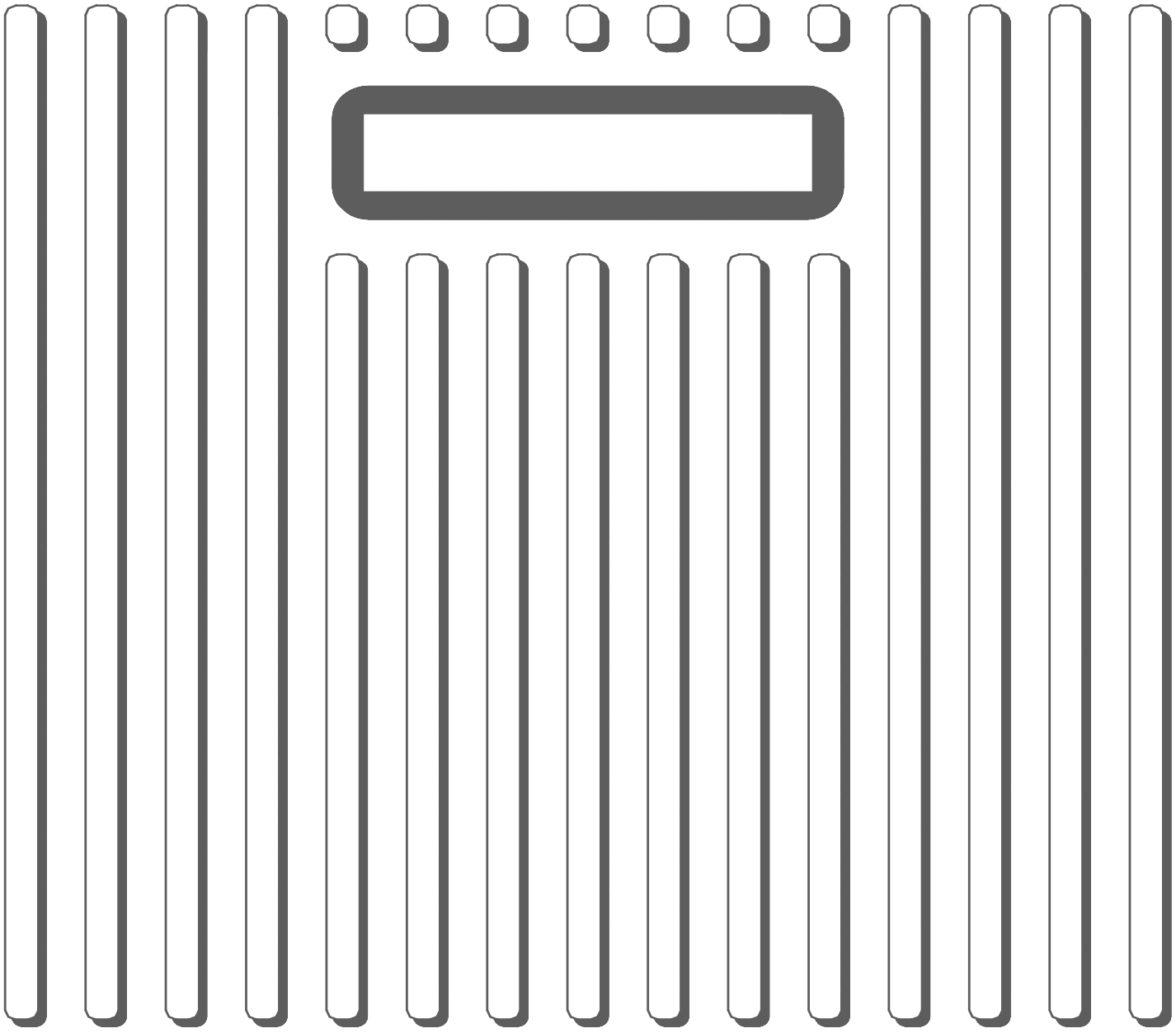
# IEC 61131-3 Programmer's Manual



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# IEC 61131-3

## Programmer's Manual

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Inquiries regarding this manual should be addressed to ABB, Inc., Totalflow Products, Technical Communications, 7051 Industrial Blvd., Bartlesville, Oklahoma 74006, U.S.A.

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# Chapter 1
# Totalflow's IEC Development Kit

## Introduction

The process and instrumentation markets have experienced unprecedented growth in recent years. Programmable Logic Controllers (PLCs) have provided the backbone for this growth. With so many PLC manufacturers providing equipment to the industry, different programming languages and techniques were bound to eventually cause a great deal of confusion. The many different controllers also created communication problems from controller to controller.

**IEC**

IEC 61131-3 was developed by the International Electro-technical Commission to provide a generic programming environment for the PLC industry. In concert with Softing, Inc., ABB Totalflow has adapted their IEC compiler, softCONTROL, to work with the Totalflow XSeries product line. This alliance has greatly enhanced the functionality of the Totalflow XSeries products by providing the end user, and third party developers, the tools with which to build custom applications.

**Applications**

Differing user applications may require different programming solutions. One application may lend itself to a graphical solution (Function Block Diagram), while another application may be best addressed through a ladder logic (Ladder Diagram) approach. Totalflow's IEC solution supports six different programming approaches.

- ST Structured Text
- FBD Function Block Diagram
- IL Instruction List
- LD Ladder Diagram
- SFC Sequential Function Chart
- C-Code C language

One, or a mix, of the above languages should provide the user with enough flexibility to address any special applications problems his field environment might present.

Once a custom IEC-61131-3 application has been created it can be downloaded to the customer's XSeries product. While only one IEC application can be supported by an XFC or XRC (XSeries FCU or RTU), an application can be constructed to handle a number of different user tasks.

## Requirements

Prior to beginning installation, you will need to meet the minimum hardware requirements listed below, and have all of the software requirements on hand.

**Hardware**

- XFC/XRC
- PC Requirements
  - Intel Pentium 133
  - Microsoft Windows 95 or greater
  - 500 Mbyte hard drive
  - 16 Mbyte RAM
  - SVGA 600 x 800
  - CD-ROM Drive

*Continued on Next Page*

## **Requirements,** Continued

**Software**

- IAR Z80/64180 compiler with security dongle
- Softing's SoftCONTROL IEC compiler license and security dongle
- Totalflow's IEC Development Kit (CD) which includes:
  - Modifications to Softing softCONTROL IEC 61131-3 Compiler
  - Totalflow Libraries
  - Totalflow Utilities (Makefiles, Loader…)

**TIP** 

It has been found that the Softing security dongle should be attached directly to the parallel port, with the IAR dongle attached second.

## Installation

**IDE**

Begin installation by inserting the Totalflow IEC Integrated Development Environment (IDE) CD. If your CD drive is configured for AutoPlay, this will automatically start the Installation Wizard, otherwise, you will need to start the wizard manually.

- To begin manually, select "Run" from the "Start menu", Type d:\setup (where d is the CD-ROM drive), click OK or press Enter.

The Wizard will step you through installation of the Totalflow Development Environment on your system.

This environment will include several directories and subdirectories. The Wizard will modify your system's Environmental Variables to support the Totalflow IEC IDE. This environment structure must be adhered to so that the various .bat (batch) and .mak (make) files will be pointing to the appropriate directories during the build process. After the Installation Wizard has run to completion, you will install the IAR tools.


Modifying the environment may put the build process in jeopardy.

**IAR**

Begin installation by inserting the IAR Z80/64180 compiler CD. Either begin manual installation detailed above, or allow the Installation Wizard to proceed. This installation should target the 'IAR' directory. The IAR installation does require that you email IAR for a permanent password, or key. This procedure is well documented in the IAR installation instructions.

## Sc30.ini File Modification

The file sc30.ini stores options and setup for the SoftCONTROL IDE (integrated development environment). The user must manually configure several items in this file. Any text editor may be used such as: notepad or wordpad. The file is divided into several sections by headers. Headers are names enclosed in square brackets. A semicolon (;) denotes a comment. Several sections must be changed to indicate the type of XSeries board that IEC is being developed to run on (XRC/XFC).

The [Online] section is used when on-line IEC debugging is done on the board. The serial configuration must match the board configuration. The port item must be set for the matching PC serial port.

The [Adaption] section also contains the directory used to read/write/update the INI and APP files.

**Sc30.ini Excerpts**

```
[Online]
Port=COM2
Baudrate=4800
Bytesize=8
Parity=0
Stopbits=1

[Adaption]
ProjectPath=%IECPath%\xfc\2101051_003

;Totalflow Ini directory
PCCUINIFILE=C:\PCCU32\IniFiles\

[Ccodegen]
CGLIB=%project path%

[Libraries]
ManufacturerLibPath=c:\IEC\xfc\2101051_003\Scasc
Manufacturer0=Standard_Lib,SLIB.ASC,SLIB.HLP
Manufacturer1=register_Lib,SCRegAccess.asc
```

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# Chapter 2
# Totalflow Framework

## The XSeries File System

The XSeries framework incorporates a sophisticated and flexible file system. Hardware supports two 'disk drives', an RDRIVE residing in the 512K RAM and an SDRIVE residing in the 16/32K of serial EEPROM. See Figure 2–1. Application configuration and data (i.e. historical logs) information can be stored on the RDRIVE. Cold boots erase RAM and therefore delete any configuration and/or data files saved on the RDRIVE. Applications will have to be reinitialized. Warm boots will not effect configuration and data files on the RDRIVE.

**SDRIVE** The Serial EEPROM, or SDRIVE, among other things, is primarily a backup drive to restore the RDRIVE in case of a Cold Boot.

**RDRIVE** The RAM, or RDRIVE, contains current configuration data, historical logs and a file storage area accessible to all applications through the file system. The RDRIVE maintains this information through a Warm Boot, not through a Cold Boot. Most instances of memory corruption can be corrected by executing a Warm Boot.

**FYI**  The RAM is backed up by an onboard lithium cell.

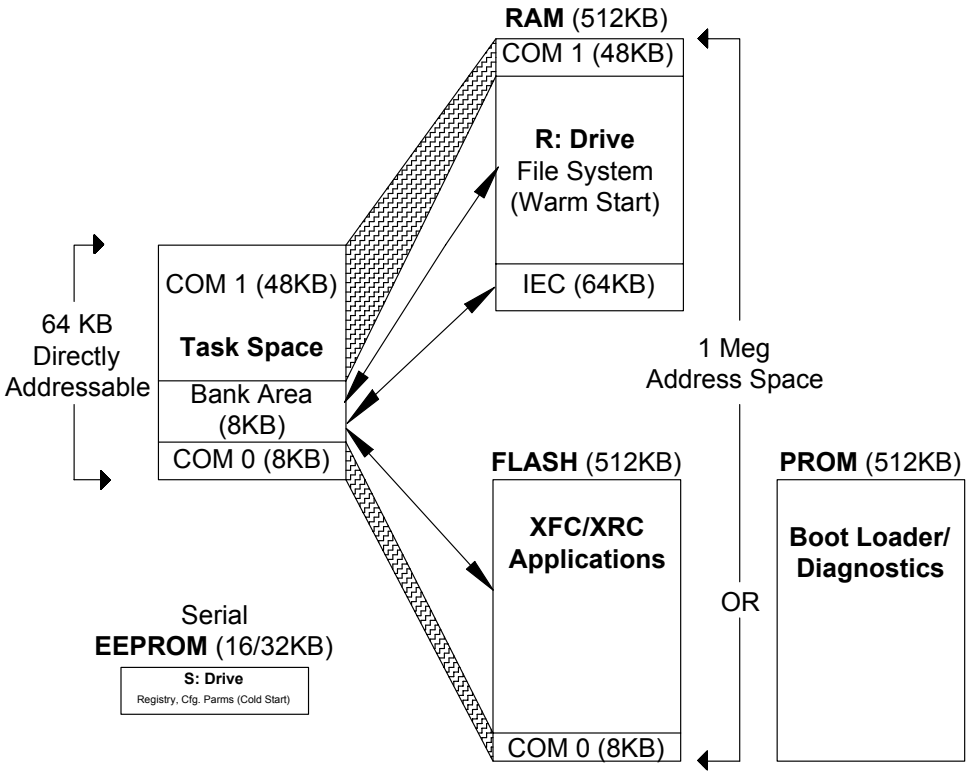


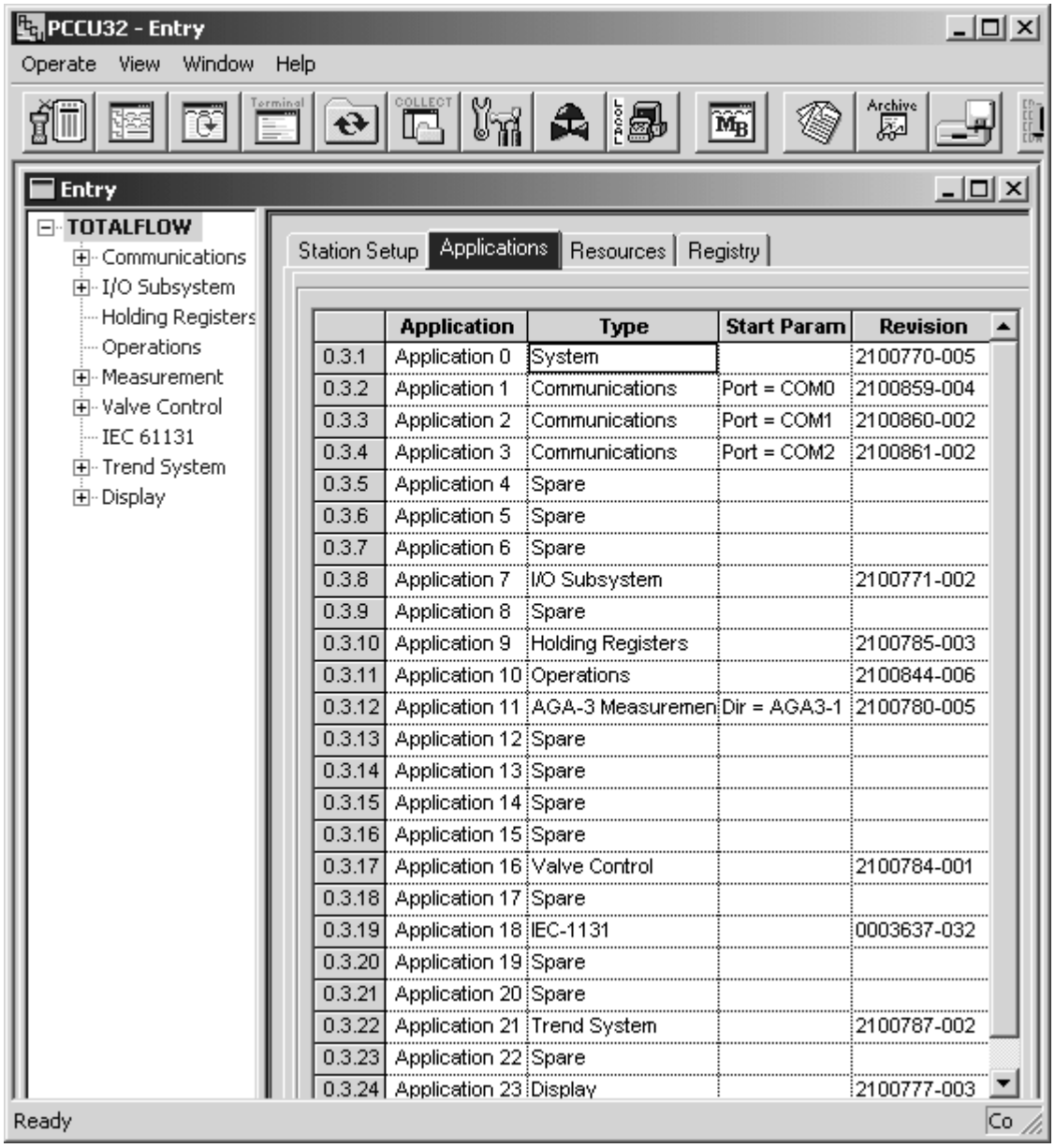

**Figure 2–1 System Architecture for the XSeries XFC and XRC**

## The XSeries Application Table

The XSeries products maintain an application table, or AppTable. This table provides application information to the system and other applications. The application slot number, the application name, access functions and application instance data are maintained.

**Application Instantiation**

Applications are instantiated (or installed) at run time using PCCU32. In Figure 2–2 you can see the various applications that have been instantiated (System, Communications, I/O Subsystem, IEC-61131-3 and Display. The pull down menu displays several additional applications that might be instantiated. These selections are fixed at compile time. Only the applications supported by Flash will be listed. Also note that the Communications application has been instantiated three times; applications 1, 2 and 3 (Communications instances 0, 1 and 2 respectively).




| | Application | Type | Start Param | Revision |
|---|---|---|---|---|
| 0.3.1 | Application 0 | System | | 2100770-005 |
| 0.3.2 | Application 1 | Communications | Port = COM0 | 2100859-004 |
| 0.3.3 | Application 2 | Communications | Port = COM1 | 2100860-002 |
| 0.3.4 | Application 3 | Communications | Port = COM2 | 2100861-002 |
| 0.3.5 | Application 4 | Spare | | |
| 0.3.6 | Application 5 | Spare | | |
| 0.3.7 | Application 6 | Spare | | |
| 0.3.8 | Application 7 | I/O Subsystem | | 2100771-002 |
| 0.3.9 | Application 8 | Spare | | |
| 0.3.10 | Application 9 | Holding Registers | | 2100785-003 |
| 0.3.11 | Application 10 | Operations | | 2100844-006 |
| 0.3.12 | Application 11 | AGA-3 Measuremen | Dir = AGA3-1 | 2100780-005 |
| 0.3.13 | Application 12 | Spare | | |
| 0.3.14 | Application 13 | Spare | | |
| 0.3.15 | Application 14 | Spare | | |
| 0.3.16 | Application 15 | Spare | | |
| 0.3.17 | Application 16 | Valve Control | | 2100784-001 |
| 0.3.18 | Application 17 | Spare | | |
| 0.3.19 | Application 18 | IEC-1131 | | 0003637-032 |
| 0.3.20 | Application 19 | Spare | | |
| 0.3.21 | Application 20 | Spare | | |
| 0.3.22 | Application 21 | Trend System | | 2100787-002 |
| 0.3.23 | Application 22 | Spare | | |
| 0.3.24 | Application 23 | Display | | 2100777-003 |

**Figure 2–2 Totalflow PCCU32 Application Table**

## Totalflow Register Addressing

Totalflow Register Addressing consists of three parts, the application slot number (APP), the array number (ARRAY) and the register index number (REG). A good example of the Totalflow Register Addressing format can be seen using PCCU32.

**PCCU32** Connect PCCU32 to the target's (XFC/XRC) local port. Connect to the target by clicking on the ENTRY button of PCCU32's upper toolbar. Referring back to Figure 2–2, the variables displayed under the various PCCU32 tabs will be shown with their appropriate Register Address (i.e. 0.3.2). Notice that the I/O Subsystem has been instantiated as application #7.

**Register** Now look at a register that is being monitored by the I/O Subsystem, for example DI 1 (See Figure 2–3). The value currently stored here is a Boolean, 'Open' (open = 0). Notice the Register Address associated with DI1, 7.2.4096. This tells us, as we've seen in Figure 2–3, that the application (I/O Subsystem) is #7, and in Figure 2–4, that the array is 2, and the register index is 4096.

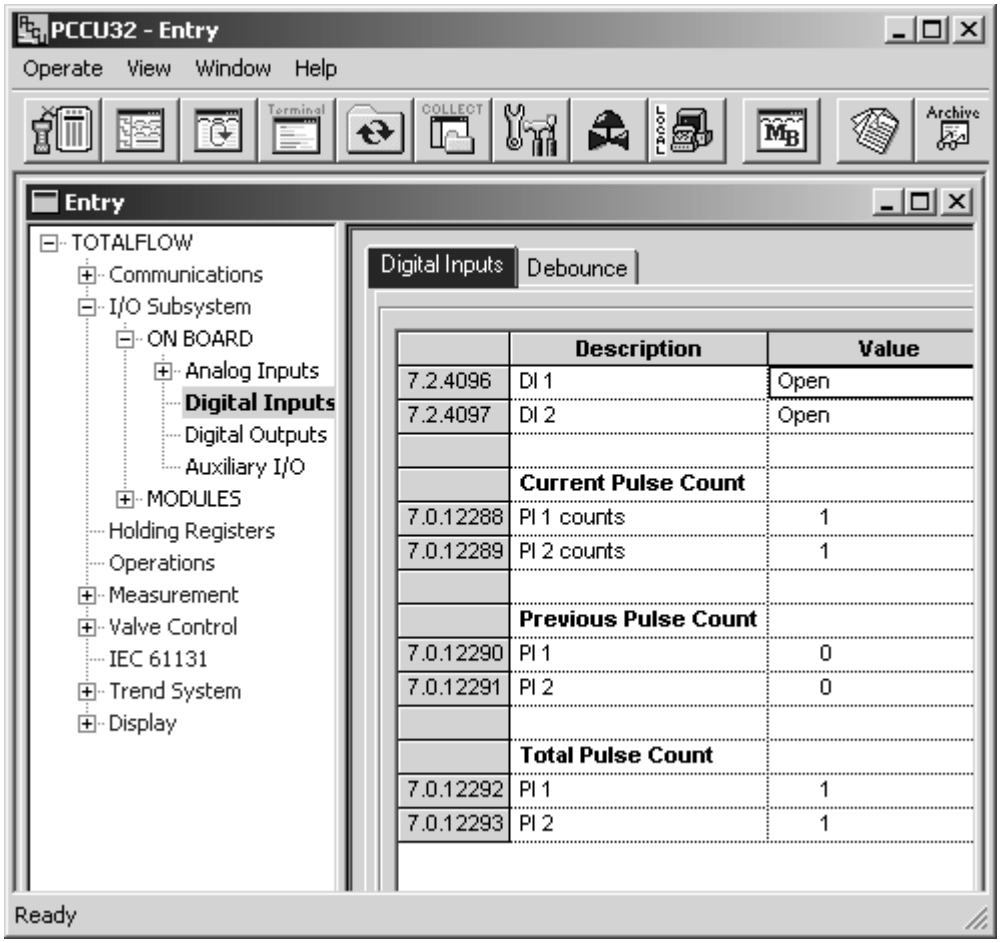



**Figure 2–3 Totalflow PCCU32 I/O Subsystem\ON BOARD\Digital Input**

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**Terminal Mode**

We can also access DI1 in terminal mode by entering the appropriate Register Address number (7.2.4096) in the terminal screen (See Figure 2–4).

TIP

While array and index values are fixed at compile time (remain constant from a user's perspective), the application instance is established at runtime. You will remember from the above example that the first (0th) instance of the I/O Subsystem application is actually the seventh (7) application in the application table.


**Figure 2–4 Totalflow PCCU32 Terminal Mode**

## An IEC Look at Totalflow

Previously in this chapter, you have studied the framework used to develop the XSeries technology, learned about the application tables and discovered how to point to information using Totalflow's Register Addressing. In this section, we will discuss the opposite view; how IEC applications work within the XSeries framework.

**IEC Memory Allocation**

The memory used by an IEC application is divided into 4 areas (see Figure 2–5):

- **FLASH**: IEC Startup
- **RAM**: Application Program (fixed 64KB block)
- **RAM**: Directly Represented Variables (%Mx)
- **RAM**: Static Variables (1536 bytes)

**Common Elements**

When programming with any language, an understanding of the common elements such as data types and variables is helpful. The presented information assumes that the programmer already has a basic understanding of IEC elements and is presented only for reference.

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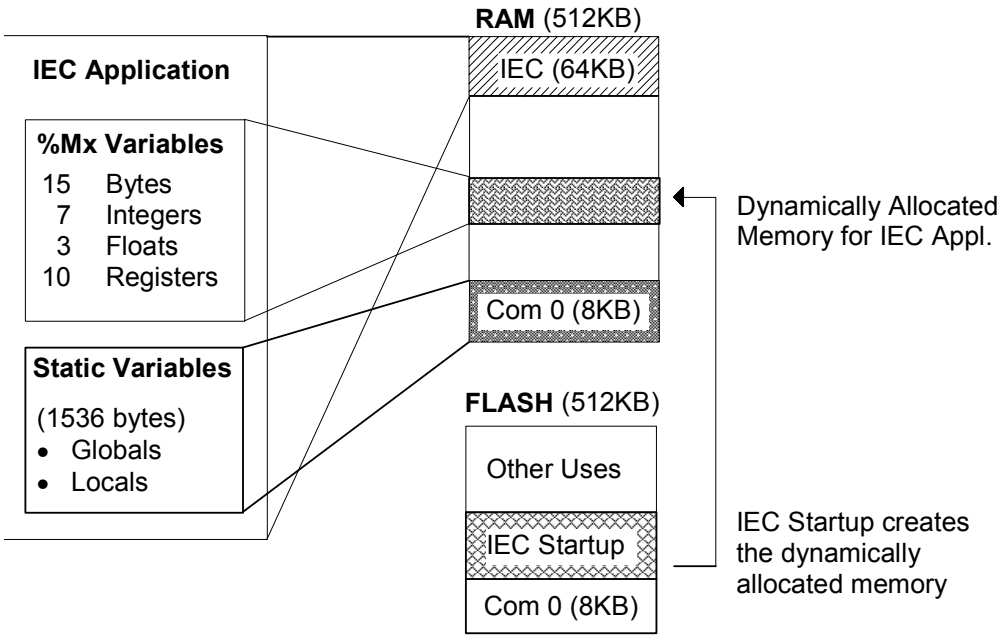


**Figure 2–5 IEC 1131 Memory Allocation Map**

**Load Sequence**

When an IEC application is initially run (COLD or WARM boot) a startup section of code residing in FLASH dynamically allocates the required memory in a section of RAM. The IEC application is loaded into a fixed 64KB block of RAM, by the IEC Loader. IEC variables will reside here.

For more information on how IEC application variables are affected by a Cold or Warm start, see the section in this chapter by the name of “IEC Variables”.

**IEC Data**

IEC recognizes may different types of data. These may be classified into 4 groups:

- INTEGER data for counts and identities
- REAL Numbers (Floating Point data) for arithmetic computations
- TIME (and date) for timing and managing batch systems
- STRING data for logical operations, holding text information, and Booleans for logical operations

A discussion of each data type may be found in the section called “IEC Data Types”.

*Continued on Next Page*

**IEC Variables**

The IEC application functions with two types of variables:

- %Mx Variables, Where x represents:
  - D for DINT, UDINT or REAL types
  - B for BYTE types
  - W for INT types
  - x for Boolean
- Static Variables, that may be further defined as either Globals or Locals.

A discussion of these variables may be found in the section called “IEC Variables”.

**IEC Register ID**

When writing an IEC-61131 application, the user will need to convert the Totalflow Register Address (APP.ARRAY.REG) into a IEC compatible Register ID. For an explanation of the Totalflow Register Address, see Totalflow Register Addressing previously in this chapter. The IEC Register ID is defined as a UDINT (Unsigned Double Integer) or a 32 Bit Address, defined below in Figure 2–6.

In Figure 2–5, we have allowed for ‘10 Registers’. These ten memory locations (32-bits each) are formatted to hold APP/ARRAY/REGISTER address information. These ‘registers’ are identified within the IEC environment by being declared with the prefix %MD0.0.x, a pointer to system memory. For more information, see “Chapter 4, Tutorial, More Information”.

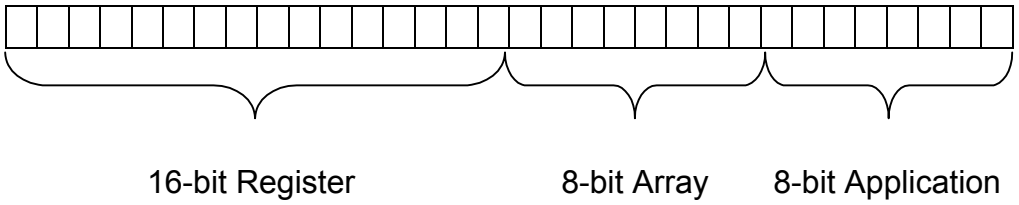


**Figure 2–6 IEC Register ID (32 Bit)**

There are several functions that will handle some of this conversion for the programmer:

- VCB2num: convert 3 integers (APP,ARRAY,REG (index)) into Register ID.
- Num2APP: convert Register ID into Integer , Application
- Num2ARR: convert Register ID into Integer, Array
- Num2REG: convert Register ID into Integer, Register Index

## IEC DATA Types

As mentioned previously, the 4 types of data are used in a comprehensive range of industrial applications. Specifically these data types may be used in IEC applications functioning in a Totalflow host.

