENTRY = 1) 3 : last value, end of transmission, check table, swap the old curve with the new curve, update TAB_ACTUAL_NUMBER
TAB_ACTUAL_ NUMBER	Contains the actual numbers of entries of the table. It shall be calculated after the transmission of the table is finished.
LEVEL_SCALE	LEVEL_SCALE contains the engineering unit high and low scale values for the conversion of the process LEVEL value from percent to a value in the engineering unit defined in LEVEL_UNIT. LEVEL_SCALE is a Foxboro Eckardt specific parameter.
SENSOR_SCALE	SENSOR_SCALE contains the engineering unit high and low scale values for the conversion of the process SENSOR_VALUE from percent to a value in the engineering unit defined in SENSOR_UNIT. SENSOR_SCALE is a Foxboro

PRIMARY_VALUE_RANGE	PRIMARY_VALUE_RANGE contains the enginnering unit high and low scale values for the conversion of the PRIMARY_VALUE from percent to a value in the engineering unit PRIMARY_VALUE_UNIT. This parameter is a Foxboro Eckardt specific parameter.
VIEW1_TB	The VIEW1_TB parameter groups the following parameters of the Transducer Block according Profile V3.0 to be read with one read request. The total length is 22. ST_REV (2 bytes) MODE_BLK (3 bytes) ALARM_SUM (8 bytes) PRIMARY_VALUE (5 bytes) LEVEL (4 bytes)
Physical Block	
SOFTWARE_REVISION	Revision-number for the software of 144LD in format xx.yy.
HARDWARE_REVISION	Revision_number for the hardware of 144LD.
DEVI CE_MAN_ID	Identification code of the manufacturer of the field device. For 144LD this is Foxboro Eckardt with the identification code 0x003F.
DEVICE_ID	Manufacturer specific identification of the device. For 144LD this is read in a format xxxxxxx.
DEVICE_SER_NUM	Serial number of the field device. This is given for 144LD in a format xx/yyyyyy.
DIAGNOSIS	Detailed information of the device, bitwize coded. More than one message possible at once. If MSB of the byte 4 is set to 1 then more diagnose information is available in the DIAGNOSIS_EXT parameter. See also Section 3.3.
DIAGNOSIS_EXT	Additional manufacturer-specific information of the device, bitwize coded. More than one message possible at once. See also Section 3.3.
DIAGNOSIS_MASK	Definition of supported DIAGNOSIS information-bits. bit = 0 : not supported bit = 1 : supported
DIAGNOSIS_MASK_EXT	Definition of supported DIAGNOSIS_EXT information-bits. bit = 0 : not supported bit = 1 : supported
WRITE_LOCKING	Software write protection. 144LD supports the following options: 0 = acyclic write service of all parameters, except this WRITE_LOCKING one, are refused, i.e. access is denied. 2457 = default value which means all writeable parameters of the device are writeable.
FACTORY_RESET	The FACTORY_RESET parameter is used to reset a device to its plant state. There are several possibilities for this function according Profile V3.0 [4]. Among these possibilities 144LD supports the following: 1 = command for resetting device for default values, but the bus address remains unchanged. 2506 = command for warm start of the device. All parametrization remains unchanged. 2712 = this command resets the bus address only. The

	IDENT_NUMBER_SELECTOR isn´t effected by this command. 32768 = this command resets the historical status of the device (Foxboro Eckardt specific option) 32769 = this command resets device for default values including the default bus address = 126 (Foxboro Eckardt specific option) 32770 = this command produces a new factory setting stored in device EEPROM (Foxboro Eckardt specific option)
DESCRIPTOR	User-definable text (string) to describe the device within the application.
DEVICE_MESSAGE	User-definable MESSAGE (string) to describe the device within the the application or in the plant.
LOCAL_OP_ENA	Local operation enable. 0 = disabled (Local operation not allowed) 1 = enabled (Local operation is allowed) The operation of the host has the higher priority than the local terminal one. The local operation of 144LD is provided via the two display keys on the front side of the device. The access priority of the master is higher than the priority of these two keys, i.e. configurations via the two keys into the device will be overwritten by the master. For more details of the access priority see [4], General Requirements, Table 60.
IDENT_NUMBER_ SELECTOR	Choice of the used IDENT_NUMBER. 0 = use the profile specific IDENT_NUMBER 0x9700 1 = use the manufacturer specific IDENT_NUMBER 0xD140 The manufacturer specific number 0xD140 should be a IDENT_NUMBER for 144LD provided by PNO (an application must be submitted!!!). Generally, 144LD is set to use the IDENT_NUMBER 0xD140. If the device is accessed with an invalid IDENT_NUMBER, the IDENT_NUMBER Violation bit in Diagnosis byte 2 (see Section 2.6.2) will be set. If 144LD is switched to the profile specific IDENT_NUMBER 0x9700, it shall interact with the profile features of the GSD file. IDENT_NUMBER_SELCTOR isn´t affected by FACTORY_RESET.
HW_WRITE_PROTE CTION	Indicates the position of a write blocking mechanism (e.g. hardware jumper) that protects all acyclic write access to all writeable parameters of a device. 144LD has a hardware jumper and supports hardware write protection. 0 = Unprotected 1 = Protected (acyclic write service of all parameters are refused, i.e. access is denied)
VIEW1_PB	The VIEW1_PB parameter groups the following parameters of the Physical Block according Profile V3.0 to be read with one read request. The total length is 17. ST_REV (2 bytes) MODE_BLK (3 bytes) ALARM_SUM (8 bytes) DIAGNOSIS (4 bytes)
PB_COMMAND	Internal parameter provided by Foxboro Eckardt.
PB_RESPONSE	Internal parameter provided by Foxboro Eckardt.