**Integer Types** Integer types may be defined in many different ways (see Table 2–1).

**Table 2–1 Integer Types**

| IEC Data Type | Description | Bits | Range |
|---|---|---|---|
| SINT | Short Integer | 8 | -128 to +127 |
| INT | Integer | 16 | -32768 to 32767 |
| DINT | Double Integer | 32 | $-2^{31}$ to $+2^{31}-1$ |
| LINT[1] | Long Integer | 64 | $-2^{63}$ to $+2^{63}-1$ |
| USINT | Unsigned Short Integer | 8 | 0 to 255 |
| UINT | Unsigned Integer | 16 | 0 to $2^{16}-1$ |
| UDINT | Unsigned Double Integer | 32 | 0 to $2^{31}-1$ |
| ULINT[1] | Unsigned Long Integer | 64 | 0 to $2^{64}-1$ |

**REAL Data** REAL data types are used to store floating point values. These may be either positive or negative and may also represent fractional values (see Table 2–2).

**Table 2–2 Real Data Types**

| IEC Data Type | Description | Bits | Range |
|---|---|---|---|
| REAL | Real Numbers | 32 | $\pm 10^{\pm 38}$ |
| LREAL[1] | Long Real Numbers | 64 | $\pm 10^{\pm 308}$ |

**TIME Data** This data may be defined in two separate ways: Duration and Literal. Duration being a period of time, as in how long a process should last, or how long before the process is begun. Literal Time data reflects a specific date or hour that something occurred or is scheduled to occur.

**STRING Data** String data may be used for character strings representing messages, identities or information being communicated. When expressed as a literal, control characters may be embedded to send non-printable commands to equipment (see Table 2–3).

Bit strings may be used for storing binary information. Boolean data has two states: True (on) or False (Off).

*Continued on Next Page*

[1] Not available on XSeries equipment.

**Table 2–3 Bit String Data Types**

| IEC Data Type | Description | Bits | Usage |
|---|---|---|---|
| BOOL | Bit String of 1 Bit | 1 | Digital, logical States |
| BYTE | Bit String of 8 Bits | 8 | Binary Information |
| WORD | Bit String of 16 Bits | 16 | Binary Information |
| DWORD | Bit String of 32 Bits | 21 | Binary Information |
| LWORD[2] | Bit String of 64 Bits | 64 | Binary Information |

## IEC Variables

To explain the importance of how an IEC Variable should be defined requires a brief discussion of the file storage structure on the XSeries Board.

**How it all Works**

When the XSeries equipment is running it may be necessary at certain times to perform either a “Cold Start” or a “Warm Start”. In most instances, a “Warm Start” is preferable, as it does not remove power to the RDRIVE, and should correct most instances of memory corruption. Less frequently should it be necessary to perform a “Cold Start”, which does remove power to the RDRIVE, thus loosing it’s contents. In these instances, you should take precautionary steps as outlined in the XSeries Manuals[3] to Collect Data and Save Station Files.

**FYI**

The values for IEC variables are held within either the IEC.cfg file or the IECglo.cfg file on the RDRIVE. These files are saved and restored with the PCCU32 “Save Station Files” and “Restore Station Files” operations.

**Warm Start**

Any variable whose value is required to be retained after a warm start must be specified as either ‘VAR_RETAIN’ or ‘VAR_GLOBAL_RETAIN’. See IEC reference for details.

Any Constant whose value is required to be retained after a warm start must be specified as either ‘VAR_CONSTANT_RETAIN’ or ‘VAR_GLOBAL_CONSTANT_RETAIN’. See IEC reference for details.

To ensure that the current values of variables are saved for a warm start the IEC application must periodically call function SCBACKUPGLOBALS.

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[2] Not available on XSeries equipment.

[3] See Appendix B, Totalflow Reference Materials.

**Cold Start**

Any variable whose value is required to be retained after a cold start must be specified as 'VAR_GLOBAL_RETAIN' and they may also be addressed as '%Mx0.0.n' variables with x as one of the following:

- D for UDINT or REAL types
- B for BYTE types
- W for INT or UINT types

And n being any value starting with 0. See IEC reference for details.

**TIP** 

Note that types LINT, ULINT, LREAL and LWORD are not supported.

If necessary for a variable to be set to a particular value on Cold Start, the IEC application must use the function SCCOLDSTARTGET to determine if a cold start has occurred and then call SCCOLDSTARTSET to reset the cold start flag.

**Arrays**

Within the IEC application, several array's can be used to read/write the values of IEC variables. In table 2–4, each array number and usage is shown.

**Table 2–4 Variable Array Descriptions**

| Array | Description | IEC Type |
|---|---|---|
| 0 | %MX Variables: Boolean | Bool |
| 1 | %MB Variables: Signed Character | SINT |
| 2 | %MB Variables: Unsigned Character | USINT |
| 3 | %MW Variables: Signed Integer | INT |
| 4 | %MW Variables: Unsigned Integer | UINT |
| 5 | %MD Variables: Singed Long | DINT |
| 7 | %MD Variables: Float | REAL |
| 10 | %MD Variables: Registers | UDINT |
| 101 | Static Variables: Real | REAL |
| 102 | Static Variables: Double Word | DINT |
| 103 | Static Variables: Boolean | BOOL |
| 105 | Static Variables: Integer | SINT |
| 106 | Static Variables: Unsigned Integer | USINT |
| 107 | Static Variables: Word | WORD |
| 108 | Static Variables: String | STRING |
| 109 | Static Variables: Singed Integer | INT |
| 110 | Static Variables: Double Integer | DINT |
| 111 | Static Variables: Unsigned Integer | UINT |
| 112 | Static Variables: Time | TIME |
| 113 | Static Variables: Character | BYTE |
| 114 | Static Variables: Unsigned Double Integer | UDINT |
| 130 | First array of array variables. | |

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**Special Arrays**

Within the IEC application, several array's hold special significance. In Table 2–5, each array number, usage and length is shown.

**Table 2–5 Special Arrays**

| Array | Description | Length |
|---|---|---|
| 255 | Array Size | Valid Arrays |
| 254 | IEC Controls | 5 |
| 253 | Array Width | Valid Arrays |
| 252 | Array Type | Valid Arrays |
| 251 | IEC Task Intervals (ms) | 0->num of tasks |
| 250 | IEC Task Event Status (Run/Standby) | 0->num of tasks |

**Array 255**

Within the IEC application, array 255 holds the number of various data types used in each of the other arrays. Shown in Table 2–6, it's REG indices (2, 3, 7, 10 & 255) hold the information is necessary for allocating sufficient memory for the IEC application. Furthermore, the REG indices of Array 255 are also the array number for that particular data type. That is, REG Index 2 of the IEC application holds the 15 bytes. REG Index 3 holds the 7 integer variables. REG Index 7 holds the 3 floating point variables. REG Index 10 holds the 10 'register' variables and REG Index 255 holds any array variables (in this example there were no arrays declared).

As shown in Figure 2–7, REG Index 253 returns the number of %M arrays. Furthermore, REG Index 252 returns the number of Static arrays in use, REG Index 255 returns the number of total arrays in use (253+252), REG Index 251 returns the number of timer driven tasks, and REG Index 250 returns the number of event driven tasks.

**Table 2–6 Array #255**

| REG Index | Number of | used by IEC Application |
|---|---|---|
| 2 | Bytes | 15 |
| 3 | Integers | 7 |
| 7 | Floats | 3 |
| 10 | Registers | 10 |
| 255 | Arrays | 0 |

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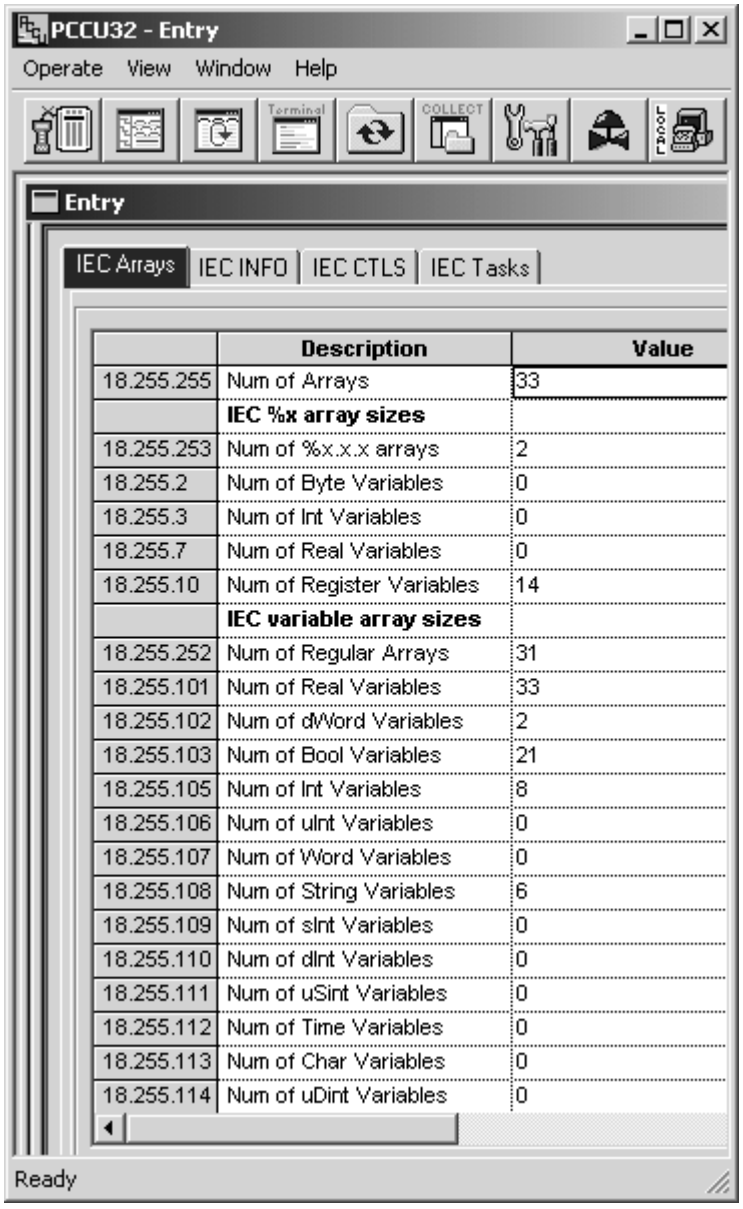


| | Description | Value |
|---|---|---|
| 18.255.255 | Num of Arrays | 33 |
| | **IEC %x array sizes** | |
| 18.255.253 | Num of %x.x.x arrays | 2 |
| 18.255.2 | Num of Byte Variables | 0 |
| 18.255.3 | Num of Int Variables | 0 |
| 18.255.7 | Num of Real Variables | 0 |
| 18.255.10 | Num of Register Variables | 14 |
| | **IEC variable array sizes** | |
| 18.255.252 | Num of Regular Arrays | 31 |
| 18.255.101 | Num of Real Variables | 33 |
| 18.255.102 | Num of dWord Variables | 2 |
| 18.255.103 | Num of Bool Variables | 21 |
| 18.255.105 | Num of Int Variables | 8 |
| 18.255.106 | Num of uInt Variables | 0 |
| 18.255.107 | Num of Word Variables | 0 |
| 18.255.108 | Num of String Variables | 6 |
| 18.255.109 | Num of sInt Variables | 0 |
| 18.255.110 | Num of dInt Variables | 0 |
| 18.255.111 | Num of uSint Variables | 0 |
| 18.255.112 | Num of Time Variables | 0 |
| 18.255.113 | Num of Char Variables | 0 |
| 18.255.114 | Num of uDint Variables | 0 |

**Figure 2–7 Array 255, IEC Arrays**

**Array 254**

Array 254, IEC Controls (see Figure 2–8), functions as the control panel for internal functions. REG Index 0 (internal use only) is used to Hold/Run the IEC task for downloading, REG Index 1 (internal use only) is used to wipe out the IEC checksum, REG Index 2 is used to request the IEC variables be saved for warm start and REG Index 3 is used to indicate a COLD start has occurred. The flag should be cleared by the IEC task when the cold start is handled. Register Index 4 (internal use only) indicates if the IEC tasks have been initiated.

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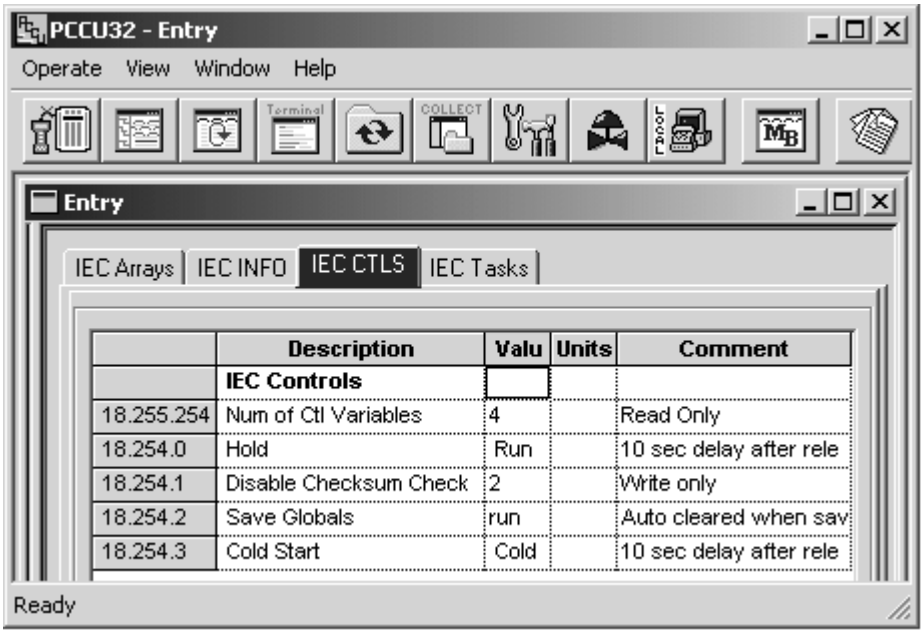


**Figure 2–8 Array 254, IEC Controls**

**Array 253** Array 253, IEC Array Width (see Figure 2–9), contains the width or space required for the variables in other arrays.

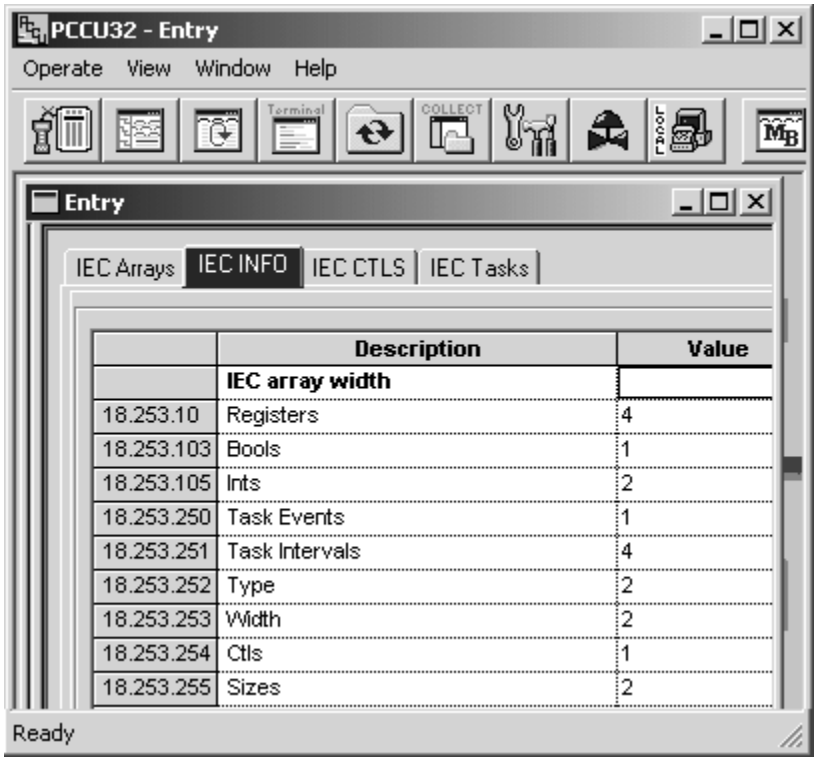


**Figure 2–9 Array 253, IEC Array Width**

**Array 252** Array 252 IEC Array Type (see Figure 2–10), contains the data types of the variables used in each of the other arrays.

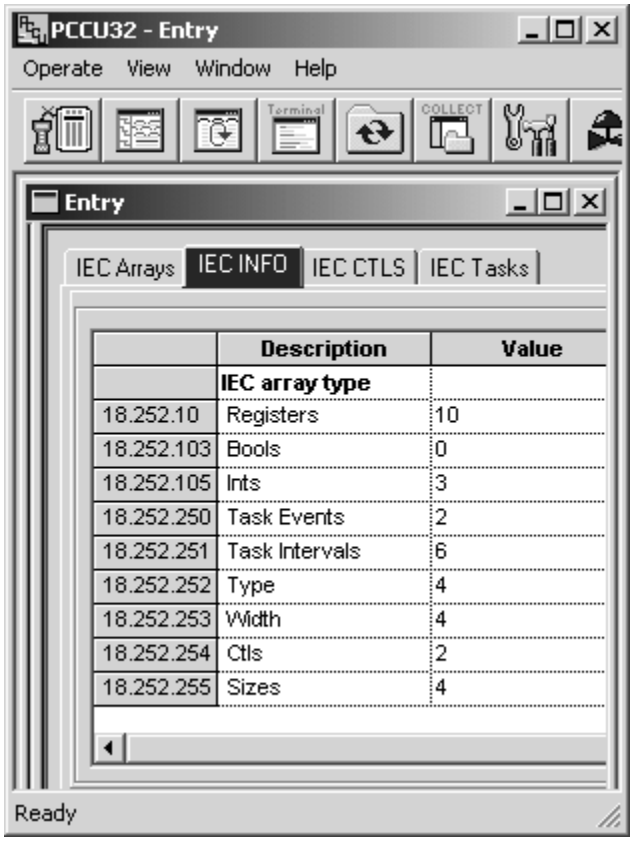


**Figure 2–10 Array 252, Array Type**

**Array 251** Array 251, IEC Task Intervals (see Figure 2–11), contains the task interval (ms) used by each IEC task (sub-task).

**Array 250** Array 250, IEC Task Run Flags (see Figure 2–11), contains the run of event value (Run/Standby) used by each IEC task (sub-task).

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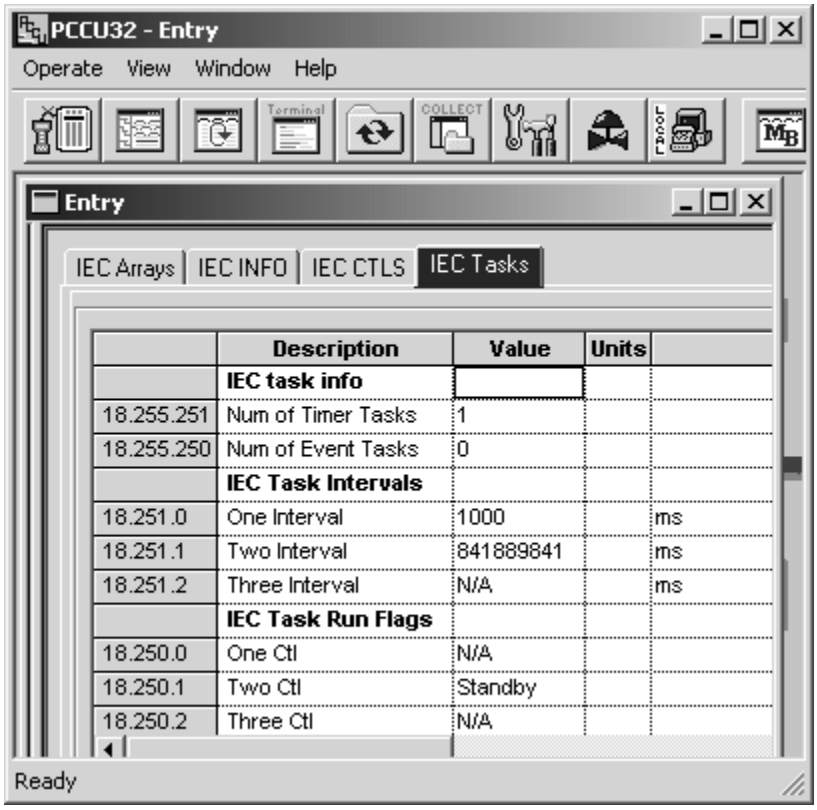


**Figure 2–11 Arrays 251 and 250**

# Chapter 3
# Building an IEC Application for Totalflow

## The Environments

The complete build environment consists of two folders and their subfolders. The ‘’IAR’ folder, shown in Figure 3–1(the IAR build environment) and the ‘IEC’ folder, shown in Figure 3–2 (the Softing build environment).

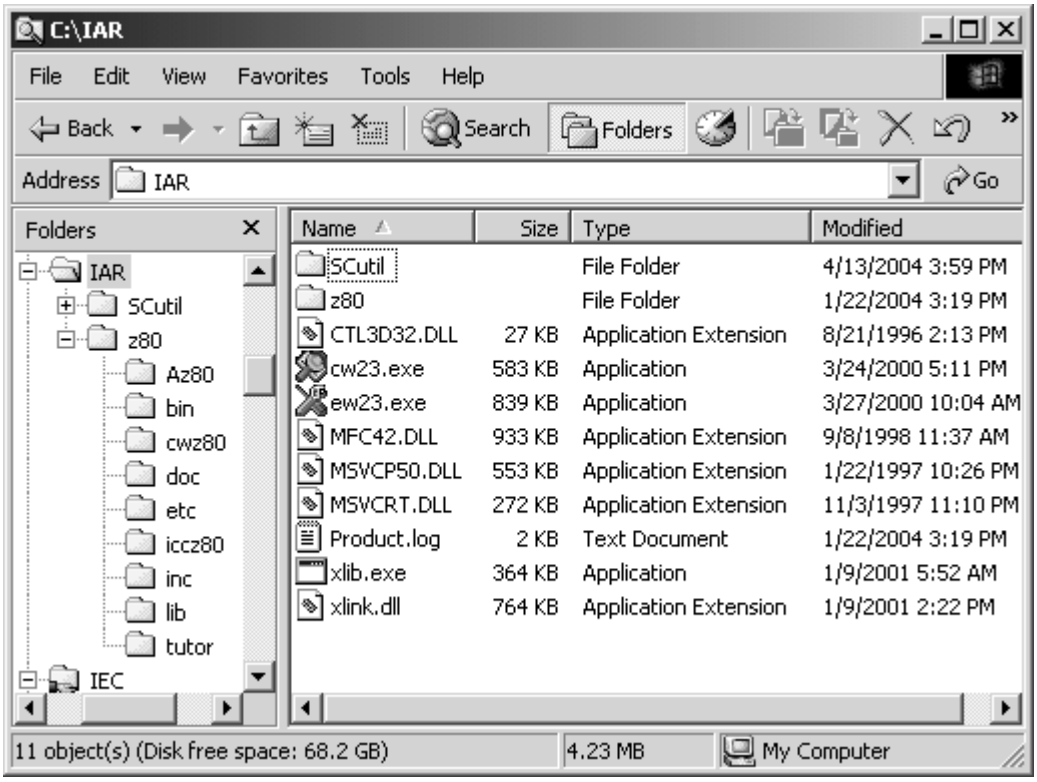


**Figure 3–1 IAR Build Environment**

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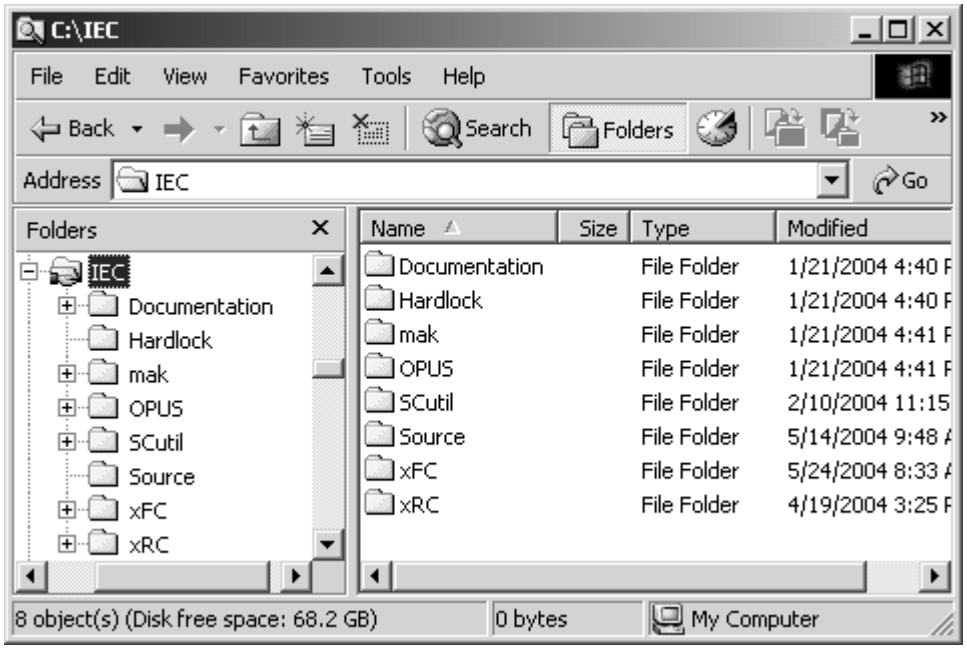


**Figure 3–2 IEC Softing Environment**

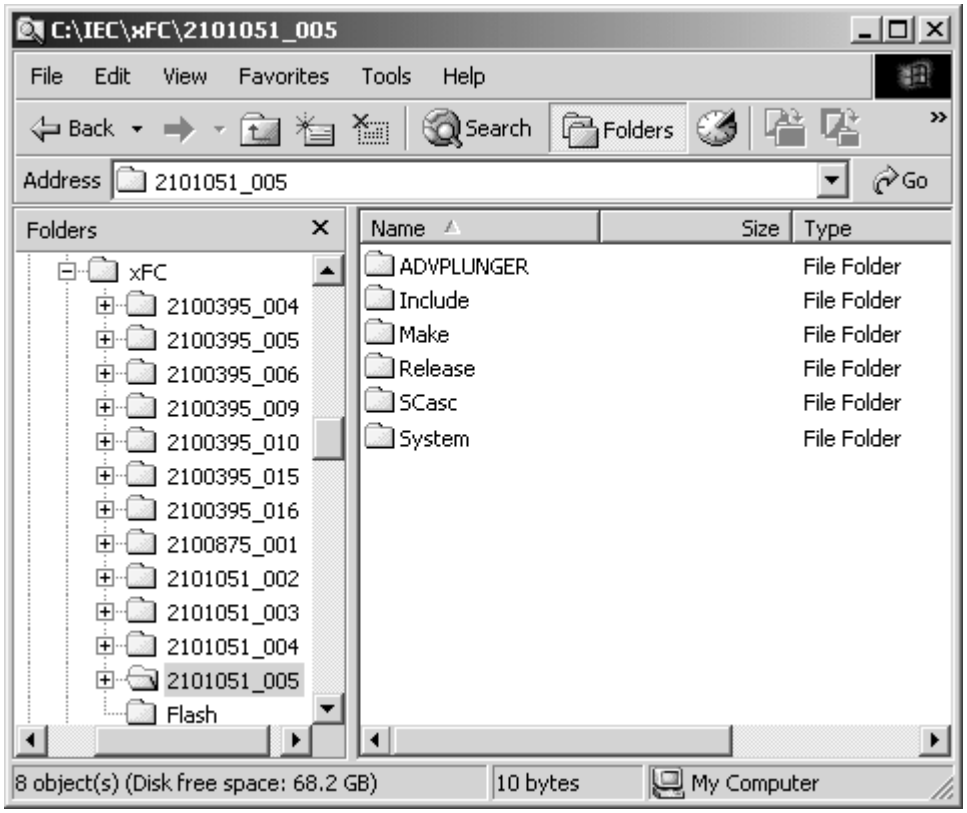


**Figure 3–3 IEC Subfolders**

**Table 3–1 IEC Subfolders, XFC and XRC**

| Folder | Contents |
|---|---|
| ADVPLUNGER | Project folder (Sample only, not included with software). |
| Include | Holds all the project header files (.h). |
| Make | Totalflow utility to generate INI files and APP file. |
| Release | The final project .bin file output is placed here.<br>i.e. LevelMaster_FCU.bin |
| Release\Lib | Project and Softing libraries are held in this folder.<br>(i.e. LevelMaster.r01, SCenoLib.r01, System.r01, etc.) |
| Release\Obj | Individual project relocatable object modules are held here. (i.e. _1plunge.r01, _valvecl.r01, etc.) |
| SCasc | Description of libraries and calling conventions. |
| System | This folder holds XFC/XRC target .s01 and SCregAccess.c. These files provide linkage between the IEC application and the target XFC or XRC. |

## Building the Application

**General Process**

In general terms the build process proceeds in this manner.

- Development of an IEC POU (Program Organization Unit) Application
- Building the IEC application using the SoftCONTROL Build environment.
- Flashing the target platform

**Development**

The IEC-61131-3 application is developed within Softing's softCONTROL development environment.

- The application can be developed using any one, or a combination, of the languages provided.
- The Totalflow library of access operations must be included.
- Softing refers to each program or function, as a POU or Program Organization Unit.
- POUs can call one another, although recursion (a POU calling itself) is not supported.

**Building**

After developing the application, you will want to 'Build' the application. The 'Build' function in the SoftCONTROL environment starts a series of processes (makefiles, compilers, linkers, special utilities, etc.).

- The SoftCONTROL IEC compiler will generate C source files for each POU in the project. SoftCONTROL will name the generated C source files using the format _XXXXXXX.c, where XXXXXXX represents the first seven characters in the original POU's name.

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**Building,** Cont.

- The make process invokes a Totalflow utility that uses the comment portion of each variable to create a Totalflow .ini file and the Totalflow.app file which represents the register map of the IEC application.
  - This utility uses the comments defined for the app/project (see Figure 3–4) to determine the name of the newly created .ini file. The comment of the Project contains the name for the .ini file being generated for PCCU32. The .ini filename is a maximum of 15 characters long (i.e. 21000796-007 or C000130-001 or plungersim-001) and must contain valid filename characters.
  - The final .ini file, in this example plungersim-001.ini, is used by PCCU32 to build a display window within PCCU32 to support the IEC application and its data.
  - The final .app file may be imported into the template editor to define the register map for this application to WinCCU.
  - Tabs will be provided in the IEC window based on the data type of the IEC variables (i.e. BOOL, REAL, UDINT, etc.). If the displayed IEC data is not formatted to the user's requirements, the .ini file can be hand edited to produce an appropriate customized IEC screen in PCCU32. This .ini file must be included in the PCCU32 \IniFiles folder for PCCU32 to find and invoke it.

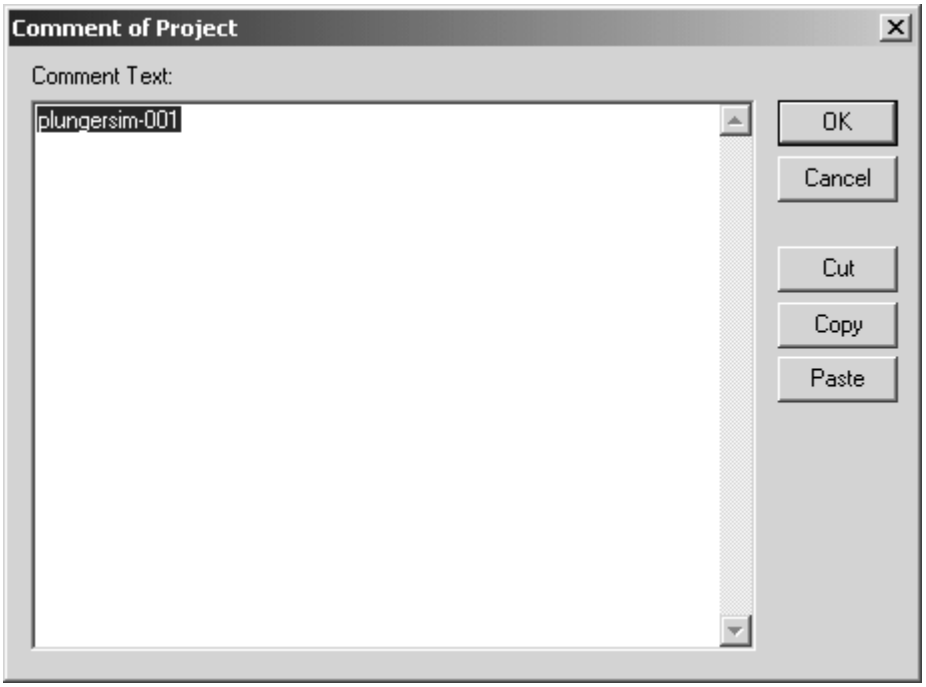


**Figure 3–4 Project Comments**

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## Building the Application, Continued

**Building,** Cont.

- Next, the makefile will invoke the IAR tools to compile and link the C source files with the appropriate libraries. These libraries need to include Totalflow libraries to support the particular target platform (XFC, XRC).
  - The IAR tools will produce .r01 (relocatable object modules) files and save them in the \Release\Obj folder.
  - The IAR linker will link these individual object modules (one for each POU) into .r01 libraries and save them in the \Release\Lib folder.
- A second link process will combine these libraries into a single binary (.bin) file for the IEC loader. This process brings in information from the appropriate .s01 (i.e. 2101051-003.s01) file containing target link mapping and checksum.
  - The .s01 file is initially generated during the build process of the Host Software (FLASH) XFC or XRC. This file, specific to your product's software revision, must be obtained from ABB Totalflow before any IEC applications can be built for download to your target device.
  - The .s01 file ties the IEC application and the Host (XRC or XFC) software together. The IEC application and the Host must share the same memory mapping and checksum information. The .s01 file accomplishes this task.
  - Before downloading an IEC application, the IEC loader compares the Host's FLASH checksum to the one in this .s01 file. If they are the same the IEC loader will proceed. If they differ the IEC loader will abort the download.
- SCregAccess is included in this process and contains the function prototypes for several functions required by the Totalflow XSeries equipment for internal register access (i.e. GetRegF and SetRegF).
- A separate Softing project folder will be required for each Host FLASH build.
  - Softing project files can be imported and exported in an ASCII format. The filename takes the form- projectname.ASC
- The output (.bin) file is the file that will be downloaded from the local port to the target platform (XFC/XRC) with the IEC loader. The IEC loader is provided with PCCU32.
- The IEC compiler generates a file "myproject.h" that contains the size definitions for each array of %Mx variables. This file is used in the C program file "PLCcustomInit.c" which runs at IEC task initialize time. IEC tasks are initialized after warm start, cold start, or after hold (app.254.0) is released. The PLCcustomInit file is copied from the directory "C:\IEC\mak\EMPTYPRJ" each time a new project is created.

**Loading**

- Using the FLASH loader included with WinCCU/PCCU, load the appropriate FLASH image, if a new FLASH is required, into your target system (XFC, XRC).
- With PCCU32, instantiate an IEC application: Under the Application Tab, select drop-menu located at position 18 (default IEC location), move down the list to IEC and select it. Send the data to the XFC, a reconnect will be automatically required, returning you to the previous position.
- Assume that a project has been built, or imported, consistent with all the rules of Softing.
  - Newly imported projects may require a library update (Project -> Update Libraries) prior to building.

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**Loading,** Cont.

- If a new file has been added to your project that replaces the functionality of a previous file, it may be necessary to delete the older xxx.r01 and _xxx.c. The make process does not delete unused relocatable modules (.r01 files). Failing to do this may result in conflicting variable names. It may be simplest to delete the user relocatable object modules (xxx.r01) in Release\Obj and all of the _xxx.c files in your project folder. Make files within the project folder must also be deleted.


Do not remove ‘make’ related files in the MAKE folder.

- Check that a new xxx.bin has been generated in your Release folder.

- Using the IEC Loader received with WinCCU/PCCU, Select the appropriate .bin file from the Release folder and download it to your target. The build process names the .bin after the project name.
- A copy of the project’s .ini must be included in the PCCU32\IniFiles folder for PCCU32 to be able to pickup the IEC data fields. This .ini can be hand modified to produce custom PCCU32 screens for the IEC application.
- The download is an automated (not user controlled) four step process.

1. FLASH checksum check to determine that the target (XFC/XRC) is an appropriate target device. Abort the download if the checksums are incompatible.
2. Halt any current IEC application
3. Download the new IEC application
4. Restart the new IEC application

- At this point the new IEC application is up and running in the host.

## Building the IEC Application Template

For each application that is built through the IEC development environment, a device template application file is generated in the PCCU32\IniFiles directory. In general, this file will contain the arrays shown in Table 3–2. This file is named xxxxxxxx.app where xxxxxxxx is the revision entered into the project comment field.

This .app file may be used in the WinCCU/PCCU Template Editor to enter the register map for the IEC application.

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**Table 3–2 IEC Register Access Array Numbers**

| IEC Type | X-Series Type | Array |
|---|---|---|
| TYPE_REAL | RegTypeFLOAT | 101 |
| TYPE_COUNT | RegTypeULONG | 102 |
| TYPE_BOOL | RegTypeBOOL | 103 |
| TYPE_INT | RegTypeSINT | 105 |
| TYPE_UINT | RegTypeUINT | 106 |
| TYPE_WORD | RegTypeUINT | 107 |
| TYPE_STRING | RegTypeSTRING | 108 |
| TYPE_SINT | RegTypeSCHAR | 109 |
| TYPE_DINT | RegTypeSLONG | 110 |
| TYPE_USINT | RegTypeUCHAR | 111 |
| TYPE_TIME | RegTypeULONG | 112 |
| TYPE_DATE | RegTypeULONG | 112 |
| TYPE_TOD | RegTypeULONG | 112 |
| TYPE_DT | RegTypeULONG | 112 |
| TYPE_CHR | RegTypeUCHAR | 113 |
| TYPE_BYTE | RegTypeUCHAR | 113 |
| TYPE_ENUM | RegTypeUCHAR | 113 |
| TYPE_UDINT | RegTypeULONG | 114 |
| TYPE_DWORD | RegTypeULONG | 114 |
| TYPE_NOT_VALID | RegTypeINVALID | 0 |
| TYPE_LINT | RegTypeINVALID | 0 |
| TYPE_ULINT | RegTypeINVALID | 0 |
| TYPE_LANA | RegTypeINVALID | 0 |
| TYPE_LREAL | RegTypeINVALID | 0 |
| TYPE_DTI | RegTypeINVALID | 0 |
| TYPE_LWORD | RegTypeINVALID | 0 |
| TYPE_ANY | RegTypeINVALID | 0 |
| TYPE_ANY_NUM | RegTypeINVALID | 0 |
| TYPE_ANY_REAL | RegTypeINVALID | 0 |
| TYPE_ANY_INT | RegTypeINVALID | 0 |
| TYPE_ANY_BIT | RegTypeINVALID | 0 |
| TYPE_ANY_DATE | RegTypeINVALID | 0 |
| TYPE_ANY_INT16 | RegTypeINVALID | 0 |
| TYPE_ANY_INT32 | RegTypeINVALID | 0 |
| TYPE_ANY_SIMPLE | RegTypeINVALID | 0 |
| TYPE_ANY_DUT | RegTypeINVALID | 0 |
| TYPE_ANY_FB | RegTypeINVALID | 0 |
| TYPE_ARRAY | RegTypeINVALID | 0 |
| TYPE_STRUCTURE | RegTypeINVALID | 0 |
| TYPE_INSTANCE | RegTypeINVALID | 0 |
| TYPE_SUBRANGE | RegTypeINVALID | 0 |
| TYPE_DIR_DRV | RegTypeINVALID | 0 |

**Procedure**

| Step | Instructions |
|---|---|
| 1. | From the initial WinCCU/PCCU window, open the Operate menu from the menu bar, select Setup, moving over to the cascading menu, select Device Template Editor. |
| 2. | When the Editor is completely loaded (see Figure 3–5), select the template that needs the IEC register map by clicking the + next to the template. This will open a drop-down list of folders. |
| 3. | Right click on the Applications line. |
| 4. | Left click on Insert from File (see Figure 3–6). |

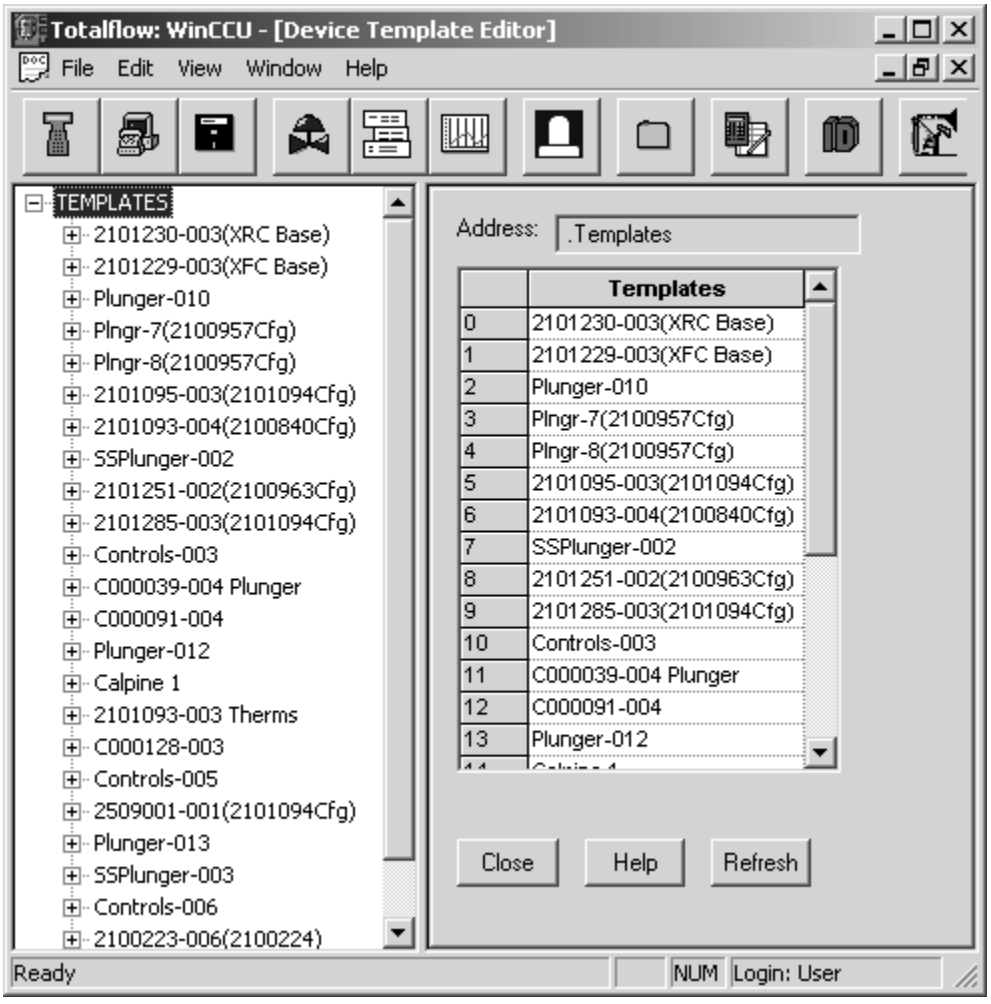


**Figure 3–5 Device Template Editor Screen**

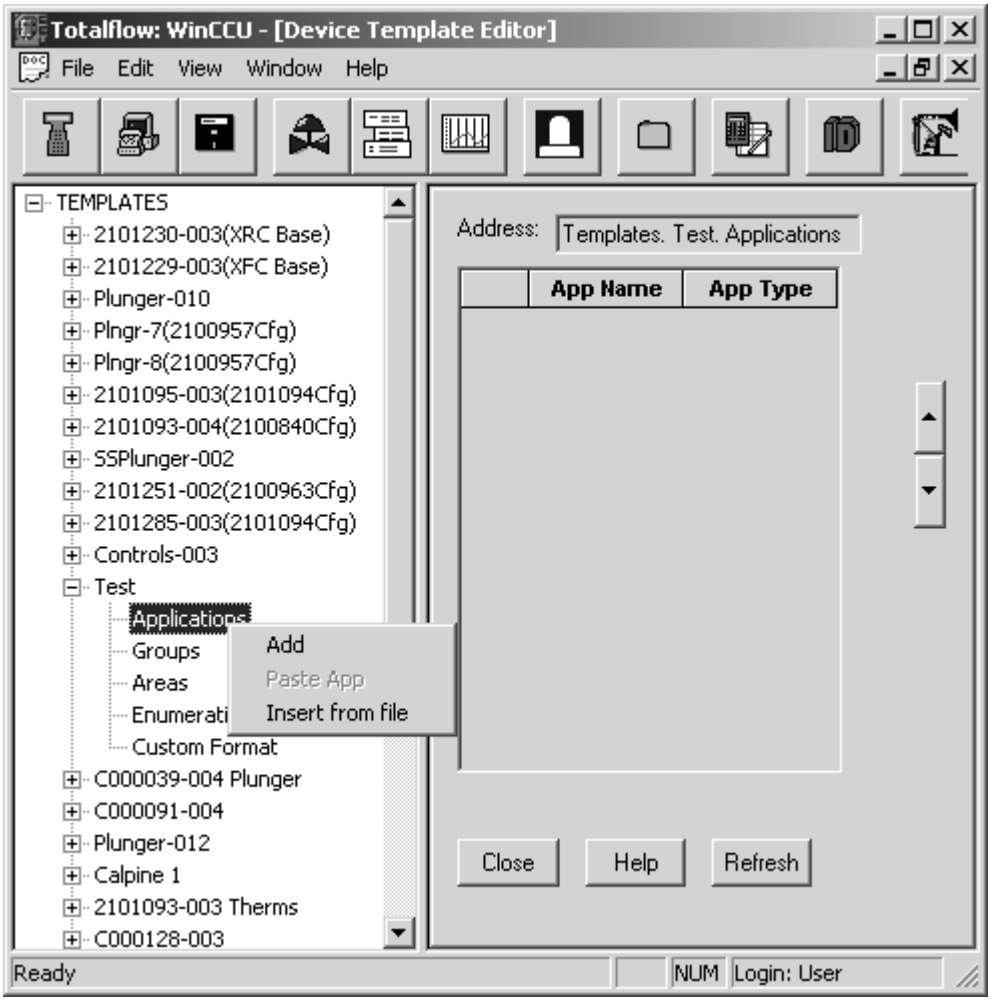


**Figure 3–6 *.App File Insertion Screen(Right Click on Application)**

**Procedure,**
Cont.

| Step | **Instructions,** Cont. |
|---|---|
| 5. | In the Open window, locate and browse the PCCU32\IniFiles directory and select the correct *.app file as shown in Figure 3–7. |
| 6. | Select the file and use the ‘Open’ button. |
| 7. | In the new window shown in Figure 3–8, select IEC(APP_IEC), click OK. The application will be added to the bottom of the list. |
| 8. | You will need to re-open the template just edited. With the Applications label highlighted, locate the application in the scroll list in the right side of the window and click once. |

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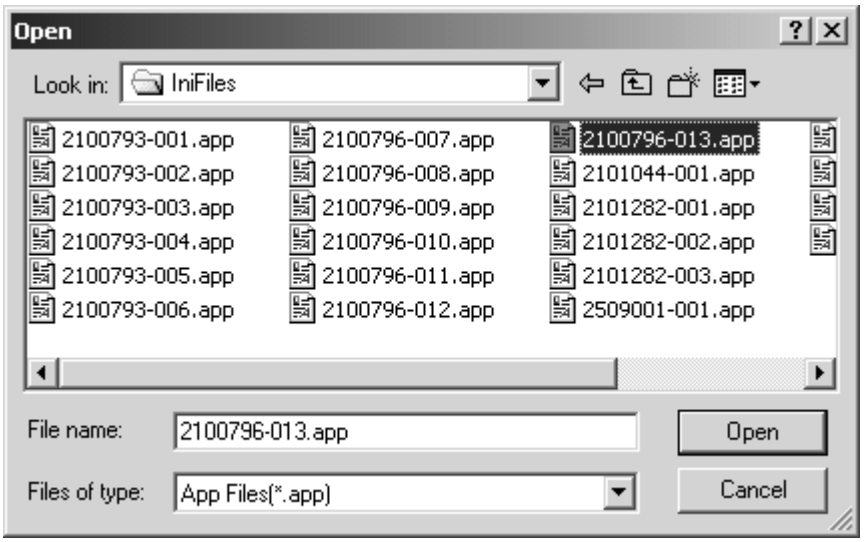


**Figure 3–7 Browse Screen for *.App Selection**

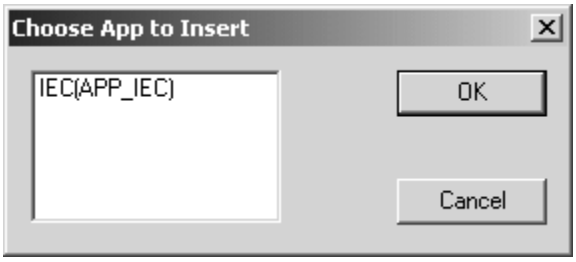


**Figure 3–8 Application Insertion**

**Procedure,**
Cont.

| Step | **Instructions,** Cont. |
|---|---|
| 9. | With the IEC application highlighted, use the spin controls (up/down arrow buttons) on the right side of the screen (shown in Figure 3–9) to move the application up or down the list. Move the IEC application to the position designated when the application was instantiated. Application 18 is the standard position. |
| 10. | To enable the variables for display, you will first need to open the IEC template that you just inserted and moved. Double click the Array (Array 10 in this example) to edit. |

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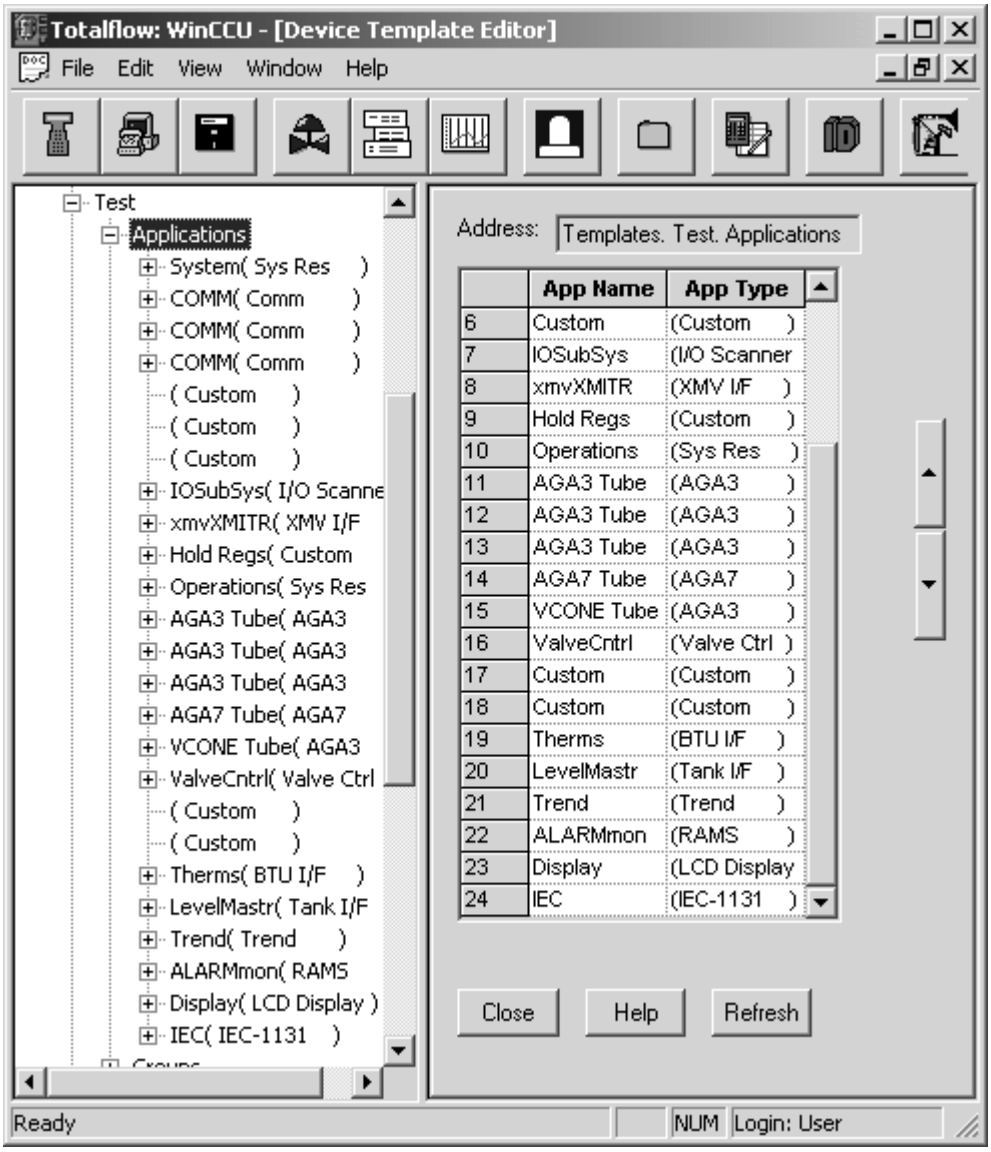


**Figure 3–9 Application, Register Map Added**

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**Procedure,**
Cont.

| Step | **Instructions,** Cont. |
|---|---|
| 11. | In the new Array Edit window shown in Figure 3–10, click the box under the I/F (interface) column to select each variable needed for display. Click OK. |
| 12. | Close the Applications folder. |
| 13. | Right click on the label Groups and select Add. In the new window, shown in Figure 3–11, type the new group name it and click OK. |
| 14. | To edit the new group, open the Groups folder, and double click the new group. |
| 15. | Now you must add the required registers into this new group. This is done by selecting (highlighting) the registers that are to be in the group and using the Modify button shown in the lower portion of the window (see Figure 3–12). |

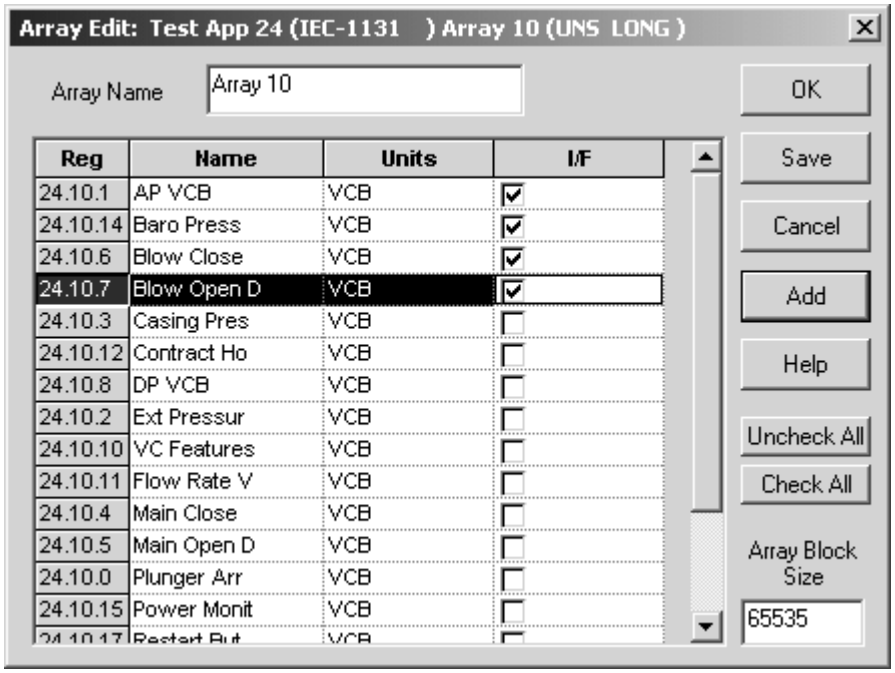


**Figure 3–10 Application Array Edit for Interface with Display Group**

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**Figure 3–11 New Display Group**