Diagnosis Extension

144LD provides a diagnosis extension in length of 6 bytes to save the historical status of the device. The first four bytes of this diagnosis extension contain all device status information. The rest two bytes are not used at present and reserved for future use. The diagnosis extension simply summarizes all status of the device appeared since the power-on start. It is visible only if at least one status exists and then the “Extension Avaliable”-bit in DIAGNOSIS (see Section 2.6.2) is set. The bits that have been set will remain so long until they are cleared by explicitly writing 32768 to the FACTROY_RESET parameter. In that case, all status in the device will be cleared, and as an indication the “Extension Avaliable”-bit in the DIAGNOSIS will be reset to 0.

The coding of the first 4 status bytes are described below.

Coding of Byte 1:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Pwr. Fail	Diag. Error	Init. Phase	PROG. ROM Init.	Dev. Busy	N/u	Mode	

Bit 7 -- Power failed
Bit 6 -- Secondary Status Byte is non-zero
Bit 5 -- Current Diagnostic Error exists
Bit 4 -- EEPROM configuration data requires initialization
Bit 3 -- EEPROM burn request has been queued
Bit 2 -- Not used
Bit 1,0 -- Mode
00 -- ONLINE mode (normal)
01 -- LOCAL mode
10-- CALIBRATE mode
11-- OFFLINE mode (FAULT, config. or factory)

Coding of Byte 2:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
N/u	N/u	S3 Range	S2 Range	S1 Range	Health Problem	Dad Msg.	Stack Warn.

Bit 7 -- Not used
Bit 6 -- Not used
Bit 5 -- Measurement S3 is out of range
Bit 4 -- Measurement S2 is out of range
Bit 3 -- Measurement S1 is out of range
Bit 2 -- Health problem
Bit 1 -- Bad message
Bit 0 -- Stack warning

Coding of Byte 3:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
N/u	Zero Point Error	Meas.Range Config.	Int. Calib	N/u	N/u	Sensor Val. OOL	PV Val. OOL

Bit 7 -- Not used
Bit 6 -- Zero point configuration invalid
Bit 5 -- Measurement range configuration invalid
Bit 4 -- Internal calibration failed (= selfcalibration failed)
Bit 3 -- Not used
Bit 2 -- Not used
Bit 1 -- Sensor value out of limit
Bit 0 -- Primary value out of limit

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
N/u	IDENT_NUM. Violation	Coldstart	Warmstart	Wr. EEPROM impossible	EEPROM wr. Error	RAM Eerror	ROM Chksum

Bit 7 -- Not used
Bit 6 -- IDENT_NUMBER violation
Bit 5 -- Cold start-up carried out
Bit 4 -- Warm start-up carried out
Bit 3 -- Write EEPROM impossible
Bit 2 -- EEPROM write error
Bit 1 -- RAM error
Bit 0 -- ROM error (check sum error)

3.4 Return Error Codes for Acyclic Data Transfer

For reading/writting parameters via DPV1-Services, the following Return Error Codes are defined. The definition comes from [3], Section 10.3.1 and from [4], Part 2: Mapping of the Profile to Profibus-DP, Section 3.2. The error codes are sent in byte 3 of an so-called “Error PDU”. Within this byte the four high bits are the Error Class and the lower four bits are the Error Subcode.

Error Class	Error Sub-code	Error Code	Error Name	Description
Access (11 = 0xB)	0	0xB0	invalid index	The parameter can not be accessed because of it is never used or it is not visible.
	1	0xB1	write length error	The length in the write request does not match (larger or smaller) to the size of the parameter.
	2	0xB2	invalid slot	Accessed a slot that contains no parameters at all.
	3	0xB3	type conflict	Not used by 144LD.
	4	0xB4	invalid area	Not used by 144LD.
	5	0xB5	state conflict	Device is busy bacause it has to work internally. This may happen, e.g. after writing the reset parameter.
	6	0xB6	access denied	The parameter can not be written because the device is write protected.
	7	0xB7	invalid range	The parameter can not be written because of the value is out of range.
	8	0xB8	invalid parameter	Not used by 144LD.
	9	0xB9	invalid type	Not used by 144LD.
	10	0xBA	read only	The parameter can never be written.
	11	0xBB	temporal invalid	Not used by 144LD.
	12 -14	0xBC-0xBE	manufacturer specific	Not used by 144LD.
	15	0xBF	other	The reason is non-specific.

Foxboro
38 Neponset Ave., Foxboro Massachusetts 02035 USA
Toll free within USA: 1-866-746-6477
Global: +1-508-549-2424

www.fielddevices.Foxboro.com

Life Is On

Foxboro
by Schneider Electric