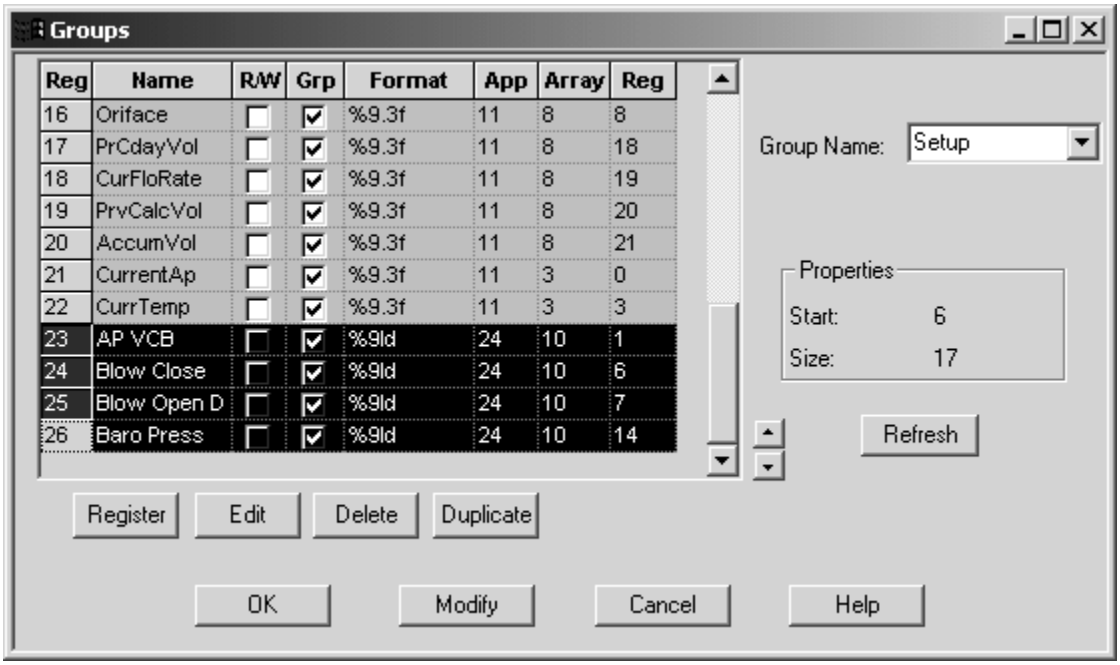


**Figure 3–12 New Group Items**

**Procedure,**
Cont.

| Step | **Instructions,** Cont. |
|---|---|
| 16. | In this window, the highlighted area designates the new items for the new group. Each line may be edited by holding the cursor over the line number (you will se a right facing arrow) and clicking. When the line is highlighted red, click on the desired action: Register, Edit, Delete or Duplicate. When finished, click OK. |

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**Procedure**

| Step | **Instructions,** Cont. |
|---|---|
| 17. | To access the new group data, you will need to create an area for each type of access you will need. To do this, right click on the label Area and select Add. In the new window, type in the new Area name and set the parameters as shown in Figure 3–13. This includes assigning the Type of the Area: Display, Handheld, Spreadsheet or Report. If you select the Type as Display, you may change the period to Refresh the information, set the Display Period, LCD Location, Width, Height and whether to Suppress the Group Name. When finished, click OK. |
| 18. | The final step is to move the Group created in step 14 through 17 into the Area created in step 18. To do this, right click the Area label created in step 18, and select edit. In the new window, Select the Interface Group created from the right side of the window. Click Add. The Group name will appear in the left side of the window under Groups in Area as shown in Figure 3–14. When finished, click OK. |
| 19. | WinCCU Host Console and/or TDS may be used to read the data over the remote communications link. |


**Figure 3–13 Area Parameter Screen**

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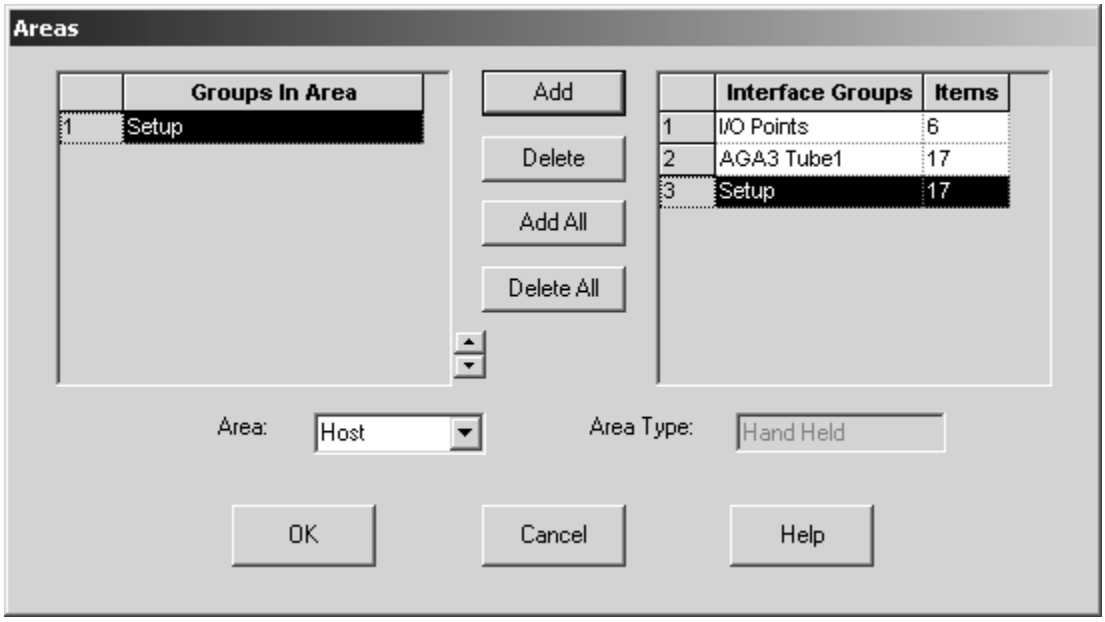


**Figure 3–14 Edit Interface Group Area**

## How to Build or Modify an PCCU32 .INI File

This section contains useful information on how to add or modify the Plungersim-001.ini file to support new commands used by an IEC application. You may refer to the complete listing of the Plungersim-001.ini file shown in Appendix A.

For most situations where an .INI file needs to be modified the user will only need to modify several keywords; **typ, fmt** and **lst**. Tree names, tab names and separators must be added by the user to increase the user friendliness. The other keywords are not generally needed but are included for completeness.

**Background**

- PCCU32 queries the XFC/XRC for each application's .INI file names. These .INI files determine how the PCCU32 screens will be presented and how the data will be displayed to the user.
- Each .INI file specifies how each screen is to be displayed, formatted, read-only, etc.

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**Keywords**

**dsc:** text name for the entry.

**cmd:** local command or register number: 0.9.1 Note: 24.N.4=>N is replaced with App number.

**typ:**

| | |
|---|---|
| S | for string |
| c | for one byte |
| i I | for short ( 2 bytes ) |
| l L | for long ( 4 bytes ) |
| F f | for float |
| e | for one byte enumerated value |
| E | for two bytes enumerated value |
| D | for date/time stamp |
| Z | for comment, displayed |
| B:5 | for bit field (0=lsb) |
| m:0:1 | mask-bits 0 through 1(multiple bit integer) |
| x | hex |

**fmt:** display format (negative size indicates left justify instead of right)

*example:*

| | |
|---|---|
| **fmt:**8.4f; | // for float |
| **fmt:**-10s; | // for string |
| **fmt:**-10.3f; | negative indicates left justify in field width |
| **fmt:**04x; | for hex display |
| **fmt:**5d; | for integer |

**lst:** enumerated list. Description=value,…If no “=value”, the value defaults to 0,1,2,3, …Note: Values of the list are not required to be in any particular order (0,64,32).

*example:*
The plunger status (line 15 in plungersim-001.ini Appendix A) has four values 0,1,2,3 which have text descriptions for a more user friendly display:

**dsc:** Plunger Status;**cmd:**13.105.0;**typ:**E;**lst:** bottom=0,rising=1, falling=2,Top=3;

**lmt:** limit ( low limit\high limit)

*example:*

| | |
|---|---|
| **lmt:**0\23; | contract hour |
| **lmt:**0\100; | percent |

**reread:** causes reconnect when changed.

**rrd:1** Reread screen tab when changed.

**col:3** display in column n.

*Continued on Next Page*

**Keywords,** Cont.

**[name]** name of tab followed by Help number and/or column descriptions

**\{name}** name of tree leaf. Each backslash indicates a lower level of the tree.

**REM** comment not displayed

**unt:** Unit Number:

| | | | |
|---|---|---|---|
| **3:** | SCF/HR | **4:** | PSIA |
| **5:** | In H2O | **6:** | Deg F |
| **7:** | Btu/SC | **8:** | Inches |
| **10:** | Mol % | **16:** | PSIA |

**sir:** show if register: (2 bytes) sir: 12.1.5=1; multiple per line possible.

**dir:** show if register: (4 bytes) use for enumeration or write protect.

**rwa:** command flags. It can be a combination of:

1 read only command
2 write only command
No **rwa** entry – Read/Write

*example:*

**rwa:**1; // read only
**rwa:**4; // show entry if the command is in the command list

**TIP** 

Each keyword data must end in a semicolon (;). Please note the examples shown.

*Continued on Next Page*

**Excerpt from plungersim-001.ini**

```
1.  {IEC61131}
2.
3.  \{Plunger Simulator}
4.
5.  [Current]
    #Columns=4,Description=200,Value=100,Units=75,Comment=100
6.
7.  REM #GLOBALS_PlungerStatus
8.  dsc:Plunger
    Status;cmd:13.105.0;typ:E;lst:Bottom=0,Rising=1,Falling=2,Top=
9.  dsc: ;col:3;typ:Z;rwa:1;
10. dsc: ;col:4;typ:Z;rwa:1;
11.
12. REM #GLOBALS_SimArrived
13. dsc:Sim Plunger Location;cmd:13.103.2;typ:e;lst:Away=0,Arrivec
14. dsc: ;col:3;typ:Z;rwa:1;
15. dsc:Plunger Location;col:4;typ:Z;rwa:1;
16.
17. REM #PlungerSim_SimPlunger_SimPlunger_ArrivedOut
18. dsc:Sim Plunger Arrived;cmd:13.103.16;typ:e;lst:Away=0,Arrivec
19. dsc: ;col:3;typ:Z;rwa:1;
20. dsc:Simulated Plunger Arrived Switch;col:4;typ:Z;rwa:1;
21.
22. REM #PlungerSim_SimPlunger_SimPlunger_PlungerDepth
23. dsc:Plunger Depth;cmd:13.101.27;typ:f;fmt:-10.4f;
24. dsc:ft;col:3;typ:Z;rwa:1;
25. dsc:Current;col:4;typ:Z;rwa:1;
26.
27. REM #GLOBALS_ValvePos
28. dsc:Main Valve position;cmd:13.101.0;typ:f;fmt:-10.4f;
29. dsc:0-1;col:3;typ:Z;rwa:1;
30. dsc:Main Valve Open;col:4;typ:Z;rwa:1;
```

**FYI** 

See Figure 3–15 for the results of these commands when displayed in PCCU32.

**Explanation**

**Line 1:** gives the name for the first tree leaf for this application. [1]

**Line 3:** gives a new leaf under the main tree leaf. [2]

**Line 5:** gives the name of the tab on the first leaf and sets the name and width of each column. [1]

**Lines 22-25:** describe one variable from the loaded IEC application. [1] These lines are generated from the comment associated with this variable (Plunger Depth).

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[1] Automatically generated at IEC compile time

[2] User manually generated

**Explanation,** Cont.

Variable “Plunger Depth” IEC comment:

```
Current|ft|dsc:Plunger Depth;
```

- The first portion of the comment, up to the first vertical bar, is the comment and is displayed in column 4 by the INI command on line 25.
- The second portion, between the two vertical bars, is the unit’s field and is displayed in column 3 by the INI command on line 24.
- The third portion, after the second vertical bar, contains commands to override the compiler defaults and is displayed in column 1 and 2 by the INI command on line 23.
- The variable name and “function” prefix is included on line 22 to uniquely identify this variable for the next time a compile occurs that rebuilds the INI file.
- A comment that starts with a pound sign (#) will cause all of the variable sections (like lines 22-55) to be comments (REM)
- A empty comment will cause an automatically generated variable section to be generated with defaults for keywords: **dsc**, **cmd**, **typ**, and **fmt** .

CAUTION

Any hard changes to the INI file variable sections (lines 22-25) are lost at compile time and must be changed in the IEC variable comment to be retained.

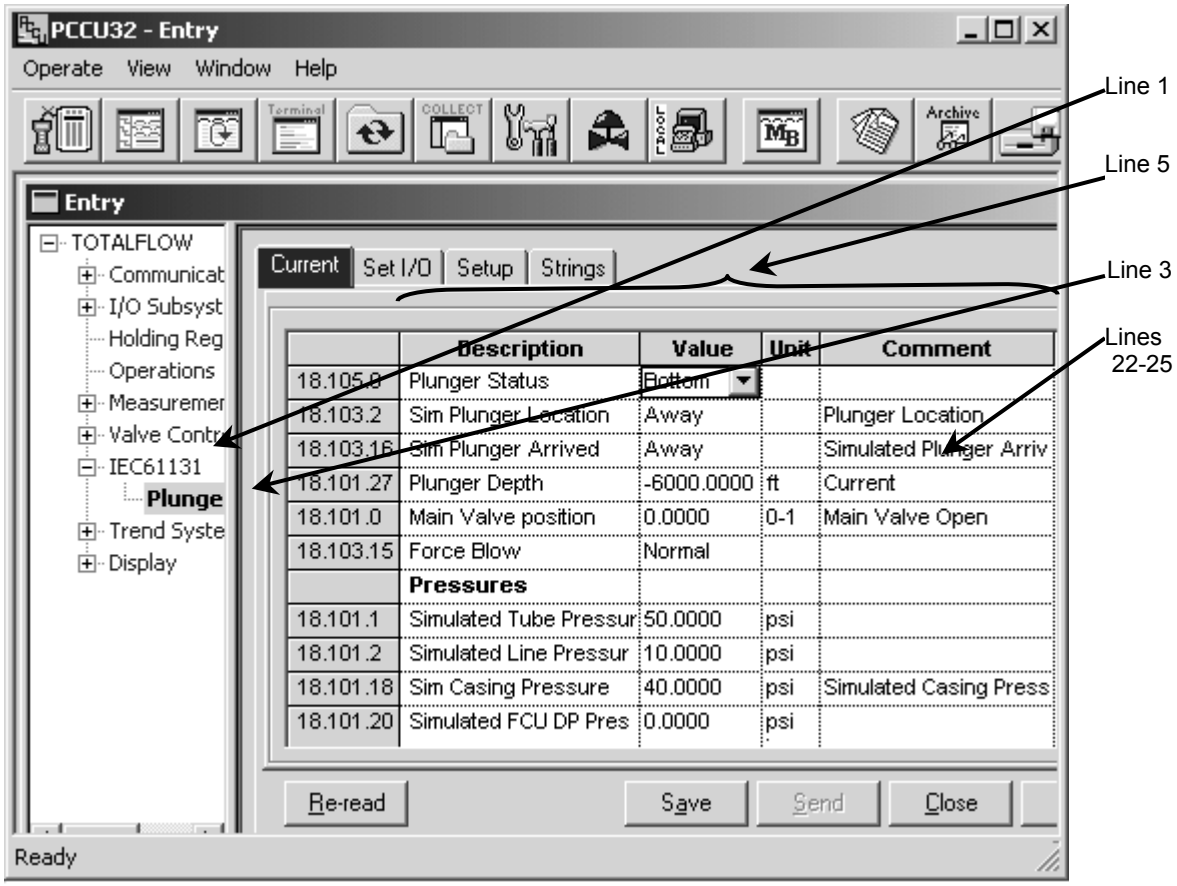


**Figure 3–15 PCCU32 Sample Screen for Plunger Simulator**

**Excerpt from plungersim-001raw.ini**

```
1. {IEC61131}
2.  [Registers]
   #Columns=4,Description=200,Value=100,Units=75,Comment=100
3.
4. REM #GLOBALS_MainOpenDI
5. dsc:Main Valve Open DI;cmd:13.10.0;typ:S;fmt:s;
6. dsc:register;col:3;typ:Z;
7. dsc: ;col:4;typ:Z;
```

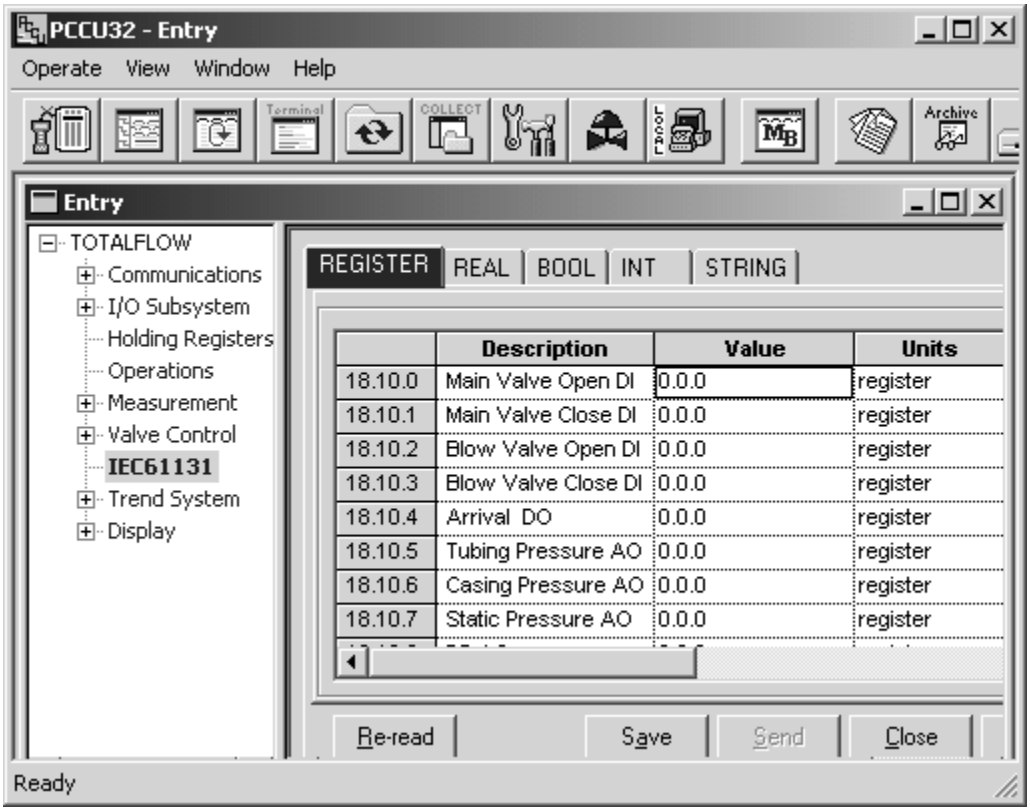


**Figure 3–16 PCCU32 Sample Screen Before Hand Edits**

## On-line Debugging

To configure the PC and XSeries for on-line IEC debugging follow these steps:

- Configure a second serial port (com1/com2) on the XSeries to Totalflow Local and connect to a second serial port on the PC.
- The standard local port is used for IEC downloading, PCCU connection, and flash loading.
- Configure the sc30.ini file to match this configuration.
- When the IEC is running, click the on-line button (looks like a target) and consult the SoftCONTROL manual for further debugging procedures.

## Changing to a New Project

**Procedure**

| Step | Instructions |
|---|---|
| 1. | When changing projects delete object files for other projects: _xxxx*.r01. |
| 2. | Use the IEC compiler to open the project.<br>• If you are redoing from source, delete all of the Tasks, POU's, and global variables, then import. |
| 3. | Edit the project comment to contain the revision number. "sample-001" |
| 4. | Use menu item: Online, "Rebuild All". |
| 5. | If no errors, load into a unit for final test. |
| 6. | Edit all released files to reflect the new version numbers. |

## Upgrading an IEC Application to a new FLASH

**Procedure**

| Step | Instructions |
|---|---|
| 1. | Copy the new flash and map files to IEC/Flash. (*.s01, *.s19) |
| 2. | In "System" directories for each flash type:<br>• Delete old map files(*.s01)<br>• Delete *makefile*.<br>• Copy new map files to:<br>♦ 2101053-xxx.s01 to …\XRC\2101053-xxx\System<br>♦ 2101051-xxx.s01 to …\XFC\2101051-xxx\System |
| 3. | Delete Flash object file 2100xxx.r01 in IEC\xxx\Release\Obj. |
| 4. | Use the IEC compiler to open the project.<br>• If you are redoing from source, delete all of the Tasks, POU's, and global variables, then import the ASCII project file (xxx.asc). |
| 5. | Use menu item: Online, rebuild all. |
| 6. | If no errors, load into a unit for final test. |

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# Chapter 4
# Tutorial

Included with the purchase and installation of the Totalflow IEC Integrated Development Environment, are support files for this tutorial. For the purpose of this tutorial, we will use the Plunger Advanced Simulator.

## Plunger Advance Simulator

**Procedure**

| Step | Instructions |
|---|---|
| 1. | Use the Project Menu to Open the Plunger Advanced Simulator. |
| 2. | Browse down to PlungerAdvSim and click on the Open button, as shown in figure 4–1. |
| 3. | This will open a new screen as shown in figure 4–2. |
| 4. | To update the libraries associated with this project, Open the Project menu from the Menu Bar. |

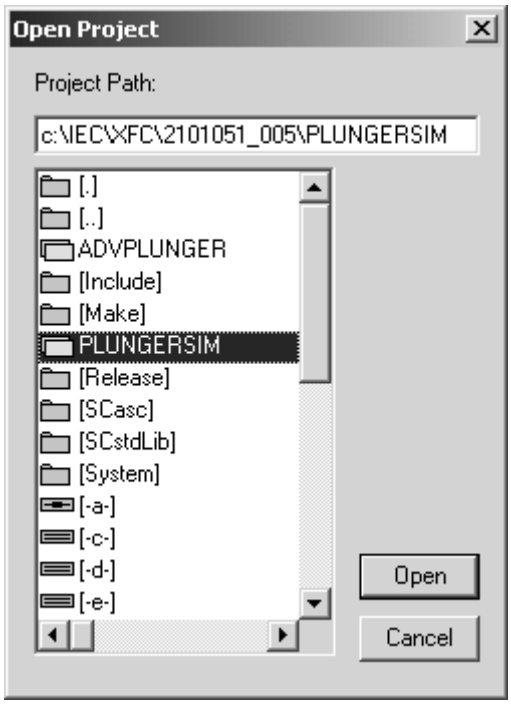


**Figure 4–1 Open Project Screen**

*Continued on Next Page*


**Figure 4–2 Project Navigator Menu**

**Procedure,**
Cont.

| Step | **Instructions,** Continued |
|---|---|
| 5. | Select Update Libraries from this drop-down menu as shown in figure 4–3. |
| 6. | When the Warning box appears, shown in figure 4–4, select Yes. |
| 7. | Following the updating of the libraries, please observe the entries under the POU_Pool in the Project Navigation portion, shown in figure 4–5. By opening the tree view by double clicking the POU. Underneath the POU you will be able to view both the Header and the Body by clicking on your selection. |

*Continued on Next Page*

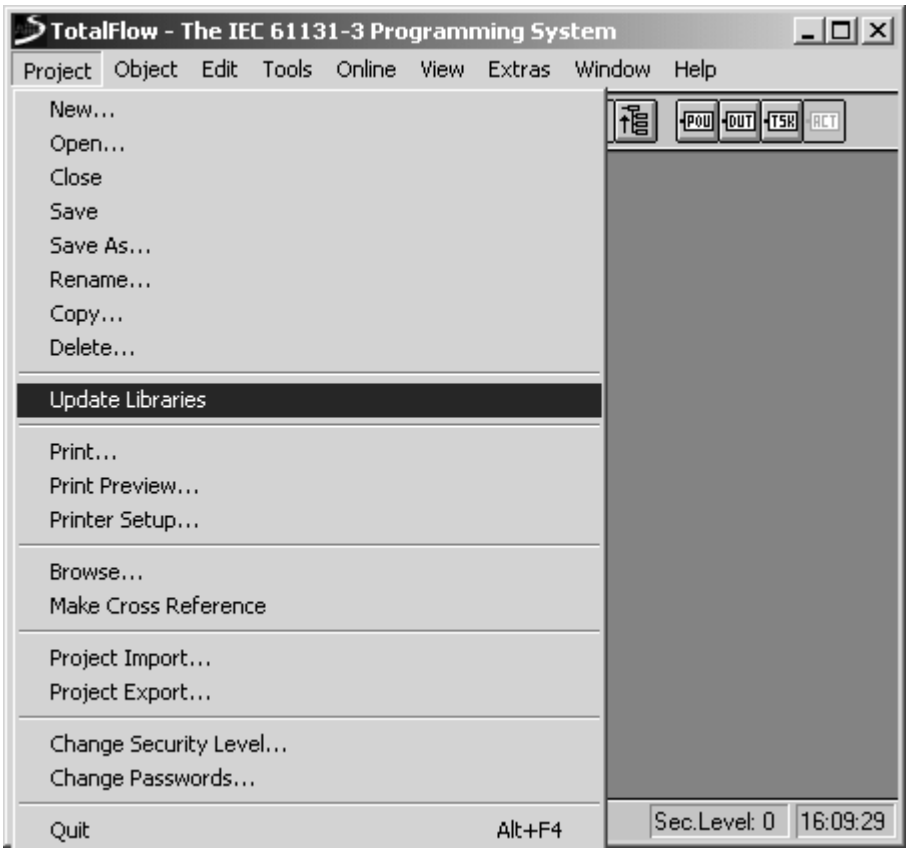


**Figure 4–3 Project Libraries Update Command**

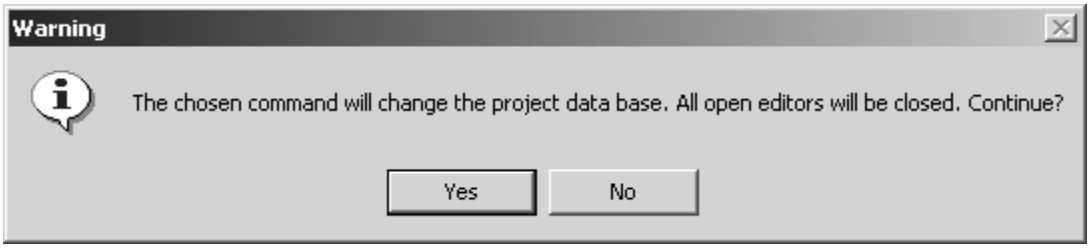


**Figure 4–4 Project Database Change Warning Screen**

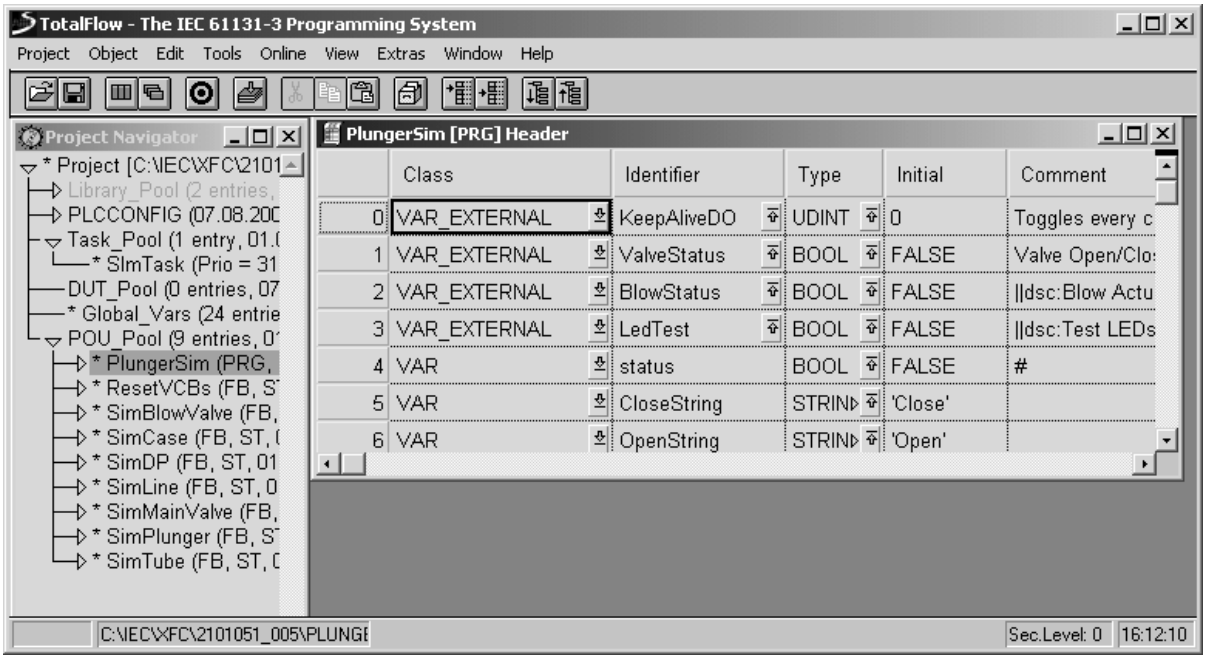


**Figure 4–5 POU Pool Menu**

**Procedure,**
Cont.

| Step | **Instructions,** Continued |
|---|---|
| 8. | In the right side of this window, you will see the list of tasks. Double click the task to open the Task Information screen shown in Figure 4–6. In this display window, you may view and change the Attributes of this task. This tutorial simulates the pressures, production valve, blow valve and plunger arrival in a plunger lift well. Please note this application is run every second. |

*Continued on Next Page*

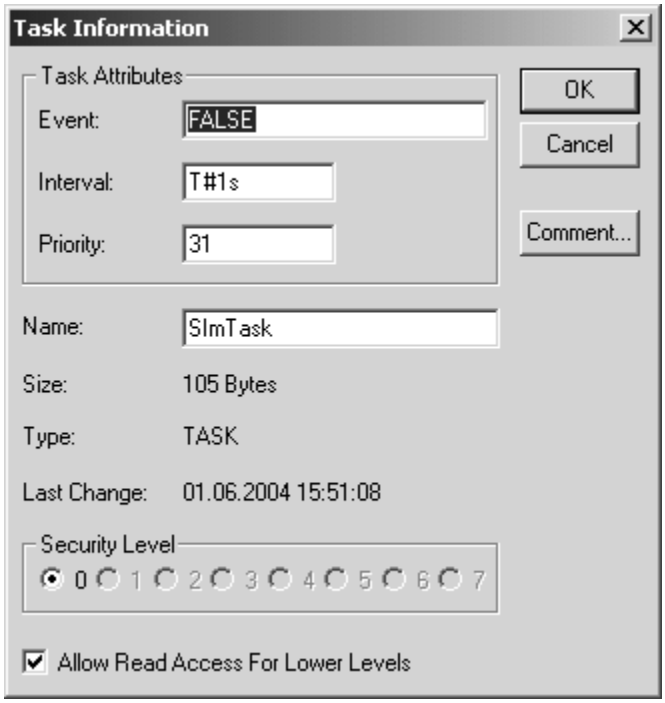


**Figure 4–6 Global Variable List-Task Information**

## More Information

**Library Pool** You will also see a couple of Totalflow libraries in the Library_Pool of the Project Navigator. The first is RegisterLib. This library maintains several access functions required to interface an IEC application with the host XFC or XRC. A more detailed description of these functions can be found in Appendix C.

**POU Pool** As discussed in Steps 7 and 8 of the Plunger Advance Simulator Tutorial, each POU in the POU_Pool has a Header and a Body. The Header lists any variables used in the POU Body, or code. The Softing literature offers a good overall explanation of variable declaration. Here we want to describe declaring variables that connect the IEC application to an actual hardware location, or register, on the host device (XRC/XFC). These variables are referred to in the IEC 61131-3 specification as 'directly represented variables'. The identities of 'directly represented variables' all begin with '%'.

**Global Vars** Open 'Global_Vars' in the Project Navigator. All of the I/O registers used in this application may be specified by the user so any mix of on board or module I/O may be used to simulate the plunger lift operation. For example the tubing pressure uses the register specified by TubPresAO, it's Class is VAR_GLOBAL_RETAIN, the Identifier, or variable name is TubPresAO, it's address is %MD0.0.6, and it's type is UDINT (unsigned double integer). This initial value is also referred to as the IEC register ID (refer to Chapter 2). So in reality, %MD0.0.5 is a pointer to an I/O Subsystem variable.

*Continued on Next Page*

## More Information, Continued

**Global Vars,** Cont.

Referring to the IEC 61131-3 specification we can see that TubPresAO is a directly represented variable (i.e. the '%'). The 'M' tells us that it accesses internal memory. The 'D' establishes the variable as a double word, or 32 bit access. The 0.0.5 establishes TubPresAO as register 5 in our Totalflow Register architecture. Assigning register 5 (%MD0.0.5) to the variable TubPresAO is completely arbitrary. It is only necessary that each variable's address be unique.

The Initial value we may assign to this variable is a bit more complicated. This Initial value is really an address pointing to the internal memory of the XFC or XRC. This address is determined by finding the appropriate register in a Register map of the device. It can also be found by connecting PCCU32 to the device in Entry mode and finding the appropriate register.

## IEC Register ID

**IEC Register ID**

In Chapter 2 we discussed the need to generate the IEC register ID from the Totalflow Register Address. The following tutorial explains how to accomplish this.

To begin with, our Totalflow Register Address (from Figure 2–4) is: 7.2.4096. From this, you need to determine the IEC Register ID to include in an argument, using the following formula:

IEC register ID = (REG * 65536) + (ARRAY * 256) + (APP)

*Example:*

Where the Totalflow Register is 7.2.4096, using the formula above,

(4096 * 65536) + (2 * 256) + 7 or (268435456) + (512) + (7), the

IEC Register Value equals 268435975.

Or more simply done using the following binary conversion table (see Table 4–1).

**Table 4–1 Determining IEC Register ID using Binary Notations**

| | | Binary Notation | | |
|---|---|---|---|---|
| **Procedure** | **Decimal** | **REG (16 bits)** | **ARRAY (8)** | **APP (8)** |
| APP Number: | 7 | 0000000000000000 | 00000000 | 00000111 |
| ARRAY Number: | 2 | 0000000000000000 | 00000010 | 00000000 |
| REGISTER INDEX | 4096 | 0001000000000000 | 00000000 | 00000000 |
| ORring the APP, ARRAY and REG INDEX renders: | | 0001000000000000 | 00000010 | 00000111 |
| Converting this 32 bit binary representation to decimal | 268435975 | 0001000000000000 | 00000010 | 00000111 |

*Continued on Next Page*

**TIP**

It should be noted that in this example it is necessary that the I/O Subsystem Application be instantiated as Application #7 in the App Table. If the not instantiated as App #7 the IEC application will not be able to correctly access any I/O points.

Figure 4–7 Shows the 32 Bit IEC Register number above.

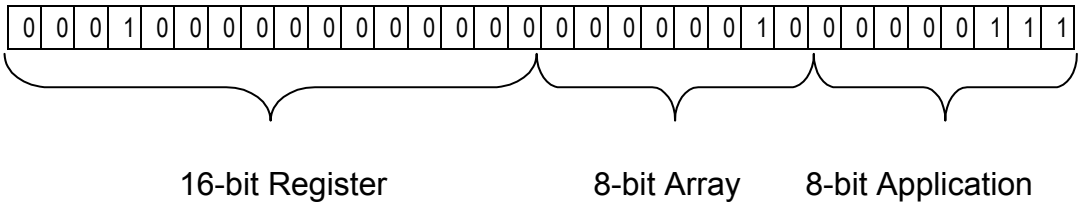


**Figure 4–7 IEC Register ID (32 Bit) Example**

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# Appendix A

## IEC Reference Materials

**IEC 61131-3 Programming**

"Programming industrial control systems using IEC 61131-3 Revised edition", by R.W. Lewis and published by:
The Institute of Electrical Engineers
Michael Faraday House, Six Hills Way
Stevenage, Herts., SGI 2AY, United Kingdom
ISBN 0 85296 950 3

**SoftCONTROL**

SoftCONTROL User Manual
Version 3.0 September 1999
Delivered via email as a .pdf file:
hsc30e99.pdf

**IEC Training**

Information regarding Totalflow's 3 day training class may be found at:

www.abb.com/totalflow

## IEC Tools

**IEC Compiler**

***SC-30-PC-EL***

Softing North America, Inc.
44 Merrimac Street
Newburyport, MA. 01950
978-499-9651
www.softing.com

**C Compiler**

***EWZ80***

IAR Systems Software, Inc.
One Maritime Plaza, Suite 1770
San Francisco, CA.
415-765-5500
www.iar.com

## Totalflow Reference Materials

**XFC User's Manual**

"XSeries Flow Computer User's Manual"
ABB Inc.
Totalflow Products
7051 Industrial Blvd., Bartlesville, Oklahoma 74006, USA
Part Number: 2100802-001

**XRC User's Manual**

"XSeries Remote Controller User's Manual"
ABB Inc.
Totalflow Products
7051 Industrial Blvd., Bartlesville, Oklahoma 74006, USA
Part Number: 2100726-001

## Table A–1 IEC Register Access Library Commands

| Name: | Description: |
|---|---|
| AppInst | Get the application number for a specific instance of app type |
| ChourTime | Checks contract hour against current system time |
| GetRegB8 | Read register: byte |
| GetRegBool | Read register: Boolean (True/False) |
| GetRegDI | Read register: double integer |
| GetRegDW | Read register: double word |
| GetRegF | Read register: floating point data |
| GetRegI | Read register: integer |
| GetRegSI | Read register: signed integer |
| GetRegUDI | Read register: unsigned long int data |
| GetRegUI | Read register: Unsigned integer data |
| GetRegUSI | Read register: byte data |
| GetRegW | Read register: word |
| Now | Read system clock time. |
| num2APP | decode register address into application portion |
| num2ARR | decode register address into array portion |
| num2REG | decode register address into index portion |
| Rand | return pseudo random number |
| ScBackupGlobals | Save current values of global variables to file on RDRIVE |
| ScColdStartGet | Fetch value of cold start flag. |
| ScColdStartSet | Set value of cold start flag. |
| set_annun | Set character to display in annunciator field for this task |
| SetReg | Write register |
| SetRegBool | Write register: Boolean value |
| Srand | set random number generator seed |
| VCB2num | Convert register address to unsigned double integer |

## Table A–2 Access Commands

| | Return | | Parameters | | |
|---|---|---|---|---|---|
| **Name** | **Type** | **Description** | **Name** | **Type** | **Description** |
| AppInst | INT | Application Number | Type | INT | APP_SYS 0 System Resources<br>APP_IOS 1 I/O Scanner<br>APP_DISP 2 LCD Display<br>APP_COMM 3 Comm Task<br>APP_AGA3 4 Aga3 Tube (G.O.)<br>APP_AGA7 5 Aga7 Tube (P.I.)<br>APP_LIQUID 6 Liquid Tube<br>APP_TREND 7 Trend Task<br>APP_RAMS 8 Alarm System<br>APP_VALVE 9 Valve Control<br>APP_USER 10 User Vals<br>APP_BTU 11 BTU Interface<br>APP_XMV 12 XMV Interface<br>APP_IEC 13 IEC-1131<br>APP_ANALYSIS 14 Analysis System<br>APP_TANK 15 Tank Interface<br>APP_PCON 16 Pump Interface<br>APP_FS2 17 FS2 Interface |
| | | | N | INT | Instance |
| ChourTime | BYTE | 1 do contract hour function<br>0 not in contract hour<br>2 Still in contract hour, but already logged. | CHOUR | BTYE | Contract hour (0=Midnight, 12=Noon, 23=11pm) |
| | | | RTN | BYTE | Initialize to zero for first time called; Otherwise, set to value returned from previous call to remember if log already occurred. |
| GetRegB8 | BYTE | Contents of specified register | VCB | UDINT | Register Address |
| GetRegBool | BOOL | Contents of specified register | VCB | UDINT | Register Address |
| GetRegDI | DINT | Contents of specified register | VCB | UDINT | Register Address |
| GetRegDW | DWORD | Contents of specified register | VCB | UDINT | Register Address |
| GetRegF | REAL | Contents of specified register, 0.0 if error | VCB | UDINT | Register Address |
| GetRegI | INT | Contents of specified register | VCB | UDINT | Register Address |
| GetRegSI | SINT | Contents of specified register | VCB | UDINT | Register Address |
| GetRegUDI | UDINT | Contents of specified register | VCB | UDINT | Register Address |
| GetRegUI | UINT | Contents of specified register | VCB | UDINT | Register Address |
| GetRegUSI | USINT | Contents of specified register | VCB | UDINT | Register Address |
| GetRegW | WORD | Contents of specified register | VCB | UDINT | Register Address |

**Table A–2 Access Commands,** Continued

| | Return | | Parameters | | |
|---|---|---|---|---|---|
| **Name** | **Type** | **Description** | **Name** | **Type** | **Description** |
| Now | UDINT | Clock date/time (epoch format) seconds since Jan 1, 1970 | Fake | INT | Not used. Must be specified |
| num2APP | INT | Application Number | VCB | UDINT | Register Address |
| num2ARR | INT | Array Number | VCB | UDINT | Register Address |
| num2REG | INT | Index into array | VCB | UDINT | Register Address |
| Rand | INT | Random number0-32,767 | Fake | INT | Not used |
| ScBackupGlobas | BOOL | Not used, always 0 | Fake | INT | Not Used |
| ScColdStartGet | BOOL | Value of Cold Start Variable:<br>0=No Cold Start<br>1=Cold Start | Fake | INT | Not Used |
| ScColdStartSet | BOOL | Not used, always 0 | Value | BYTE | Value to write to cold start variable. |
| set_annun | INT | Set character to display in annunciator field for this task if enabled | Annunciator | USINT | Character to display, ascii plus special[1] |
| SetReg | BOOL | Success/Failure | AnyNum | ANY_NUM | Value to write to register, any type |
| | | | VCB | UDINT | Resister Address |
| SetRegBool | BOOL | Success/Failure | Value | BOOL | Value to write to register: Boolean Type |
| | | | VCB | UDINT | Register Address |
| Srand | INT | Not used, always 0 | Seed | INT | Generator Seed |
| VCB2num | UDINT | Encoded value of register address | APP | INT | Application Number |
| | | | ARR | INT | Array Number |
| | | | Index | INT | Index into array |

[1] See Appendix A, Table A-3

## Totalflow Annunciator Display Characters

**Table A–3 Annunciator Character List**

| Character Value | | Description |
|---|---|---|
| 0x00 | | None |
| 0xff | | Annunciator off character |
| 0x01 | | Hi Limit |
| 0x02 | | Lo Limit |
| 0x03 | | Low Lithium Battery |
| 0x04 | | Low Charger |
| 0x05 | | A/D OV |
| 0x06 | | Backflow |
| 0x07 | | Remote Low Battery |
| 0xF8 | | Valve Override |
| 0xA2 | | Valve Full Open |
| 0xA3 | | Valve Full Closed |
| 0x01 | | Valve Opening |
| 0x02 | | Valve Closing |
| 0x03 | | Valve Local Lockout |
| 0x07 | | Valve Low Battery |
| '=' | | Valve on SetPoint |
| 'X' | | Remote Task Killed Annunciator |
| 'H' | | Live inputs on HOLD |
| 'L' | | Local attached |
| 'M' | | Modbus ASCII Protocol |
| 'm' | | Modbus RTU Protocol |
| 'T' | | Local Terminal Protocol or TESORO tankgauge |
| 'C' | | Local Console Protocol |
| '?' | | Exception? Processing |
| 'R' | | ROS tankgauge |
| 'a' | | ADP Protocol |
| 0xb7 | | Remote Listen |
| 0x7e | | Remote Transfer (Send) |
| 0x7f | | Remote Download (Receive) |
| 0x5c | | Waiting for SYNC |
| 0xCE | | Waiting for Ack |
| '+' | | Protocol Ack |
| '!' | | Protocol Nack |
| 'Z' | | Tube Zero Flow |
| 'A' | | Tube limit alarm |

## XSeries Listing of Plungersim-001.ini File

```
1.  {IEC61131}
2.
3.  \{Plunger Simulator}
4.
5.  [Current] #Columns=4,Description=200,Value=100,Units=75,Comment=100
6.
7.  REM #GLOBALS_PlungerStatus
8.  dsc:Plunger Status;cmd:13.105.0;typ:E;lst:Bottom=0,Rising=1,Falling=2,Top=3;
9.  dsc: ;col:3;typ:Z;rwa:1;
10. dsc: ;col:4;typ:Z;rwa:1;
11.
12. REM #GLOBALS_SimArrived
13. dsc:Sim Plunger Location;cmd:13.103.2;typ:e;lst:Away=0,Arrived=1;
14. dsc: ;col:3;typ:Z;rwa:1;
15. dsc:Plunger Location;col:4;typ:Z;rwa:1;
16.
17. REM #PlungerSim_SimPlunger_SimPlunger_ArrivedOut
18. dsc:Sim Plunger Arrived;cmd:13.103.16;typ:e;lst:Away=0,Arrived=1;
19. dsc: ;col:3;typ:Z;rwa:1;
20. dsc:Simulated Plunger Arrived Switch;col:4;typ:Z;rwa:1;
21.
22. REM #PlungerSim_SimPlunger_SimPlunger_PlungerDepth
23. dsc:Plunger Depth;cmd:13.101.27;typ:f;fmt:-10.4f;
24. dsc:ft;col:3;typ:Z;rwa:1;
25. dsc:Current;col:4;typ:Z;rwa:1;
26.
27. REM #GLOBALS_ValvePos
28. dsc:Main Valve position;cmd:13.101.0;typ:f;fmt:-10.4f;
29. dsc:0-1;col:3;typ:Z;rwa:1;
30. dsc:Main Valve Open;col:4;typ:Z;rwa:1;
31.
32. REM #PlungerSim_SimPlunger_SimPlunger_PlungerFail
33. dsc:Force Blow;cmd:13.103.15;typ:e;lst:Normal=0,Force=1;
34. dsc: ;col:3;typ:Z;rwa:1;
35. dsc: ;col:4;typ:Z;rwa:1;
36.
37. dsc:Pressures;typ:Z;
38. dsc: ;col:3;typ:Z;
39. dsc: ;col:4;typ:Z;
40.
41. REM #GLOBALS_SimTubePress
```

```
42. dsc:Simulated Tube Pressure;cmd:13.101.1;typ:f;fmt:-10.4f;
43. dsc:psi;col:3;typ:Z;rwa:1;
44. dsc: ;col:4;typ:Z;rwa:1;
45.
46. REM #GLOBALS_SimLinePress
47. dsc:Simulated Line Pressure;cmd:13.101.2;typ:f;fmt:-10.4f;
48. dsc:psi;col:3;typ:Z;rwa:1;
49. dsc: ;col:4;typ:Z;rwa:1;
50.
51. REM #PlungerSim_SimCasing_SimCase_SimCasing
52. dsc:Sim Casing Pressure;cmd:13.101.18;typ:f;fmt:-10.4f;
53. dsc:psi;col:3;typ:Z;rwa:1;
54. dsc:Simulated Casing Pressure;col:4;typ:Z;rwa:1;
55.
56. REM #PlungerSim_SimDP_SimDP_SimFCUDP
57. dsc:Simulated FCU DP Pressure;cmd:13.101.20;typ:f;fmt:-10.4f;
58. dsc:psi;col:3;typ:Z;rwa:1;
59. dsc: ;col:4;typ:Z;rwa:1;
60.
61. dsc:Main Valve;typ:Z;
62. dsc: ;col:3;typ:Z;
63. dsc: ;col:4;typ:Z;
64.
65. REM #GLOBALS_ValveStatus
66. dsc:Valve Status;cmd:13.103.0;typ:e;lst:Close=0,Open=1;
67. dsc: ;col:3;typ:Z;rwa:1;
68. dsc:Valve Open/Closed Status;col:4;typ:Z;rwa:1;
69.
70. REM #PlungerSim_SimMainValve_SimMainValve_ValveOpen
71. dsc:Valve Open Command;cmd:13.103.6;typ:e;lst:Off=0,Opening=1;
72. dsc: ;col:3;typ:Z;rwa:1;
73. dsc: ;col:4;typ:Z;rwa:1;
74.
75. REM #PlungerSim_SimMainValve_SimMainValve_ValveClose
76. dsc:Valve Close Command;cmd:13.103.7;typ:e;lst:Off=0,Closing=1;
77. dsc: ;col:3;typ:Z;rwa:1;
78. dsc: ;col:4;typ:Z;rwa:1;
79.
80. dsc:Blow Valve;typ:Z;
81. dsc: ;col:3;typ:Z;
82. dsc: ;col:4;typ:Z;
83.
```

## XSeries Listing of Plungersim-001.ini File, Continued

```
84.  REM #GLOBALS_BlowStatus
85.  dsc:Blow Actual Status;cmd:13.103.1;typ:e;lst:Close=0,Open=1;
86.  dsc: ;col:3;typ:Z;rwa:1;
87.  dsc: ;col:4;typ:Z;rwa:1;
88.
89.  REM #PlungerSim_SimBlowValve_SimBlowValve_BlowOpen
90.  dsc:Blow Open Command;cmd:13.103.9;typ:e;lst:Off=0,Opening=1;
91.  dsc: ;col:3;typ:Z;rwa:1;
92.  dsc: ;col:4;typ:Z;rwa:1;
93.
94.  REM #PlungerSim_SimBlowValve_SimBlowValve_BlowClose
95.  dsc:Blow Close Command;cmd:13.103.10;typ:e;lst:Off=0,Closing=1;
96.  dsc: ;col:3;typ:Z;rwa:1;
97.  dsc: ;col:4;typ:Z;rwa:1;
98.
99.  [Set I/O] #Columns=4,Description=200,Value=100,Units=75,Comment=100
100.
101. REM #GLOBALS_MainOpenDI
102. dsc:Main Valve Open DI;cmd:13.10.0;typ:S;fmt:s;
103. dsc:register;col:3;typ:Z;rwa:1;
104. dsc: ;col:4;typ:Z;rwa:1;
105.
106. REM #GLOBALS_MainCloseDI
107. dsc:Main Valve Close DI;cmd:13.10.1;typ:S;fmt:s;
108. dsc:register;col:3;typ:Z;rwa:1;
109. dsc: ;col:4;typ:Z;rwa:1;
110.
111. REM #GLOBALS_BlowOpenDI
112. dsc:Blow Valve Open DI;cmd:13.10.2;typ:S;fmt:s;
113. dsc:register;col:3;typ:Z;rwa:1;
114. dsc: ;col:4;typ:Z;rwa:1;
115.
116. REM #GLOBALS_BlowCloseDI
117. dsc:Blow Valve Close DI;cmd:13.10.3;typ:S;fmt:s;
118. dsc:register;col:3;typ:Z;rwa:1;
119. dsc: ;col:4;typ:Z;rwa:1;
120.
121. REM #GLOBALS_ArrivalDO
122. dsc:Arrival  DO;cmd:13.10.4;typ:S;fmt:s;
123. dsc:register;col:3;typ:Z;rwa:1;
124. dsc: ;col:4;typ:Z;rwa:1;
125.
```

## XSeries Listing of Plungersim-001.ini File, Continued

```
126. REM #GLOBALS_TubPresAO
127. dsc:Tubing Pressure AO;cmd:13.10.5;typ:S;fmt:s;
128. dsc:register;col:3;typ:Z;rwa:1;
129. dsc: ;col:4;typ:Z;rwa:1;
130.
131. REM #GLOBALS_CasPresAO
132. dsc:Casing Pressure AO;cmd:13.10.6;typ:S;fmt:s;
133. dsc:register;col:3;typ:Z;rwa:1;
134. dsc: ;col:4;typ:Z;rwa:1;
135.
136. REM #GLOBALS_StaticAO
137. dsc:Static Pressure AO;cmd:13.10.7;typ:S;fmt:s;
138. dsc:register;col:3;typ:Z;rwa:1;
139. dsc: ;col:4;typ:Z;rwa:1;
140.
141. REM #GLOBALS_DiffAO
142. dsc:DP AO;cmd:13.10.8;typ:S;fmt:s;
143. dsc:register;col:3;typ:Z;rwa:1;
144. dsc: ;col:4;typ:Z;rwa:1;
145.
146. REM #GLOBALS_LineAO
147. dsc:Line Press AO;cmd:13.10.9;typ:S;fmt:s;
148. dsc:register;col:3;typ:Z;rwa:1;
149. dsc: ;col:4;typ:Z;rwa:1;
150.
151. REM #GLOBALS_MainDO
152. dsc:Main Status DO;cmd:13.10.10;typ:S;fmt:s;
153. dsc:register;col:3;typ:Z;rwa:1;
154. dsc: ;col:4;typ:Z;rwa:1;
155.
156. REM #GLOBALS_BlowDO
157. dsc:Blow Status DO;cmd:13.10.11;typ:S;fmt:s;
158. dsc:register;col:3;typ:Z;rwa:1;
159. dsc: ;col:4;typ:Z;rwa:1;
160.
161. REM #GLOBALS_KeepAliveDO
162. dsc:Keep Alive DO;cmd:13.10.12;typ:S;fmt:s;
163. dsc:register;col:3;typ:Z;rwa:1;
164. dsc:Toggles every cycle to show alive;col:4;typ:Z;rwa:1;
165.
```

## XSeries Listing of Plungersim-001.ini File, Continued

```
166. REM #GLOBALS_PlungerHeightDO1
167. dsc:Plunger Height DO1;cmd:13.10.13;typ:S;fmt:s;
168. dsc:register;col:3;typ:Z;rwa:1;
169. dsc:Show Plunger Height via LEDS;col:4;typ:Z;rwa:1;
170.
171. REM #PlungerSim_FindIOs_ResetVCBs_ResetVCBs
172. dsc:Find default IO registers;cmd:13.103.20;typ:e;lst: False=0, True=1;
173. dsc: ;col:3;typ:Z;rwa:1;
174. dsc: ;col:4;typ:Z;rwa:1;
175.
176. [Setup] #Columns=4,Description=200,Value=100,Units=75,Comment=100
177.
178. REM #GLOBALS_SimPress
179. dsc:Master Simulated Pressure;cmd:13.101.3;typ:f;fmt:-10.4f;
180. dsc: ;col:3;typ:Z;rwa:1;
181. dsc: 0 to 1;col:4;typ:Z;rwa:1;
182.
183. REM #PlungerSim_SimMainValve_SimMainValve_ValveSpeed
184. dsc:Main Valve Speed;cmd:13.101.4;typ:f;fmt:-10.4f;
185. dsc:percent/second;col:3;typ:Z;rwa:1;
186. dsc:Main Valve percent speed;col:4;typ:Z;rwa:1;
187.
188. REM #PlungerSim_SimTube_SimTube_NewPress
189. dsc:Tube New;cmd:13.101.7;typ:f;fmt:-10.4f;
190. dsc: ;col:3;typ:Z;rwa:1;
191. dsc: ;col:4;typ:Z;rwa:1;
192.
193. REM #PlungerSim_SimTube_SimTube_RandPress
194. dsc:Tube Rand;cmd:13.101.8;typ:f;fmt:-10.4f;
195. dsc: ;col:3;typ:Z;rwa:1;
196. dsc: ;col:4;typ:Z;rwa:1;
197.
198. REM #PlungerSim_SimTube_SimTube_TubeRand
199. dsc:Tube Rand percent;cmd:13.101.9;typ:f;fmt:-10.4f;
200. dsc: ;col:3;typ:Z;rwa:1;
201. dsc: ;col:4;typ:Z;rwa:1;
202.
203. REM #PlungerSim_SimTube_SimTube_TubeMin
204. dsc:Tube Min Pressure;cmd:13.101.10;typ:f;fmt:-10.4f;
205. dsc:psi;col:3;typ:Z;rwa:1;
206. dsc:Tubing Min Pressure to simulate;col:4;typ:Z;rwa:1;
207.
```

```
REM #PlungerSim_SimTube_SimTube_TubeMax
dsc:Tube Max Pressure;cmd:13.101.11;typ:f;fmt:-10.4f;
dsc:psi;col:3;typ:Z;rwa:1;
dsc:Tubing Max Pressure to simulate;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimTube_SimTube_TubeDeltaClos
dsc:Tube Delta Close;cmd:13.101.12;typ:f;fmt:-10.4f;
dsc:0-1;col:3;typ:Z;rwa:1;
dsc:Speed of Tubing Pressure Change if Closed;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimTube_SimTube_TubeDeltaOpen
dsc:Tube Delta Open;cmd:13.101.13;typ:f;fmt:-10.4f;
dsc:0-1;col:3;typ:Z;rwa:1;
dsc:Speed of Tubing Pressure Change if Open;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimCasing_SimCase_CasingMin
dsc:Casing Min Pressure;cmd:13.101.16;typ:f;fmt:-10.4f;
dsc:psi;col:3;typ:Z;rwa:1;
dsc:Casing Min Pressure to simulate;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimCasing_SimCase_CasingMax
dsc:Casing Max Pressure;cmd:13.101.17;typ:f;fmt:-10.4f;
dsc:psi;col:3;typ:Z;rwa:1;
dsc:Casing Max Pressure to simulate;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimDP_SimDP_DPmax
dsc:DP Max Pressure;cmd:13.101.19;typ:f;fmt:-10.4f;
dsc:psi;col:3;typ:Z;rwa:1;
dsc:DP Max Pressure to simulate;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimLine_SimLine_LineMin
dsc:Line Min Pressure;cmd:13.101.26;typ:f;fmt:-10.4f;
dsc:psi;col:3;typ:Z;rwa:1;
dsc:Line Min Pressure to simulate;col:4;typ:Z;rwa:1;

REM #PlungerSim_SimPlunger_SimPlunger_WellDepth
dsc:Well Depth;cmd:13.101.28;typ:f;fmt:-10.4f;
dsc:ft;col:3;typ:Z;rwa:1;
dsc: ;col:4;typ:Z;rwa:1;
```

```
248. REM #PlungerSim_SimPlunger_SimPlunger_PlungerSpdUp
249. dsc:Plunger Speed Up;cmd:13.101.30;typ:f;fmt:-10.4f;
250. dsc:ft/min;col:3;typ:Z;rwa:1;
251. dsc: ;col:4;typ:Z;rwa:1;
252.
253. REM #PlungerSim_SimPlunger_SimPlunger_PlungerSpdFall
254. dsc:Plunger Speed Down;cmd:13.101.31;typ:f;fmt:-10.4f;
255. dsc:ft/min;col:3;typ:Z;rwa:1;
256. dsc: ;col:4;typ:Z;rwa:1;
257.
258. REM #PlungerSim_SimPlunger_SimPlunger_TubePressPlung
259. dsc:Tube Pressure Plunger;cmd:13.101.32;typ:f;fmt:-10.4f;
260. dsc:psi;col:3;typ:Z;rwa:1;
261. dsc:min press to move plunger;col:4;typ:Z;rwa:1;
262.
263. REM #GLOBALS_LedTest
264. dsc:Test LEDs;cmd:13.103.3;typ:e;lst:Normal=0,TEST=1;
265. dsc: ;col:3;typ:Z;rwa:1;
266. dsc: ;col:4;typ:Z;rwa:1;
267.
268. REM #GLOBALS_PlungerHeightCnt
269. dsc:Plunger Height Count;cmd:13.105.1;typ:i;fmt:5d;
270. dsc: ;col:3;typ:Z;rwa:1;
271. dsc:Number of LEDs in Height simulation;col:4;typ:Z;rwa:1;
272.
273. REM #PlungerSim_SimPlunger_SimPlunger_SwitchTimer
274. dsc:Switch Timer;cmd:13.105.4;typ:i;fmt:5d;
275. dsc:secs;col:3;typ:Z;rwa:1;
276. dsc: ;col:4;typ:Z;rwa:1;
277.
278. REM #PlungerSim_SimPlunger_SimPlunger_SwitchTime
279. dsc:Switch Time;cmd:13.105.5;typ:i;fmt:5d;
280. dsc:secs;col:3;typ:Z;rwa:1;
281. dsc:Switch Time for Arrival to turn off;col:4;typ:Z;rwa:1;
282.
283. REM #PlungerSim_SimPlunger_SimPlunger_LEDon
284. dsc:LEDon;cmd:13.105.6;typ:i;fmt:5d;
285. dsc: ;col:3;typ:Z;rwa:1;
286. dsc: ;col:4;typ:Z;rwa:1;
287.
288. [Strings] #Columns=4,Description=200,Value=100,Units=75,Comment=100
289.
```

## XSeries Listing of Plungersim-001.ini File, Continued

```
290. REM #PlungerSim_CloseString
291. dsc:CloseString;cmd:13.108.0;typ:S;fmt:-32s;
292. dsc: ;col:3;typ:Z;rwa:1;
293. dsc: ;col:4;typ:Z;rwa:1;
294.
295. REM #PlungerSim_OpenString
296. dsc:OpenString;cmd:13.108.1;typ:S;fmt:-32s;
297. dsc: ;col:3;typ:Z;rwa:1;
298. dsc: ;col:4;typ:Z;rwa:1;
299.
300. REM #PlungerSim_AwayString
301. dsc:AwayString;cmd:13.108.2;typ:S;fmt:-32s;
302. dsc: ;col:3;typ:Z;rwa:1;
303. dsc: ;col:4;typ:Z;rwa:1;
304.
305. REM #PlungerSim_ArrivString
306. dsc:ArrivString;cmd:13.108.3;typ:S;fmt:-32s;
307. dsc: ;col:3;typ:Z;rwa:1;
308. dsc: ;col:4;typ:Z;rwa:1;
309.
310. REM #PlungerSim_ValveText
311. dsc:ValveText;cmd:13.108.4;typ:S;fmt:-32s;
312. dsc: ;col:3;typ:Z;rwa:1;
313. dsc: ;col:4;typ:Z;rwa:1;
314.
315. REM #PlungerSim_SimPlunger_SimPlunger_PlungerText
316. dsc:Plunger Status Text;cmd:13.108.5;typ:S;fmt:-32s;
317. dsc: ;col:3;typ:Z;rwa:1;
318. dsc: ;col:4;typ:Z;rwa:1;
```

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# Appendix B
# Totalflow® Definitions and Acronyms

| TERM | DEFINITION |
|---|---|
| $\mu$ | Greek letter for “mu”. Often used in math and engineering as the symbol for “micro”. Pronounced as a long u. |
| $\mu$ FLO | Totalflow’s Micro Flow Computer is a low power, microprocessor based units designed to meet a wide range of measurement, monitor and alarming applications for remote gas systems, while being a cost effective alternative. |
| $\mu$ FLO IMV | $\mu$FLO’s measurement and operational features are housed in this single unit assembly. The main electronic board ($\mu$FLO-195 Board), communication connection, power, SP, DP and Temperature readings are all housed in this unit. |
| $\mu$ FLO-2100767 Board | Main Electronic Board used in the $\mu$FLO Computers. It is housed on the IMV and operates at 195 MHz while drawing minimal power. |
| $\mu$ Sec | Micro Second. |
| *.CSV file | See Comma Separated Values (I.E. spreadsheet format). |
| *.INI file | See Initialization File. |
| A/D | Analog-to-digital. |
| ABB Inc. | Asea, Brown & Boveri, parent company of Totalflow |
| Absolute Pressure | Gauge pressure plus barometric pressure. Absolute pressure is used by most Totalflow devices for flow calculations. |
| Absolute Zero | The zero point on the absolute temperature scale. It is equal to -273.16 degrees C, or 0 degrees K (Kelvin), or -459.69 degrees F, or 0 degrees R (Rankine). |
| AC | See Alternating Current. |
| Accuracy | How closely a measured value agrees with the correct value. |
| ACK | See Acknowledgment. |
| Acknowledgment | This refers to a response over a remote communication device to a request such as a PING. Basically, saying, "I'm here, and I saw your request!" |
| ACM | See Analyzer Control Module. |
| Active Analog Output | Analog Output to a host providing power to the host. |
| Active Mode | An operational mode used by the LevelMaster for measuring dual float levels by applying a signal to the primary windings, reading the voltage level on the secondary windings and using an algorithm to determine the oil and water levels. |
| ADC | See Analog-to-Digital Converter. |
| Address | A unique memory designation for location of data or the identity of a peripheral device; allows each device on a single communications line to respond to its own message. |
| Adsorption | Adhesion of a species onto the surfaces of particles |
| Aerial | A length of wire designed to transmit or receive radio waves. (See also Antenna) |
| Aerosol Liquids | Minute liquid particles suspended in gas. Aerosols will behave like a fluid and can be transported by pipes and pumping. When aerosols contact each other they coalesce into droplets. Aerosols may be present in gas, or may be generated by glow shearing off the skim inside of a pipeline. |
| AGA | American Gas Association. Trade group representing natural gas distributors and pipelines. |
| AGA-10 | American Gas Association Report No. 10, Speed of Sound in Natural Gas and Other Related Hydrocarbon Gases. Method for calculation of the speed of sound in gases. |
| AGA-3 | American Gas Association Report No. 3, Orifice Metering of Natural Gas. Method for calculating gas volume across an Orifice Plate. |
| AGA-5 | American Gas Association Report No. 5, Fuel Gas Energy Metering. Methods (Volume, Mass or Energy) for calculating BTUs without knowing the composition of the gas. |
| AGA-7 | American Gas Association Report No. 7, Measurement of Gas by Turbine Meters. Method for calculating gas volume using a Pulse Meter. |

| TERM | DEFINITION |
|---|---|
| AGA-8 | American Gas Association Report No. 8, Compressibility Factor of Natural Gas and Related Hydrocarbon Gases. Method for calculating the Super Compressibility Factor, Fpv. |
| AGA-9 | American Gas Association Report No. 9, Measurement of Gas by Multipath Ultrasonic Meters. Method for calculating gas based on transit-times. |
| AGC | Automatic Gain Control |
| AH | See Ampere-Hour. |
| AI | Analog Input |
| Alkane | The simplest homologous series of saturated aliphatic hydrocarbons, consisting of methane, ethane, propane, butane; also know as olefins. Unsaturated hydrocarbons that contain one or more carbon-carbon double bonds. |
| Alkynes | Unsaturated hydrocarbons that contain one or more carbon-carbon triple bonds. |
| Alternating Current | An electric current whose direction changes with a frequency independent of circuit components. |
| Aluminum Powder Coating | Totalflow aluminum enclosures have a baked-on Powder Coating designed to our specifications to ensure paint adhesion, weather resistance and durability. |
| Amp | See Ampere. |
| Ampere | The unit of electrical current. Also milliamp (one thousandth of an amp) and microamp (one millionth of an amp). One amp corresponds to the flow of about $6 \times 10^{18}$ electrons per second. |
| Ampere-Hour | The quantity of electricity measured in ampere-hours (Ah) which may be delivered by a cell or battery under specified conditions. A current of one ampere flowing for one hour. |
| Ampere-Hour Efficiency | The ratio of the output of a secondary cell or battery, measured in ampere-hours, to the input required to restore the initial state of charge, under specified conditions. |
| Amplitude | The highest value reached by voltage, current or power during a complete cycle. |
| Amplitude Modulation | Where audio signals increase and decrease the amplitude of the "carrier wave". |
| AMU | See Analog Measurement Unit. |
| AMU/IMV | Generic reference to the Measurement unit. See (Integral) Multivariable Transducer for more definition. |
| Analog | A system in which data is represented as a continuously varying voltage/current. |
| Analog Input | Data received as varying voltage/current. |
| Analog Measurement Unit | A device for converting energy from one form to another. (e.g. Static and Differential pressure to electrical signals) |
| Analog Output | Data is transmitted as varying voltage/current. |
| Analog Trigger | A trigger that occurs at a user-selected point on an incoming analog signal. Triggering can be set to occur at a specific level on either an increasing or a decreasing signal (positive or negative slope). |
| Analog-to-Digital Converter | An electronic device, often an integrated circuit, that converts an analog voltage to a number. |
| Analyzer Control Module | Consists of various electronic components used for analysis. |
| Annunciator | Display of a status on a screen. |
| ANSI | American National Standards Institute. |
| Antenna | A length of wire or similar that radiates (such as a transmitting antenna) or absorbs (such as a radio antenna) radio waves. The two basic types are: Yagi (directional) or Omni (bi-directional). |
| AO | Analog Output |
| AP | See Absolute Pressure. |
| API 14.3 | American Petroleum Institute Report No. 14.3 addresses the 1992 equation regarding the AGA-3 method for calculating gas volume across an Orifice Plate. |
| API 21.1 | American Petroleum Institute Report No. 21.1 addresses the equation regarding AGA-8 Fpv or Supercompressibility Factor and the energy content of the gas. |

| TERM | DEFINITION |
|---|---|
| Archive | A file containing historical records in a compressed format for more efficient long term storage and transfer. Totalflow archive records are non-editable, meaning that when they are stored they may not be changed. These records are used during an audit of data. |
| Artificial Drives | Techniques for producing oil after depletion or in lieu of natural drives; includes waterflooding, natural gas reinjection, inert gas injection, flue gas injection and in-situ combustion. |
| Artificial Lift | Any of the techniques, other than natural drives, for bringing oil to the surface. |
| ASCII | American Standard Code for Information Interchange. A very popular standard method of encoding alphanumeric characters into 7 or 8 binary bits. |
| Asynchronous | A communications protocol where information can be transmitted at an arbitrary, unsynchronized point in time, without synchronization to a reference time or "clock". |
| ATEX | Certification Directive for Explosive Atmospheres. |
| Atmosphere | A unit of pressure; the pressure that will support a column of mercury 760 mm high at 0 °C. |
| Atmospheric Pressure | The pressure due to the weight of the atmosphere (air and water vapor) on the earth's surface. The average atmospheric pressure at sea level (for scientific purposes) has been defined at 14.696 pounds per square inch absolute. |
| Audio Frequency | Generally in the range 20 Hz to 20 KHz. |
| Audit | To examine or verify data for accuracy. Totalflow's DB1 and DB2 records may be edited to generate a more accurate representation of data information. |
| Audit Trail | Using the Long Term Archive files to justify changes made to records that more accurately reflects the correct data. Peripheral information used to edit data is recorded without exception, to justify the accuracy of the edited data records. |
| Automatic Frequency Control | Similar to Automatic Fine Tune (AFT). A circuit that keeps a receiver in tune with the wanted transmission. |
| Back Pressure | Pressure against which a fluid is flowing. May be composed of friction in pipes, restrictions in pipes, valves, pressure in vessels to which fluid is flowing, hydrostatic head, or other resistance to fluid flow. |
| Backflush | Technique used in chromatography to reverse direction of the flow after the lighter components have been measured, allowing the heavier components to remain in the column until measured, shortening the length of the column. |
| Background Acquisition | Data is acquired by a DAQ system while another program or processing routine is running without apparent interruption. |
| Bandwidth | The range of frequencies available for signaling; the difference between the highest and lowest frequencies of a band expressed in Hertz. |
| Bar | Bar is equal to 1 atmosphere of pressure. I.e. .987 Standard atmospheric pressure or 14.5 lbs./psia. |
| Barometer | An instrument which measures atmospheric pressure. |
| Barrel | The unit of volume measurement used for petroleum and it's products; 1 barrel = 42 US gallons. |
| Base Pressure | The pressure used as a standard in determining gas volume. Volumes are measured at operating pressures and then corrected to base pressure volume. Base pressure is normally defined in any gas measurement contract. The standard value for natural gas in the United States is 14.73 psia, established by the American National Standards Institute as standard Z-132.1 in 1969. |
| Battery | Two or more electrochemical cells electrically interconnected in an appropriate series/parallel arrangement to provide the required operating voltage and current levels. |
| Baud | Unit of signaling speed. The speed in baud is the number of discrete conditions or events per second. If each event represents only one bit condition, baud rate equals bits per second (bps). |
| Baud Rate | Serial communications data transmission rate expressed in bits per second (b/s). |
| Bias | Term used when calibrating. Amounts to offset the actual measurement taken. On a LevelMaster, it refers to adjusting the measurement of the float level to agree with a calibrated measurement. On an RTD (Resistant Thermal Detector), it refers to adjusting the measurement of the temperature to agree with a calibrated temperature. This figure maybe either a positive or negative figure. |

| TERM | DEFINITION |
|---|---|
| BIAS Current | A very low-level DC current generated by the panel meter and superimposed on the signal. This current may introduce a measurable offset across a very high source impedance. |
| Binary Number | System based on the number 2. The binary digits are 0 and 1. |
| Binary-Coded Decimal | A code for representing decimal digits in a binary format. |
| BIOS | Basic Input/Output System. A program, usually stored in ROM, which provides the fundamental services required for the operation of the computer. These services range from peripheral control to updating the time of day. |
| Bipolar | A signal range that includes both positive and negative values. |
| Bipolar Transistor | The most common form of transistor. |
| Bit | Binary Digit - the smallest unit of binary data. One binary digit, either 0 or 1. See also byte. |
| Bits Per Second | Unit of data transmission rate. |
| Blue Dot Technology | Technological changes to the DC and ACM Modules, decreasing noise by changing ground. Allows amplification of the results, gains resolution. |
| Board | Common name used to identify the Main Electronic Board. Also called Motherboard, Engine Card and Circuit Board. |
| Bottom Solids and Water | Refers to materials that settle to the bottom of an oil tank, including the heavy water. |
| Bounce | Bouncing is the tendency of any two metal contacts in an electronic device to generate multiple signals as the contacts close or open. When you press a key on your computer keyboard, you expect a single contact to be recorded by your computer. In fact, however, there is an initial contact, a slight bounce or lightening up of the contact, then another contact as the bounce ends, yet another bounce back, and so forth. A similar effect takes place when a switch made using a metal contact is opened. |
| BPS | See Bits Per Second. |
| Bridge | Generally a short-circuit on a PC board caused by solder joining two adjacent tracks. |
| British Thermal Unit | Energy required to raise one pound of water one degree Fahrenheit. One pound of water at 32 F° requires the transfer of 144 BTUs to freeze into solid ice. |
| Browser | Software which formats Web pages for viewing; the Web client |
| BS&W | See Bottom Solids (or sediment) and Water. |
| Btu | See British Thermal Unit. |
| Btu Method | A method of allocating costs between different operations or between different products based upon the heat content of products produced in the various operations or of the various produced products. |
| Btu per Cubic Foot | A measure of the heat available or released when one cubic foot of gas is burned. |
| Btu, Dry | Heating value contained in cubic foot of natural gas measured and calculated free of moisture content. Contractually, dry may be defined as less than or equal to seven pounds of water per Mcf. |
| Btu, Saturated | The number of Btu's contained in a cubic foot of natural gas fully saturated with water under actual delivery pressure, temperature and gravity conditions. See BTU, DRY. |
| Btu/CV | Used to express the heating content of gas. See British Thermal Units or Calorific Value. |
| BtuMMI | Refers to the interface program or software that operates the Btu Analyzer. |
| Buffer | (1) A temporary storage device used to compensate for a difference in data rate and data flow between two devices (typically a computer and a printer); also called a spooler; (2) An amplifier to increase the drive capability, current or distance, of an analog or digital signal. |
| BUS | A data path shared by many devices (e.g., multipoint line) with one or more conductors for transmitting signals, data, or power. |
| Bus Master | A type of controller with the ability to read and write to devices on the computer bus. |
| Busbar | A heavy, rigid conductor used for high voltage feeders. |

| TERM | DEFINITION |
|---|---|
| Butane (C4H10) | A saturated hydrocarbon (Alkane) with four carbon atoms in it's molecule ($C_4H_{10}$). A gas at atmospheric pressure and normal temperature, but easily liquefied by pressure. Generally stored and delivered in liquefied form and used as a fuel in gaseous form, obtained by processing natural gas as produced and also from a process in petroleum refining. Contains approximately 3,260 Btu per cubic foot. |
| Byte | A group of binary digits that combine to make a word. Generally 8 bits. Half byte is called a nibble. Large computers use 16 bits and 32 bits. Also used to denote the amount of memory required to store one byte of data. |
| Cache Memory | Fast memory used to improve the performance of a CPU. Instructions that will soon be executed are placed in cache memory shortly before they are needed. This process speeds up the operation of the CPU. |
| Calibrate | To ascertain, usually by comparison with a standard, the locations at which scale or chart graduations should be placed to correspond to a series of values of the quantity which the instrument is to measure, receive or transmit. Also, to adjust the output of a device, to bring it to a desired value, within a specified tolerance for a particular value of the input. Also, to ascertain the error in the output of a device by checking it against a standard. |
| Capacitor | An electronic component that stores electrical charge. |
| Capacity | The total number of ampere-hours (or watt-hours) that can be withdrawn from a cell/battery under specified conditions of discharge. |
| Carbon | Base of all hydrocarbons and is capable of combining with hydrogen in many proportions, resulting in numberless hydrocarbon compounds. The carbon content of a hydrocarbon determines, to a degree, the hydrocarbon's burning characteristics and qualities. |
| Carbon Dioxide | Colorless, odorless and slightly acid-tasting gas, consisting of one atom of carbon joined to two atoms of oxygen. C02. Produced by combustion or oxidation of materials containing carbon. |
| Carrier Gas | Totalflow recommends that Helium be used as a carrier gas. Carrier gas is used in the "Mobile Phase" of chromatography, pushing the sample gas through the columns ("Stationary Phase"). Because Helium has no heating value, it does not affect the Btu values. |
| Catalyst | A substance that speeds up a chemical reaction without being consumed itself in the reaction. A substance that alters (usually increases) the rate at which a reaction occurs. |
| Catalytic | The process of altering, accelerating or instigating a chemical reaction. |
| Cathode | An electrode through which current leaves any nonmetallic conductor. An electrolytic cathode is an electrode at which positive ions are discharged, or negative ions are formed, or at which other reducing reactions occur. The negative electrode of a galvanic cell; of an electrolytic capacitor. |
| C-Code | C language (IEC supported programming language) |
| CCU | See Dos CCU, WINCCU or PCCU. |
| CCV | See Closed Circuit Voltage. |
| Cd | Coefficient of Discharge factor. |
| CE | European Community Certification Bureau. |
| Cell | The basic electrochemical unit used to generate or store electrical energy. |
| Cenelec | European Committee for Electro-technical Standardization. Also known as the European Standards Organization. |
| Central Processing Unit | The central part of a computer system that performs operations on data. In a personal computer the CPU is typically a single microprocessor integrated circuit. |
| Certification | The process of submitting equipment to specific tests to determine that the equipment meets the specifications or safety standards. |
| CFG | Configuration File. When saving new configuration files, the file is saved as a *.cfg file. |
| Characteristics | Detailed information pertaining to it's description. The XFC stores this information in the PROM chip. A feature or quality that makes somebody or something recognizable. |
| Charge | The conversion of electrical energy, provided in the form of a current from an external source, into chemical energy within a cell or battery. |
| Chip | Another name for integrated circuit or the piece of silicon on which semiconductors are created. |

| TERM | DEFINITION |
|---|---|
| Chromatograph | An instrument used in chemical analysis, to determine the make-up of various substances, and often used to determine the Btu content of natural gas. Chromatography- A method of separating gas compounds by allowing it to seep through an adsorbent so that each compound is adsorbed in a separate layer. |
| CIM | Communication Interface Module. Totalflow's version is called TFIO Communication Interface Module. |
| Circuit | 1. The complete path between two terminals over which one-way or two-way communications may be provided. 2. An electronic path between two or more points, capable of providing a number of channels. 3. A number of conductors connected together for the purpose of carrying an electrical current. 4. An electronic closed-loop path among two or more points used for signal transfer. 5. A number of electrical components, such as resistors, inductances, capacitors, transistors, and power sources connected together in one or more closed loops. |
| Circuit board | Sometimes abbreviated PCB. Printed circuit boards are also called cards. A thin plate on which chips and other electronic components are placed. They fall into the following categories:<br>Motherboard: Typically, the mother board contains the CPU, memory and basic controllers for the system. Sometimes call the system board or main board.<br>Expansion board: Any board that plugs into one of the computer's expansion slots, including controller boards, LAN cards, and video adapters.<br>Daughter Card: Any board that attaches directly to another board.<br>Controller board: A special type of expansion board that contains a controller for a peripheral device.<br>Network Interface Card (NIC): An expansion board that enables a PC to be connected to a local-area network (LAN).<br>Video Adapter: An expansion board that contains a controller for a graphics monitor. |
| Class 1, Division 1 | Class 1 refers to the presence of hazardous gas. Division 1 refers to the conditions at the location: meaning that there is not sufficient airflow around the equipment to dissipate any gases that are accumulating in the vicinity. i.e. An enclosed space. |
| Class 1, Division 2 | Class 1 refers to the presence of hazardous gas. Division 2 refers to the conditions at the location: meaning that there is sufficient airflow around the equipment to dissipate any gases that are accumulating in the vicinity. |
| Clock | The source(s) of timing signals for sequencing electronic events (e.g. synchronous data transfer). |
| Closed Circuit Voltage | The difference in potential between the terminals of a cell/battery when it is discharging (on- load condition). |
| CMOS | See Complimentary Metal-Oxide-Semiconductor. |
| CNG | See Compressed Natural Gas |
| Coalbed Methane | A methane-rich, sulfur-free natural gas contained within underground coal beds. |
| Coefficient of expansion | The ratio of the change in length or volume of a body to the original length or volume for a unit change in temperature. |
| Coil | A conductor wound in a series of turns. |
| Cold Start | A rebooting technique which will clear all operational errors, loose all data files, but will not damage configuration files if stored on the SDRIVE. |
| Collector | The semiconductor region in a bipolar junction transistor through which a flow of charge carriers leaves the base region. |
| Column | Hardware component used in gas chromatography to separate components into measurable units. |
| Combustible | Classification of liquid substances that will burn on the basis of flash points. A combustible liquid means any liquid having a flash point at or above 37.8°C (100°F) but below 93.3°C (200°F), except any mixture having components with flash points of 93.3°C (200°F) or higher, the total of which makes up 99 percent or more of the total volume of the mixture. |

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| Comma Separated Values | These file types are importable records used by spreadsheet programs to display and manipulate data. |
| Communication Port | Comm. Port (abbreviation) refers to the host computer's physical communication's port being used to communicate with the equipment. Used by Totalflow when discussing local or remote communication with various equipment including the XFC, FCU, XRC, RTU and LevelMaster etc. |
| Complimentary Metal-Oxide-Semiconductor | Family of logic devices that uses p-type and n-type channel devices on the same integrated circuit. It has the advantage of offering medium speed and very low power requirements. |
| Component | (1) A small object or program that performs a specific function and is designed in such a way to easily operate with other components and applications. Increasingly, the term is being used interchangeably with applet. (2) A part of a device. |
| Compressed Gas | A gas or mixture of gases having, in a container an absolute pressure exceeding 40 psi at 21.1°C (70°F). A gas or mixture having in a container, an absolute pressure exceeding 104 psi at 54.4°C (130°F) regardless of the pressure at (21.1°C (70°F). A liquid having a vapor pressure exceeding 40 psi at 37.8°C (70°F) as determined by ASTM D-323-72. |
| Compressed Natural Gas | Natural gas in high-pressure surface containers that is highly compressed (though not to the point of liquefaction). CNG is used extensively as a transportation fuel for automobiles, trucks and buses in some parts of the world. Small amounts of natural gas are also transported overland in high-pressure containers. |
| Compressibility | The property of a material which permits it to decrease in volume when subjected to an increase in pressure. In gas-measurement usage, the compressibility factor "Z" is the deviation from the ideal Boyle and Charles' law behavior. See SUPERCOMPRESSIBILITY FACTOR. |
| Compressibility Factor | See Supercompressibility Factor. |
| Concentration | Amount of solute per unit volume or mass of solvent or of solution. |
| Concurrent | Performing more than one task at a time. |
| Condensate | A term used to describe light liquid hydrocarbons separated from crude oil after production and sold separately. |
| Condensation | Liquefaction of vapor. |
| Condensed Phases | The liquid and solid phases; phases in which particles interact strongly. |
| Condensed States | The solid and liquid states. |
| Configuration No. | The Configuration number is a 10 digit suffix of the serial number which defines the characteristics of the unit. |
| Console Mode | A local user interface typically used with custom applications that are not supported through any other mechanism. Also referred to as Printer Console Mode. |
| Contact | Current carrying part of a switch, relay or connector. |
| Conversion Time | The time required, in an analog input or output system, from the moment a channel is interrogated (such as with a read instruction) to the moment that accurate data is available. This could include switching time, settling time, acquisition time, A/D conversion time, etc. |
| Coprocessor | Another computer processor unit that operates in conjunction with the standard CPU. Can be used to enhance execution speed. For example, the 8087 is designed to perform floating point arithmetic. |
| COR | See Corrected Runtime. |
| Corrected Runtime | Correction to signal made to decrease/increase “ZERO phase” and eliminate the shift between RT and COR for increased accuracy. |
| Cos | Co-sign. |
| Cosine | The sine of the complement of an arc or angle. |
| CPU | See Central Processing Unit. |

| TERM | DEFINITION |
|---|---|
| CPUC | California Public Utilities Commission |
| CRC | See Cyclic Redundancy Check. |
| CRC | Cycling Redundancy Character |
| CSA | Canadian Standards Association. Canadian certification agency. |
| CTS | Communication abbreviation for Clear To Send. |
| Cubic Foot | The most common unit of measurement of gas volume in the US. It is the amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure, and water vapor. |
| Cubic Foot Metered | The quantity of gas that occupies one cubic foot under pressure and temperature conditions in the meter. |
| Cubic Foot, Standard | That quantity of gas which under a pressure of 14.73 psia and at a temperature of 60 degrees occupies a volume of one cubic foot without adjustment for water vapor content. |
| Cumulative Capacity | The total number of ampere-hours (or watt hours) that can be withdrawn from a cell/battery under specified conditions of discharge over a predetermined number of cycles or the cycle life. |
| Current | Current is measured in amps (milliamps and microamps). It is the passage of electrons. Conventional current flows from positive to negative. Electrons flow from negative to positive - called "electron flow". |
| Cursor | Dots used to indicate the location of the next character or symbol to be entered. |
| Custody Transfer | The legal and commercial transfer of a commodity such as natural gas, LNG, etc. from one party to another. |
| Custody Transfer Transaction | The Custody Transfer Transaction is the hand-off of the physical commodity from one operator to another. |
| Cut-Off Voltage | The cell/battery voltage at which the discharge is terminated. |
| CV | Calorific Value. European value of heating content. |
| Cycle | One complete sequence of events. One complete alteration of an AC current or Volt. The discharge and subsequent charge of a rechargeable cell/battery is called a cycle. |
| Cycle Life | The number of cycles under specified conditions which were available from a rechargeable cell/battery before it fails to meet specified criteria as to performance. |
| Cyclic Redundancy Check | An ongoing verification of the validity of transmitted and received data providing assurance that the message conforms to a pre-agreed upon convention of communications. |
| D/A | See Digital-to-analog. |
| D/I | See Digital Input. |
| D/O | See Digital Output. |
| DAC | See Digital to Analog Converter. |
| Data Acquisition | Gathering information from sources such as sensors and AMUs in an accurate, timely and organized manner. Modern systems convert this information to digital data, which can be stored and processed by a computer. |
| Data Collect | Physically, locally or remotely, retrieving data stored with a Totalflow unit. This data is typically stored in records located in a data base format. |
| DB1 | Acronym for Data Base 1. This refers to the previous data base structure used to store data in Totalflow products. |
| DB2 | Acronym for Data Base 2. This refers to the current data base structure used to store data in Totalflow products. |
| DC | See Direct Current |
| DCD | Communication abbreviation for Data Carrier Detect |
| DCS/PLC | Distribution Control System/Programmable Logic Controller |
| DDE | See Digital Data Exchange. Also called Dynamic Data Exchange. May refer to Totalflow's DDE Server TDS32. |
| Dead Weight Tester | Portable pressure tester used to check calibration and to calibrate AMU's utilizing a system of calibrated weights. |

| TERM | DEFINITION |
|---|---|
| De-bounce | De-bouncing is any kind of hardware device or software that ensures that only a single signal will be acted upon for a single opening or closing of a contact. When you press a key on your computer keyboard, you expect a single contact to be recorded by your computer. In fact, however, there is an initial contact, a slight bounce or lightening up of the contact, then another contact as the bounce ends, yet another bounce back, and so forth. A similar effect takes place when a switch made using a metal contact is opened. The usual solution is a de-bouncing device or software that ensures that only one digital signal can be registered within the space of a given time (usually milliseconds) |
| Decibel | A logarithmic measure of the ratio of two signal levels. A practical unit of gain. |
| Decimal | A numbering system based on 10. |
| Default | A value assigned or an action taken automatically unless another is specified. |
| Delivery Point | Point at which gas leaves a transporter's system completing a sale or transportation service transaction between the pipeline company and a sale or transportation service customer. |
| Demand Day | That 24-hour period specified by a supplier-user contract for purposes of determining the purchaser's daily quantity of gas used (e.g., 8 AM to 8 AM, etc.). This term is primarily used in pipeline-distribution company agreements. It is similar to, and usually coincides with, the distribution company "Contract Day". |
| Demand Load | The rate of flow of gas required by a consumer or a group of consumers, often an average over a specified short time interval (cf/hr or Mcf/hr). Demand is the cause; load is the effect. |
| Demand Meters | A device which indicates or records the instantaneous, maximum or integrated (over a specified period) demand. |
| Demand, Average | The demand on a system or any of its parts over an interval of time, determined by dividing the total volume in therms by the number of units of time in the interval. |
| Density | Mass per unit Volume: D=MV |
| Desaturization | Doesn’t cause the composition of the gas to change, enabling a more representative sample of gas. |
| Detector Bead | See Thermal Conductivity Detector. |
| Dewar | A glass or metal container made like a vacuum bottle that is used especially for storing liquefied gases. Also called “Dewar flask”. |
| DG | Display Group. When display group files are created |
| Diaphragm | A bellows inside a displacement type gas meter. Also, a membrane separating two different pressure areas within a control valve or regulator. |
| Differential Pressure | The pressure difference between two points in a system. For example, the difference in pressure between the upstream and downstream taps of an orifice plate, used to measure volume passing through the orifice. |
| Digital | A signal which has distinct states, either on or off (0 or 1). Digital computers process data as binary information having either true of false states. |
| Digital Data | Information transmitted in a coded form (from a computer), represented by discrete signal elements. |
| Digital Data Exchange or Dynamic Data Exchange | A Microsoft data exchange format generally used to transfer data from one program to another. It is a very simple format to use and Totalflow customers often use TDS to acquire data from Totalflow devices and then transfer the data to an Excel spreadsheet using DDE. The Totalflow Driver, TDS32, supports DDE and its network version, NetDDE. |
| Digital Electronics | The branch of electronics dealing with information in binary form. |
| Digital Input | Refers to the signal received in binary format. |
| Digital Output | Refers to the signal emitted in binary format. |
| Digital to Analog Conversion | The process of translating discrete data into a continuously varying signal. Common uses are to present the output of a digital computer as a graphic display or as a test stimulus. |
| Digital-to-Analog Converter | An electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current. |
| DIN | Deutsches Institut für Normung. German Institute for Standardization. |
| DIN Rail | Rail on which modules are mounted. Allows modules to snap on and slide right and left. |
| Diode | A semiconductor that allows current to flow in one direction only. |

| TERM | DEFINITION |
|---|---|
| DIP Switches | A bank of switches typically used in setting the hardware configuration and base address of an option card. |
| Direct Current | A current that does not change in direction. |
| Direct Memory Access | A method by which information can be transferred from the computer memory to a device on the bus without using the processor. |
| Discharge | The conversion of chemical energy of a cell/battery into electrical energy and withdrawal of the electrical energy into a load. |
| Discharge Rate | The rate, usually expressed in amperes, at which electrical current is taken from the cell/battery. |
| Discrete Manifold | Also called Tubing Manifold. Used in instances when the XFC is not mounted directly on the Orifice, usually pipe mount or wall mount. |
| Distillates | The distillate or middle range of petroleum liquids produced during the processing of crude oil. Products include diesel fuel, heating oil, kerosene and turbine fuel for airplanes. |
| Distillation | The first stage in the refining process in which crude oil is heated and unfinished petroleum products are initially separated. |
| Distribution | The act or process of distributing gas from the city gas or plant that portion of utility plant used for the purpose of delivering gas from the city gate or plant to the consumers, or to expenses relating to the operating and maintenance of distribution plant. |
| Distribution Company | Gas Company which obtains the major portion of its gas operating revenues from the operation of a retail gas distribution system, and which operates no transmission system other than incidental connections within its own system or to the system of another company. For purposes of A.G.A. statistics, a distribution company obtains at least 90 percent of its gas operating revenues from sales to ultimate customers, and classifies at least 90 percent of mains (other than service pipe) as distribution. Compare INTEGRATED COMPANY; TRANSMISSION COMPANY, GAS. |
| DN | Inside diameter standard. |
| DOS | Disk Operating System. |
| DOS CCU | Refers to the DOS version of the Calibration and Collection Unit. Also known as FS/2, hand held or Dog Bone. |
| DOT Matrix | A group of dots/pixels forming a character or symbol, usually five dots across and seven dots down. |
| DOT/Pixel | An active element that forms a character or symbol when combined in a matrix. |
| Download | This refers to a Totalflow procedure in which any file(s) located on a laptop PC or storage device, may be copied to the on-board memory of a Totalflow Host device for purposes of restoring, configuration or repair. |
| Downstream | The oil industry term used to refer to all petroleum activities from the processing of refining crude oil into petroleum products to the distribution, marketing, and shipping of the products. Also see Upstream. |
| Downstream Pipeline | The pipeline receiving natural gas at a pipeline inter-connect point. |
| DP | See Differential Pressure. |
| DRAM | See Dynamic Random Access memory. |
| Driver (Hardware) | An electronic circuit that provides input to another electronic circuit. |
| Driver (Software) | A program that exercises a system or system component by simulating the activity of a higher level component. |
| Drivers | Software that controls a specific hardware device, such as interface boards, PLCs, RTUs, and other I/O devices. |
| Droplet Liquids | Large liquid particles |
| Dry Contact | Contacts which neither break nor make a circuit. 0 Ohms. |
| DSP | Digital Signal Processor. |
| Dual-Access Memory | Memory that can be sequentially accessed by more than one controller or processor but not simultaneously accessed. Also known as shared memory. |
| Duplex | The ability to both send and receive data simultaneously over the same communications line. |

| TERM | DEFINITION |
|---|---|
| DVI | The Port Manager and communication engine of the iVision SCADA System. This software can multiplex among several communication formats and thus supporting several vendor's equipment over a single radio frequency. It "pushes" new data to the iVision database, saving time and network resources by not transmitting redundant data. The DVI includes the Totalflow WinCPC code and thus supports all Totalflow software and functions – including WinCCU, TDS, PCCU, Report by exception, cryout, etc. |
| Dynamic Random Access memory | This is the most common form of computer memory It needs to be continually refreshed in order to properly hold data, thus the term "dynamic." |
| $E^2$Prom | See Electrically Erasable Programmable Read-Only Memory. Also called EEPROM. |
| Earth | Can mean a connection to the earth itself or the negative lead to the chassis or any point to zero voltage. |
| EC | European Community. |
| Edit | Making changes to information, data or configuration files. |
| EEPROM | See Electrically Erasable Programmable Read-Only Memory. |
| EFI | Electromechanical Frequency Interface. |
| EFM | See Electronic Flow Measurement. |
| EFR | Enhance Feature Release. |
| Electrically Erasable Programmable Read-Only Memory | ROM that can be erased with an electrical signal and reprogrammed. Also referred to as the S Drive. It is a persistent drive that will not loose it's memory unless manually reprogrammed. Also called $E^2$Prom. Totalflow's XFC and XRC have a Serial EEPROM on board, which generally holds registry, application configuration and warranty information (non-volatile). |
| Electrode | The site, area, or location at which electrochemical processes take place. |
| Electromagnetic Compatibility | IEEE Standards for Electromagnetic Compatibility. |
| Electromagnetic Interference | Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like. |
| Electronic Flow Measurement | Historically, flow measurement was tracked using a chart recording technology. Developments in the field of electronics allowed for electronic measurement devices to overtake the chart recording market. This field continues to develop into peripheral markets, making the "Flow Meter" a valuable asset with multi-tasking "Control" capabilities. Totalflow's answer to this developing market is the XSeries equipment. |
| EMC | See Electromagnetic Compatibility |
| EMI | See Electromagnetic Interference. |
| Emitter | One terminal of a transistor. |
| EN | Euro Norm (European Standard) |
| Enagas | Spain's Certification Board |
| Encoder | A device that converts linear or rotary displacement into digital or pulse signals. The most popular type of encoder is the optical encoder, which uses a rotating disk with alternating opaque areas, a light source, and a photodetector. |
| Environmental Conditions | All conditions in which a transducer may be exposed during shipping, storage, handling, and operation. |
| EPROM | See Erasable Programmable Read-Only Memory. |
| Erasable Programmable Read-Only Memory | ROM that can be erased using Ultraviolet Light. The EPROM maybe re-programmed by removing the EPROM from the circuit and using special equipment to write to it. |
| Ethane (C2H6) | A colorless hydrocarbon gas of slight odor having a gross heating value of 1,773 Btu per cubic foot and a specific gravity of 1.0488. It is a normal constituent of natural gas. |
| Ethylene (C2H4) | A colorless hydrocarbon gas of slight odor having a gross heating value of 1,604 Btu per cubic foot and a specific gravity of 0.9740. It is usually present in manufactured gas, constituting one of its elements. |

| TERM | DEFINITION |
|---|---|
| EU | European Union. Formerly known as the European Community (EC). Members of this union are replacing individual national regulations of member countries with a series of Directives. These Directives are legislative instruments which oblige member states to introduce them into their existing laws. These directives harmonize a variety of existing practices, preserve the different legal traditions and settle constraints for further developments. |
| Event | Important incident: an occurrence, especially one that is particularly significant. |
| Event File | Stored records specifying a notable change. The XFC stores up to 200 records, containing: Time, Day, Description, Old Value, New Value. |
| Events | Signals or interrupts generated by a device to notify another device of an asynchronous event. The contents of events are device-dependent. |
| Ex | Potential Explosive. |
| Exp Enclosure | Explosion Proof Enclosure for Class 1 Division 1 locations |
| Expansion Board | A plug-in circuit board that adds features or capabilities beyond those basic to a computer, such as a data acquisition system expansion board. |
| Expansion Slots | The spaces provided in a computer for expansion boards than enhance the basic operation of the computer. |
| Extended Binary Coded Decimal Interchange Code | EBCDIC. An eight-bit character code used primarily in IBM equipment. The code allows for 256 different bit patterns. |
| External Multivariable Transducer | Multivariable Transducer located outside of the Flow Computer enclosure. Used in multi-tube configurations and on systems where the actual Flow Computer is located at a distance from the flowing tube. |
| F.O.B. | Abbreviation of free on board with the cost of delivery to a port and loading onto a ship included. |
| Fa | Orifice Thermal Expansion factor. |
| Faux | Full Well Stream Factor. |
| Fb | Basic Orifice factor. |
| FBD | Function Block Diagram (IEC supported programming language) |
| FCC | Federal Communications Commission. |
| FCU | Flow computer unit |
| Feed Points | Connections between gas feeder lines and distribution networks. |
| Feedback | Occurs when some or all of the output of the device (such as an amplifier) is taken back to the input. This may be accidental (such as the acoustic feedback from a speaker to microphone) or intentional , to reduce distortion. |
| Feeder (Main) | A gas main or supply line that delivers gas from a city gate station or other source of supply to the distribution networks. |
| FET | Field-effect transistor. Transistor with electric field controlling output: a transistor, with three or more electrodes, in which the output current is controlled by a variable electric field. |
| Fg | Specific Gravity factor. |
| Field Pressure | The pressure of natural gas as it is found in the underground formations from which it is produced. |
| Film Liquids | Aerosols liquids who have contacted each other and become adhered to the inside of the pipeline. |
| Firmware | A computer program or software stored permanently in PROM or ROM or semi-permanently in EPROM. |
| Firmware Version | This refers to the version of firmware contained in the equipment. |
| Fixed-Point | A format for processing or storing numbers as digital integers. |
| Flammable | A liquid as defined by NFPD and DOT as having a flash point below 37.8°C (100°F). |
| Flange | For pipe, a metal collar drilled with bolt holes and attached to the pipe with its flat surface at right angles to the pipe axis so that it can be securely bolted to a mating flange on a valve, another pipe section, etc. |

| TERM | DEFINITION |
|---|---|
| FLASH | Re-programmable memory onboard an XFC/XRC, similar to an EPROM, except that it can be programmed while in circuit using a Boot Loader Program to write to it. Generally used for the operating system and application code space (non-volatile). |
| Flash ADC | An Analog to Digital Converter whose output code is determined in a single step by a bank of comparators and encoding logic. |
| Flash Point | The temperature at which a liquid will yield enough flammable vapor to ignite. There are various recognized industrial testing methods; therefore the method used must be stated. |
| Flow Computer, X Series | A device placed on location to measure SP, DP and temperature (to calculate flow) of gases or liquids being transferred, for remote unattended operation. |
| Flow Formulas | In the gas industry, formulas used to determine gas flow rates or pressure drops in pipelines, regulators, valves, meters, etc. |
| Fluids | Substances that flow freely; gases and liquids. |
| Font | The style of lettering used to display information. |
| Footprint | The surface space required for an object. |
| Fpb | Pressure Base factor. |
| Fpv | See Supercompressibility Factor. |
| Fr | Reynolds Number factor. |
| Frequency | The number of cycles per second for any periodic waveform - measured in cycles per second - now called Hertz. The number of repeating corresponding points on a wave that pass a given observation point per unit time. |
| Frequency Modulation | Modulation where the frequency of the sinewave carrier alters with the amplitude of the modulating signal. |
| FRP | Fiberglass Reinforced Polyurethane. A non-flexible material used for LevelMaster sensors. |
| FS/2 | Ruggadized handheld computer device for programming and collecting data from an XFC. Also referred to a Husky or Dog Bone. |
| Ftb | Temperature Base factor. |
| Ftf | Flowing Temperature factor. |
| Fuel Oils | The heavy distillates from the oil refining process that are used primarily for heating, for fueling industrial processes, for fueling locomotives and ships, and for fueling power generation systems. |
| Full Duplex | Simultaneous, two-way (transmit and receive), transmission. |
| Function | A set of software instructions executed by a single line of code that may have input and/or output parameters and returns a value when executed. |
| Fuse | A short length of wire that will easily burn out when excessive current flows. |
| Fw | Water Vapor factor. |
| G | The symbol used for giga or gigabyte. |
| Gain | The factor by which a signal is amplified, sometimes expressed in dB. |
| Gain Accuracy | A measure of deviation of the gain of an amplifier from the ideal gain. |
| Gas | That state of matter which has neither independent shape nor volume. It expands to fill the entire container in which it is held. It is one of the three forms of matter, the other two being solid and liquid. |
| Gas Chromatograph | An analytical instrument that separates mixtures of gas into identifiable components by means of chromatography. |
| Gas Chromatograph Module | Software module used in conjunction with PCCU32 and WINCCU to interact with Btu Chromatograph equipment and software. |
| Gas Chromatograph Module Coefficient | A co-efficient generated by the factory allowing user to start calibration on location without having a calibration gas available. |
| Gas Chromatography | Preferred method for determining the Btu value of natural gas. |
| Gas Field | A district or area from which natural gas is produced. |
| Gas Injection | An enhanced recovery technique in which natural gas is injected under pressure into a producing reservoir through an injection well to drive oil to the well bore and the surface. |

| TERM | DEFINITION |
|---|---|
| Gas, Associated | Gas produced in association with oil, or from a gas cap overlying and in contact with the crude oil in the reservoir. In general, most states restrict associated gas production since its indiscriminate production could reduce the ultimate oil recovery. Also, since some wells producing associated gas cannot be shut-in without also shutting-in the oil production, natural gas pipelines are generally required to take associated gas produced from oil wells on a priority basis. |
| Gas, C1 | Methane. |
| Gas, C2 | Ethane. |
| Gas, C3 | Propane. |
| Gas, C6+ | Hexanes Plus (C6, C7, C8, C9, C10, C11, etc.). |
| Gas, CO2 | Carbon Dioxide. |
| Gas, Dry | Gas whose water content has been reduced by a dehydration process. Gas containing little or no hydrocarbons commercially recoverable as liquid product. Specified small quantities of liquids are permitted by varying statutory definitions in certain states. |
| Gas, IC4 | Iso-Butane. |
| Gas, IC5 | Iso-Pentane. |
| Gas, Liquefied Petroleum (LPG) | A gas containing certain specific hydrocarbons which are gaseous under normal atmospheric conditions but can be liquefied under moderate pressure at normal temperatures. Propane and butane are the principal examples. |
| Gas, Low Btu | Gas with a heating value of less than 250 Btu's per cubic foot. Typically heating values fall between 120 and 180 Btu's per cubic foot. |
| Gas, Manufactured | A gas obtained by destructive distillation of coal, or by the thermal decomposition of oil, or by the reaction of steam passing through a bed of heated coal or coke, or catalyst beds. Examples are coal gases, coke oven gases, producer gas, blast furnace gas, blue (water) gas, and carbureted water gas. Btu content varies widely. |
| Gas, Natural | A naturally occurring mixture of hydrocarbon and non-hydrocarbon gases found in porous geologic formations beneath the earth's surface, often in association with petroleum. The principal constituent is methane. |
| Gas, NC4 | Normal Butane. |
| Gas, NC5 | Normal Pentane. |
| Gas, NeoC5 | Neo-Pentane. |
| Gas, Non-associated | Free natural gas not in contact with, nor dissolved in, crude oil in the reservoir. |
| Gas, Oil | A gas resulting from the thermal decomposition of petroleum oils, composed mainly of volatile hydrocarbons and hydrogen. The true heating value of oil gas may vary between 800 and 1600 Btu per cubic foot depending on operating conditions and feedstock properties. |
| Gas, Sour | Gas found in its natural state, containing such amounts of compounds of sulfur as to make it impractical to use, without purifying, because of its corrosive effect on piping and equipment. |
| Gas, Sweet | Gas found in its natural state, containing such small amounts of compounds of sulfur that it can be used without purifying, with no deleterious effect on piping and equipment. |
| Gas, Unconventional | Gas that can not be economically produced using current technology. |
| Gas, Wet | Wet natural gas is unprocessed natural gas or partially processed natural gas produced from strata containing condensable hydrocarbons. The term is subject to varying legal definitions as specified by certain state statutes. |
| Gate Station | Generally a location at which gas changes ownership, from one party to another, neither of which is the ultimate consumer. It should be noted, however, that the gas may change from one system to another at this point without changing ownership. Also referred to as city gate station, town border station, or delivery point. |
| Gathering | The act of operating extensive low-pressure gas lines which aggregate the production of several separate gas wells into one larger receipt point into an interstate pipeline. |
| Gathering Agreement | Agreement between a producer and a gathering system operator specifying the terms and conditions for entry of the producer's gas into the gathering system. |
| Gathering Line | A pipeline, usually of small diameter, used in gathering gas from the field to a central point. |

| TERM | DEFINITION |
|---|---|
| Gathering Station | A compressor station at which gas is gathered from wells by means of suction because pressure is not sufficient to produce the desired rate of flow into a transmission or distribution system. |
| Gathering System | The gathering pipelines plus any pumps, tanks, or additional equipment used to move oil or gas from the wellhead to the main pipeline for delivery to a processing facility or consumer. |
| Gauge, Pressure | Instrument for measuring the relative pressure of a fluid. Types include gauge, absolute, and differential. |
| Gauging Tape Measurements | This refers to a manual method of measuring the level of a liquid in a tank. These measurements may be used to calibrate float levels. |
| GC | See Gas Chromatograph. |
| GCM | See Gas Chromatograph Module |
| GCMC | See Gas Chromatograph Module Coefficient. |
| GCN | Gravity, Carbon Dioxide and Nitrogen compounds. Used in NX-19 GCN Supercompressibility Factor. |
| GCNM | Gravity, Carbon Dioxide, Nitrogen and Methane compounds. Used in NX-19 GCNM Supercompressibility Factor. |
| GDF | Gasde of France |
| GND | See Ground. |
| GOST | Russian Certification |
| GPA 2145 | Gas Processors Association standard for values of gas components. |
| GPM | Gallons of liquid per thousand cubic feet. |
| GPS 2261 | See Gas Processors Standard 2261. |
| GRD | See Ground. |
| Ground | 1) An electronically neutral circuit having the same potential as the surrounding earth. Normally, a non-current carrying circuit intended for the safety purposes. A reference point for an electrical system. 2) A large conducting body (as the earth) used as a common return for an electric circuit and as an arbitrary zero of potential. |
| Grounding Strap | A grounding strap is a conductive device used to make connection between the person handling the board, and a high quality ground potential. |
| Half Duplex | Communication transmission in one direction at a time. |
| Handshaking | Exchange of predetermined signals between two devices establishing a connection. Usually part of a communications protocol. |
| Hardware | The physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, cables, and so on. It does not include data or computer programs. |
| Harmonic | A sinusoidal component of a waveform that is a whole multiple of the fundamental frequency. An oscillation that is an integral sub-multiple of the fundamental is called a sub-harmonic. |
| HART | Communication Interface. |
| Hazardous Area Classification | Any area likely to have an explosive combination of oxygen and fuel. |
| Heat | A form of energy that flows between two samples of matter because of their differences in temperature. |
| Heat Capacity | The amount of heat required to raise the temperature of a body (of any mass) one degree Celsius. |
| Heat of Condensation | The amount of heat that must be removed from one gram of a vapor at it's condensation point to condense the vapor with no change in temperature. |
| Heat of Vaporization | The amount of heat required to vaporize one gram of a liquid at its boiling point with no change in temperature. Usually expressed in J/g. The molar heat of vaporization is the amount of heat required to vaporize one mole of liquid at its boiling point with no change in temperature and usually expressed ion kJ/mol. |
| Heating Value | The amount of heat developed by the complete combustion of a unit quantity of a material. |

| TERM | DEFINITION |
|---|---|
| Heavy Crude | Crude oil of 20-degree API gravity or less; often very thick and viscous. |
| Heavy Hydrocarbons | More susceptible to increases in temperature and decreases in pressure, thus causing liquids to form. |
| Hertz | Cycles per second. A measure of frequency or bandwidth. |
| Hexadecimal | A numbering system to the base 16, 0 through F. |
| Hexanes | A saturated hydrocarbon (Alkane) with two carbon atoms in it's molecule ($C_2H_6$). A liquid under normal conditions. |
| Hierarchical | A method of organizing computer programs with a series of levels, each with further subdivisions, as in a pyramid or tree structure. |
| High Btu Gas | A term used to designate fuel gases having heating values of pipeline specification, i.e., greater than about 900 Btu's per standard cubic foot. |
| Host Console | Host Console via Local Port uses the PCCU cable between the computer and the device's Local PCCU port but running Remote Protocol. Host Console via Remote Port uses the remote protocol |
| Hub | A market or supply area pooling/delivery where gas supply transaction point occur that serve to facilitate the movement of gas between and among interstate pipelines. Transactions can include a change in title, a change in transporter, or other similar items. |
| HV | See Heating Value. |
| Hydrocarbon | A chemical compound composed solely of carbon and hydrogen. The compounds having a small number of carbon and hydrogen atoms in their molecules are usually gaseous; those with a larger number of atoms are liquid, and the compounds with the largest number of atoms are solid. |
| Hyperterm | Terminal emulation program provided with Windows. |
| Hysteresis | The maximum difference between output readings for the same measured point, one point obtained while increasing from zero and the other while decreasing from full scale. The points are taken on the same continuous cycle. The deviation is expressed as a percent of full scale. |
| I/O | See Input/Output. |
| I/O Address | A method that allows the CPU to distinguish between the different boards in a system. All boards must have different addresses. |
| $I^2C$ | Serial communications channel to I/O modules (developed by Phillips Semiconductor) |
| IAR | Maker and distributor of the Embedded Workbench, a compiler, assembler, linker development system for the Z80/64180 microprocessor family. |
| IC | See Integrated Circuit |
| ID | Identification Number. You must assign an ID to the unit. Units are communicated to by this ID number, therefore the ID assigned in the software must agree with the hardware. |
| IEC | International Electro-technical Commission. Developers of the IEC-61131-3 standard. Programming Language used by Totalflow for user applications in X Series equipment. |
| IEEE | Institute of Electrical and Electronics Engineers |
| IL | Instruction List (IEC supported programming language) |
| IMV | See Integral Multivariable Transducer. |
| IMV | See Multivariable Transducer. |
| Inch of Mercury | A pressure unit representing the pressure required to support a column of mercury one inch high at a specified temperature; 2.036 inches of mercury (at 32 degrees F and standard gravity of 32.174 ft/sec2) is equal to a gauge pressure of one pound per square inch. |
| Inch of Water | A pressure unit representing the pressure required to support a column of water one inch high. Usually reported as inches W.C. (water column) at a specified temperature; 27.707 inches of water (at 60o and standard gravity of 32.174 ft/sec2) is equal to a gauge pressure of one pound per square inch. |
| Industry Canada | Canadian Certification. |
| Inert | A material not acted upon chemically by the surrounding environment. Nitrogen and carbon dioxide are examples of inert constituents of natural gases; they dilute the gas and do not burn, and thus add no heating value. |

| TERM | DEFINITION |
|---|---|
| Initialization File | Generic file used to support the display of Totalflow application data in PCCU32. |
| Input | That part of a circuit that accepts a signal for processing. |
| Input Sense | To examine or determine the status of the input. |
| Input/Output | The transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces. |
| Instantiate | Starting an instance of an object. |
| Instrument Manifold | Manifold type used when XFC is mounted directly on the Orifice. |
| Insulator | Any material that resists the flow of electrical current. |
| Integral Multivariable Transducer | A Multivariable Transducer that is a part of the flow computer enclosure. Also see Multivariable Transducer. |
| Integrated Circuit | A circuit component consisting of a piece of semiconductor material containing up to thousands of transistor and diodes. A chip. |
| Integrating ADC | An ADC whose output code represents the average value of the input voltage over a given time interval. |
| Interface (computer) | Usually refers to the hardware that provides communication between various items of equipment. |
| Interface (liquid) | The area between two liquids that are not easily mixed, i.e. oil and water. |
| Interference | A disturbance to the signal in any communications system. |
| Inverter | A circuit in both analogue and digital systems that provides an output that is inverse to the input. |
| Inverter, DC to AC | Converts DC to AC at a high frequency. |
| ioINT | Interrupt signal from the I/O modules. |
| ioVBB | i/o Battery Voltage- Unregulated 13.8 volts. Host supplies 2.5 amps to the I/O modules. |
| ioVDD | Unregulated 5.6 volts from the host for I/O modules. |
| ISO | International Standards Organization. |
| Isobutane (C4H10) | A hydrocarbon of the same chemical formula as butane but different molecular structure, resulting in different physical properties, notably lower boiling point. Gross heating value 3261 Btu/cu. ft. gas. |
| Isokenetic Sampling | Laboratory technique where gas sample is tested after removing liquids, therefore not allowing the atomized liquid to return to the gaseous state, changing the sample accuracy. |
| IVision | SCADA system designed for oil and gas applications |
| Joule-Thompson Effect | Created by reducing the gas pressure by constriction, causing the gas to cool, creating condensation. |
| K | Kilo. 1) In referring to computers, a "kilo" is 1024 or 2 to the 10th power (Note that it is actually slightly more than an even 1000.). 2) the standard metric prefix for 1,000, or $10^3$, used with units of measure such as volts, hertz, and meters. |
| Kbytes/s | A unit for data transfer that means 1,000 or $10^3$ bytes/s. |
| Kerosene | An oily liquid obtained in the distilling of gasoline in a temperature range from 174-288 degree C. A hydrocarbon of specific gravity of 0.747 to 0.775. Used as fuel for some internal combustion engines, heating equipment, and illuminating purposes. A heavy grade known as range oil is used for cooking and heating. |
| KHz | Electronic abbreviation for Kilohertz. |
| kilobyte | 1024 bytes. |
| kilowatt-hour kWh | A unit of energy when one kilowatt of power is expended for one hour. Example A radiator bar is usually rated at 1,000 watts and this switched on for one hour consumes one kilowatt-hour of electricity. |
| KPa | Kilopascal-Measure of Pressure |
| LACT | Lease Automatic Custody Transfer. |
| Latent Heat of Vaporization | Represents the amount of heat required to vaporize a liquid. In the instance of natural gas, the equation appears: 1 Btu = heat to change. This is the most likely scenario for causing gas to liquefy. |

| TERM | DEFINITION |
|---|---|
| LCD | Liquid Crystal Display. |
| LD | Ladder Diagram (IEC supported programming language) |
| LED | Light Emitting Diodes. |
| LevelMaster | Intelligent Digital Level Sensor and is designed for custody transfer accuracy in demanding level measurement applications in tanks. LevelMaster is the name of the Totalflow's Tank Gauging System. |
| Life | For rechargeable batteries, the duration of satisfactory performance, measured in years (float life) or in the number of charge/discharge cycles (cycle life). |
| Light Crude | Crude oil with a high API gravity due to the presence of a high proportion of light hydrocarbon fractions. |
| Light Hydrocarbons | More volatile. |
| Linearity | The maximum deviation of the calibration curve from a straight line between zero and full scale, expressed as a percent of full scale output and measured on increasing measurement only. |
| Liquefied Natural Gas | Natural gas which has been liquefied by reducing its temperature to minus 260 degrees Fahrenheit at atmospheric pressure. It remains a liquid at -116 degrees Fahrenheit and 673 psig. In volume, it occupies 1/600 of that of the vapor at standard conditions. |
| Liquefied Petroleum Gas | A gas containing certain specific hydrocarbons which are gaseous under normal atmospheric conditions, but can be liquefied under moderate pressure at normal temperatures. Propane and butane are the principal examples. |
| Liquid Crystal Display | A reflective display that requires very low power for operation. |
| Liquids, Natural Gas | Those liquid hydrocarbon mixtures which are gaseous at reservoir temperatures and pressures but are recoverable by condensation or absorption. Natural gasoline and liquefied petroleum gases fall in this category. |
| LNG | See Liquefied Natural Gas. |
| Load (electrical) | A load is an energy consuming device. The device can be an actual device such as a bulb of a flash light, radio, cassette player, motor, etc., a resistor or a constant current load. |
| Load (units) | The amount of gas delivered or required at any specified point or points on a system; load originates primarily at the gas consuming equipment of the customers. Also, to load a pressure regulator is to set the regulator to maintain a given pressure as the rate of gas flow through the regulator varies. Compare DEMAND. |
| Location File | This is a file containing the configuration of the Location or site and the LevelMasters assigned to the Location. You may have a file that contains everything or a file for each Location name. The information from the file is displayed on the main MasterLink screen in the form of a tree structure. See the Main Screen topic for more information. |
| Location Name | Location Name is the top of the hierarchy tree of a Location File. Included in the Location Name is the LevelMaster's name, ID, S/N, Sensor File and Configuration no. |
| Log Period | In a XFC, the specified length between writing the calculated accumulated volume to record. You may record volumes as often as every minute and as seldom as every hour. More frequent recording reduces the number of days of records possible between collection. |
| Long Term | For Totalflow's purpose, the application of this term refers to storing data over a period of time that is greater than a minimal time. Such as data collected weekly versus data collected weekly but stored indefinitely. |
| LPG | See Liquefied Petroleum Gas. |
| LSB | Least Significant Byte |
| M | Mega, the prefix for 1,048,576, or $2^{20}$, when used with byte to quantify data or computer memory. Also 1000, as in MCF or 1000 Cubic Ft. |
| Manifold | The conduit of an appliance which supplies gas to the individual burners. Also, a pipe to which two or more outlet pipes are connected. |
| Man-Machine Interface | Software program that converts machine instructions and commands into a user interface. |
| Manometer | A two-armed barometer. |

| TERM | DEFINITION |
|---|---|
| MasterLink | MasterLink is the name of the software program used to communicate with the LevelMaster for purposes of doing setup, calibration, troubleshooting, generating site files, monitoring levels and collecting data. |
| Mbytes/s | A unit for data transfer that means 1 million or $10^6$ bytes/s. |
| Mcf | The quantity of natural gas occupying a volume of 1000 cubic feet at a temperature of 60° Fahrenheit and at a pressure of 14.73 psia. |
| Measurement Unit Assembly | μFLO's measurement and operational features are housed in this single unit assembly. The main electronic board (μFLO-195 Board), communication connection, power, SP, DP and Temperature readings are all housed in this unit. |
| Mega | Multiplier indicating that a quantity should be multiplied by 1,000,000. |
| Memory | Electronic devices that enable a computer to store and recall information. In its broadest sense, memory refers to any hardware capable of serving that end, e.g., disk, tape, or semiconductor storage. |
| Menu | The list of available functions for selection by the operator, usually displayed on the computer screen once a program has been entered. |
| MEPAFLOW | SICK Engineering's Menu-based Measurement and Parameterization Software for the TotalSonic system (MMI). |
| Mercaptans | Compounds of carbon, hydrogen and sulfur found in sour crude and gas; the lower mercaptans have a strong, repulsive odor and are used, among other things, to odorize natural gas. |
| Meter Manifold | Gas piping between gas service line and meter. Also, gas piping supplying two or more meters. |
| Meter, Orifice | A meter using the differential pressure across an orifice plate as a basis for determining volume flowing through the meter. Ordinarily, the differential pressure is charted. |
| Meter, PD | See Meter, Positive Displacement. |
| Meter, Positive Displacement | An instrument which measures volume on the basis of filling and discharging gas in a chamber. |
| Meter, Turbine | 1) Pulse meter. 2)A velocity measuring device in which the flow is parallel to the rotor axis and the speed of rotation is proportional to the rate of flow. The volume of gas measured is determined by the revolutions of the rotor and converting them to a continuously totalized volumetric reading. |
| Methane (CH4) | A hydrocarbon (Alkane)with the lightest molecule. A gas under normal conditions. The first of the paraffin series of hydrocarbons. The chief constituent of natural gas. Pure methane has a heating value of 1012 Btu per cubic foot. |
| Micro Flow Computer | See μFLO. |
| Microprocessor | This term is commonly used to describe the CPU. More specifically, it refers to the part of the CPU that actually does the work, since many CPUs now contain L1 and L2 caches on-chip. |
| Milli | One thousandth e.g. one milli-watt - 1mW. one milli-amp - 1mA. one milli-volt -1mV. |
| MIPS | Million instructions per second. The unit for expressing the speed of processor machine code instructions. |
| MMBtu | A thermal unit of energy equal to 1,000,000 Btu's, that is, the equivalent of 1,000 cubic feet of gas having a heating content of 1,000 BTUs per cubic foot, as provided by contract measurement terms. |
| MMcf | A million cubic feet. See CUBIC FOOT. (1,000,000 CF) |
| MMI | See Man-Machine Interface. |
| Modbus | Messaging structure developed and used to establish master-slave/client-server communication between intelligent devices. Generic protocol supported by most process automation vendors. |
| Modem | Modulator-Demodulator. A device used to convert serial digital data from a transmitting terminal to a signal suitable for transmission over a common carrier, or to reconvert the transmitted signal to digital data for acceptance by a receiving terminal. |
| Module | Typically a board assembly and its associated mechanical parts, front panel, optional shields, and so on. A module contains everything required to occupy one or more slots in a mainframe. |

| TERM | DEFINITION |
|---|---|
| Mole Percent | The number of moles of a component of a mixture divided by the total number of moles in the mixture. |
| MRB | Modbus Request Block. When requesting storage space after adding a new Modbus application, the file is saved as a *.mrb file. |
| MRM | Modbus Register Map. When requesting storage space after adding a new Modbus register, the file is saved as a *.mrm file. |
| MS | Milliseconds. One-thousandth of a second. |
| MSB | Most Significant Byte |
| Multi-tasking | A property of an operating system in which several processes can be run simultaneously. |
| Multi-tube Sites | Locations where many flow tubes are all within a prescribed distance allowing one flow meter with multitube capabilities, such as the XSeries product line, to monitor and maintain flow records for each tube in one Flow Computer. |
| Multivariable Transducer | Transducer supplying more than 1 variable. Totalflow uses this term to encompass units that read Static Pressure, Differential Pressure and Temperature. Historically these units were coined AMU for Analog Measurement Unit. As a result of advanced technology, the unit no longer functions as only an analog measurement unit. Therefore the newer terminology, Multivariable Transducer, more aptly describes the functionality of this design. The abbreviation XIMV, refers to the External version of the multivariable. The abbreviation IMV refers to the Integral version of the multivariable. |
| MW | Acronym for Molecular Weight. |
| N.C. | See Normally Closed. |
| N.O. | See Normally Open. |
| N2 | Nitrogen |
| NAK | See Negative Acknowledgement |
| NAMUR | Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie (Standards study group for measurement and process control technology in the chemical industry). |
| Natural Gas Distillate | Material removed from natural gas at the "heavy end" portion; that is, aliphatic compounds ranging from C4 to C8 (butanes and heavier). |
| Natural Gas Liquids | The hydrocarbon components: propane, butanes, and pentanes (also referred to as condensate), or a combination of them that are subject to recovery from raw gas liquids by processing in field separators, scrubbers, gas processing and reprocessing plants, or cycling plants. The propane and butane components are often referred to as liquefied petroleum gases or LPG. |
| Negative Acknowledgment | This refers to a response over a remote communication device, such as a PING. Basically, saying, "I don't acknowledge your request!" This is the opposite of ACK. NAK is a slang term that means that you disagree or do not acknowledge something. |
| NEMA | National Electrical Manufacturers Association. |
| Newton Meter | Torque measurement unit equal to 8.84 Inch Pounds. |
| NGL | See Natural Gas Liquids. |
| Nm | Abbreviation for Newton Meter. Metric Torque measurement. |
| Noise | An undesirable electrical signal. Noise comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Unwanted disturbances superimposed upon a useful signal that tends to obscure its information content. |
| Non-Persistent | Refers to data that is no longer available after a Warm Start. |
| Normally Closed | Designation which states that the contacts of a switch or relay are closed or connected when at rest. When activated, the contacts open or separated. |
| Normally Open | Designation which states that the contacts of a switch or relay are normally open or not connected. When activated the contacts close or become connected. |
| Norsok | Norwegian Certification Bureau |
| NPN | Negative-Positive-Negative (Transistor). |
| NPT | National Pipe Thread. |

| TERM | DEFINITION |
|---|---|
| NRTL | Nationally Recognized Testing Laboratory. |
| NX-19 | American Gas Association Report referring to a specific method to calculate the Supercompressibility factor. |
| OCV | See Open Circuit Voltage. |
| ODBC | See Open Database Connectivity. |
| OHM | The unit of resistance usually shown as the symbol "R". One thousand ohms is written "k" and one million ohms is written "M". Resistance is measured with a multimeter, set to the "ohms range". |
| OLE | Object Linking and Embedding. A set of system services that provides a means for applications to interact and interoperate. Based on the underlying Component Object Model, OLE is object-enabling system software. Through OLE Automation, an application can dynamically identify and use the services of other applications, to build powerful solutions using packaged software. OLE also makes it possible to create compound documents consisting of multiple sources of information from different applications. |
| Ole for Process Control | This is a data interchange format and supporting software. Typically, vendors (such as ABB) write OPC server drivers which can talk to their devices. SCADA system vendors (again like ABB) write OPC clients that can gather data from OPC Servers. The idea is to provide a universal way to collect data into a SCADA system regardless of the equipment vendor. This standard was developed and is maintained by the OPC Foundation. The Totalflow Driver, TDS32, supports OPC. |
| Ole for Process Control Database | A programming interface to databases. IVision supports the OLEDB interface. |
| OLEDB | See Ole for Process Control Database. |
| Olefins | Basic chemicals made from oil or natural gas liquids feedstocks; commonly used to manufacture plastics and gasoline. Examples are ethylene and propylene. |
| OOP | Object-Oriented Programming. The XFC/XRC architecture incorporates an object-oriented approach. |
| OPC | See Ole for Process Control. |
| Open Circuit | A complete break in a metal conductor path. |
| Open Circuit Voltage | The difference in potential between the terminals of a cell/battery when the circuit is open (no-load condition). |
| Open Collector | A single NPN transistor with the base connected to the logic driving circuitry and with the emitter grounded. The collector is the output pin of the gate. |
| Open Database Connectivity | A widely accepted application-programming interface (API) for database access. It is based on the Call-Level Interface (CLI) specifications from X/Open and ISO/IEC for database APIs and uses Structured Query Language (SQL) as its database access language. Using ODBC, you can create database applications with access to any database for which your end-user has an ODBC driver. This allows access for authorized users to databases over any network, including the Internet. The iVision SCADA system provides an ODBC driver, making the database accessible to authorized users anywhere on a corporate network, or even over the Internet if the network is properly configured. |
| Operating System | Base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices. |
| Orifice Meter | Device to record differential pressure measurement which uses a steel plate with a calibrated hole or orifice to generate a drop in pressure between the two sides of the plate. Also the primary element of the meter run. |
| Orifice Plate | A plate of non-corrosive material which can be fastened between flanges or in a special fitting perpendicular to the axis of flow and having a concentric circular hole. The primary use is for the measurement of gas flow. |
| ORing | Boolean algebra logical function. Described as the addition or summing of switches or inputs, in the case of Boolean elements, the 0 and 1 represent two possible states of a premise or hypothesis: True or False, On or Off. When adding Boolean elements not real numbers, you will find these results:<br>1 or 1 = 1<br>1 or 0 = 1<br>0 or 1 = 1<br>0 or 0 = 0 |

| TERM | DEFINITION |
|---|---|
| O-Ring | A flat ring made of rubber or plastic, used as a gasket. |
| Output | That part of a circuit where the processed signal is available. |
| P/I | See Pulse Input. |
| Parameter | (1) Characteristic. For example, *specifying parameters* means defining the characteristics of something. In general, parameters are used to customize a program. For example, file names, page lengths, and font specifications could all be considered parameters. (2) In programming, the term *parameter* is synonymous with argument, a value that is passed to a routine. |
| Passive Analog Output | Analog Output to a host that is powered by an outside source. |
| PCCU | Portable Collection and Calibration Unit. |
| PCCU32 | Windows version of PCCU communications software to process, archive and collect data from the Totalflow equipment. Generally run from a laptop. |
| Peak Area | The retention time the element takes to exit the column. This is used in calculating the amount of each component in the sample or Mole %. |
| Pentane (C5H12) | A saturated hydrocarbon (Alkane) with five carbon atoms in it's molecule ($C_5H_{12}$). A liquid under normal conditions. |
| Peripheral | The input/output and data storage devices attached to a computer such as disk drives, printers, keyboards, displays, data acquisition systems, etc. |
| Persistent | Refers to data that remains available after a Warm Start. |
| PEX | A flexible material used for LevelMaster sensors. |
| Phenol | Hydrocarbon derivative containing an [OH] group bound to an aromatic ring. |
| Physical Change | A change in which a substance changes from one physical state to another but no substances with different composition are formed. Example Gas to Liquid - Solid. |
| PID | See Proportional, Integral, Derivative. |
| Piezoceramic | A ceramic material that has piezoelectric properties similar to those of some natural crystals. |
| PLC | See Programmable logic controller |
| Plunger Lift | A technique used to optimize gas production. A Steel plunger is inserted into the production tubing in the well. The flow is turned off and this shut-in causes plunger to fall allowing fluid to collect above plunger. Different techniques are used to decide how long to shut in and flow the well. |
| Polling | A snapshot view of the readings taken by the Totalflow equipment. |
| Port | A communications connection on a computer or a remote controller. A place of access to a device or network, used for input/output of digital and analog signals. |
| Positive Temperature Co-efficient fuse | Opens circuit when high current condition occurs. Closes when condition no longer exists. Replaces typical fuses, which require replacement when blown. |
| POU | Program Organization Unit. This is Softing's term for an 'independent programming unit'. Programs, functions, etc. |
| Pressure Differential | Difference in pressure between any two points in a continuous system. |
| Pressure Markers | Pressure testing at different levels of pressure. Used for comparison purposes. |
| Pressure, Absolute | See PSIA. |
| Pressure, Atmospheric | See Atmospheric Pressure. |
| Pressure, Gas | In the natural gas industry pressure is measured by the force applied to a designated area. PSI and OSI refer to how much pressure (pound or ounce) is applied to one square inch. Inches Water Column (In.W.C.) is also used to express gas pressure and is measured using a manometer for lower pressure readings. 1 PSIG=27.21 Inches Water Column. |
| Pressure, Gauge | See PSIG. |
| Primary Cell (or Battery) | A cell or battery which is not intended to be recharged and is discarded when the cell or battery has delivered all its electrical energy. |
| PRM | Acronym for Pressure Regulator Module. |
| Process Gas | Gas use for which alternate fuels are not technically feasible, such as in applications requiring precise temperature controls and precise flame characteristics. |

| TERM | DEFINITION |
|---|---|
| Programmable Logic Controller | A highly reliable special-purpose computer used in industrial monitoring and control applications. PLCs typically have proprietary programming and networking protocols, and special-purpose digital and analog I/O ports. |
| Programmable Read Only Memory | Computer memory in which data can be written to. ROM is used for storing programs (e.g. operating systems) and characteristic files on a permanent basis. (non-volatile) |
| Programmed I/O | The standard method a CPU uses to access an I/O device-- each byte of data is read or written by the CPU. |
| PROM | See Programmable Read Only Memory |
| Propane (C3H8) | A saturated hydrocarbon (Alkane) gas, the molecule of which is composed of three carbon and eight hydrogen atoms. Propane is present in most natural gas and is the first product refined from crude petroleum. It has many industrial uses and may be used for heating and lighting. Contains approximately 2,500 Btu per cubic foot. |
| Proportional, Integral, Derivative | PID Controllers are designed to eliminate the need for continuous operator attention. An example would be the cruise control in a car or a house thermostat. These controllers are used to automatically adjust some variable to hold the measurement (or process variable) at the set-point. The set-point is where you would like the measurement to be. Error is defined as the difference between set-point and measurement. |
| Protocol | A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems. |
| PSI | Pounds per Square Inch. |
| PSIA | Pounds per Square Inch Absolute. Absolute pressure uses a perfect vacuum as the zero point. A perfect vacuum is 0 PSIA.<br>PSIA=PSIG + Atmospheric Pressure. |
| PSIG | Pounds per Square Inch Gauge. Gauge pressure uses the actual atmospheric pressure as the zero point. |
| PTB | Physikalisch Technische Bundesanstalt (Federal Physical Technical Office) or Technical Institute for Certification. |
| PTC | See Positive Temperature Co-efficient Fuse. |
| Pulse Input | Any digital input to a meter (usually a turbine) that is used to measure pulses over a time period. This calculates volume and flow rate for each period of time. |
| Pulse Mode | An operational mode used by the LevelMaster for measuring single float levels by transmitting a pulse to the primary windings, reading the voltage level on both the primary and secondary windings and using a calculation whereby one is subtracted from another to determine the single fluid level. |
| Pulse Output | Any digital output that is used to measure pulses over a period of time. Frequency of Pulses in a predetermined time frame represents a value to be used in calculating volume and flow rate. |
| Radio Frequency | RF for short. That part of the spectrum from approx. 50kHz to gigahertz. |
| Radio Frequency Interference | Electromagnetic radiation which is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits. |
| RAM | See Random Access Memory. |
| RAM Disk | A lithium backed storage chip. Also see Random Access Memory. |
| Random Access Memory | Onboard read/write volatile memory, generally used for application variables and the file system. Data stored is lost if power is removed (volatile). |
| Rated Capacity | The number of ampere-hours a cell/battery can deliver under specific conditions (rate of discharge, cut-off voltage, temperature). |
| RBUS | Communication abbreviation for Results Bus. |
| RCV | Communication abbreviation for Received. |
| RD | Acronym for Relative Density. |
| RDrive | Refers to Totalflow's SRam Drive (solid state memory chip) located on the main board, used to store data and configuration files. The RDrive is a lithium backed, volatile memory chip and is not affected by a warm start. |

| TERM | DEFINITION |
|---|---|
| Read Only Memory | Computer memory in which data can be routinely read but written to only once using special means when the ROM is manufactured. ROM is used for storing data or programs (e.g. operating systems) on a permanent basis. |
| Real Time | Data acted upon immediately instead of being accumulated and processed at a later time. |
| Real Time Data Base | The iVision SCADA system has an in-memory RTDB for the data it collects from various devices. Real-time generally means that the data is acquired often enough that the user can make operational changes to the process while it is still useful to do so. On a factory floor, this can be in milliseconds. For remote devices which may require a couple of hours of drive time to reach, real-time can be thought of in tens of minutes or even hours. The iVision data base can meet either of these requirements. |
| Real Time Operating System | Any operating system where interrupts are guaranteed to be handled within a certain specified maximum time, thereby making it suitable for control of hardware in embedded systems and other time-critical applications. RTOS is not a specific product but a class of operating system. |
| Recharge/Charge | The conversion of electrical energy, provided in the form of a current from an external source (charger), into chemical energy within a cell/battery. |
| Recommended Standard 232 | This is the standard interface for full-duplex data communication conducted with two way independent channels. It employs unbalanced signaling and refers to point-to-point communications between one driver and one receiver in a 4-wire bus system.<br>The RS-232 (single-ended) transmits at a relatively slow data rate (up to 20K bits per second) and short distances (up to 50 Ft. @ the maximum data rate). |
| Recommended Standard 422 | This is the standard interface for half-duplex communications conducted with a dual-state driver. It employs balanced signaling and refers to multi-drop communications between one driver and up to ten receivers, known as “straight-through” cabling in a 4-wire bus system.<br>The RS-422 (Differential) transmits a much faster data rate (up to 100K bits per second) and longer distances (up to 4000 Ft. @ the maximum data rate). |
| Recommended Standard 485 | This is the standard interface for half-duplex communications conducted in the tri-state or common mode. It employs balanced signaling and refers to true multi-point communications between up to 32 drivers and 32 receivers, in 2-wire bus system.<br>The RS-485 (Differential) transmits a much faster data rate (up to 100K bits per second) and longer distances (up to 4000 Ft. @ the maximum data rate). It also supports more nodes per line because it uses lower impedance drivers and receivers. |
| Relay | Electromechanical device containing a coil and set of contacts. The contacts close when the coil is activated. |
| Remote Controller, X Series. | Totalflow’s X series Remote Controller is a low power, microprocessor based unit designed to meet a wide range of automation, monitor, control, alarming and measurement applications. |
| Remote Terminal Unit | An industrial data collection device similar to a PLC, designed for location at a remote site, that communicates data to a host system by using telemetry (such as radio, dial-up telephone, or leased lines). |
| Resistance | The measure of the ability of a material to pass a current. |
| Resistant Thermal Detector | A metallic probe that measures temperature based upon its coefficient of resistivity. |
| Resistor | Passive component with a known resistance. The value of resistance is usually shown by a set of colored bands on the body of the component. |
| Resolution | The smallest significant number to which a measurement can be determined. For example, a converter with 12-bit resolution can resolve 1 part in 4096. |
| Restore | This refers to a Totalflow procedure in which all the Station or Configuration files are restored to the SDRIVE from the file located on the laptop. This process is very helpful prior to doing a Cold Start when you want to continue using the Configuration and Station files. |
| RFI | See Radio Frequency Interference. |
| Ribbon Cable | A flat cable in which the conductors are side by side rather than in a bundle. |
| ROM | See Read Only Memory |
| RRTS | Communication abbreviation for Remote Ready To Send. |
| RS-232 | See Recommended Standard 232. |

| TERM | DEFINITION |
|---|---|
| RS-422 | See Recommended Standard 422. |
| RS-485 | See Recommended Standard 485. |
| RT | See Runtime. |
| RTD | See Resistant Thermal Device. |
| RTDB | See Real Time Data Base. |
| RTOS | See Real Time Operating System. |
| RTS | Communication abbreviation for Ready To Send. |
| RTU | See Remote Terminal Unit |
| Runtime | The time required for an acoustic signal to travel from point A to point B. This measurement is used in calculating the speed of Sound, gas velocity and volume in the TotalSonic Meter. |
| RXD | Communication abbreviation for Receive Data. |
| S/N | Serial Number. The whole Serial Number is made up of a prefix of 5 digits and the suffix, a 10 digit configuration number. |
| Saddle | A fitted plate held in place by clamps, straps, heat fusion, or welding over a hole punched or drilled in a gas main to which a branch line or service line connection is made. The saddle also may serve as a reinforcing member for repair. |
| Sample Loop | A tube with a given volume used in conjunction with a valve for measuring and holding the sample gas before pushing it into the chromatograph column. |
| Saturated Hydrocarbons | Hydrocarbons that contain only single bonds. They are also called Alkanes or paraffin hydrocarbons. |
| Save | This refers to a Totalflow procedure in which all the Station or Configuration files are copied from the RDRIVE or the SDRIVE, to a file created on a laptop. |
| Savitsky-Golay Smoothing | Digital Signal Smoothing. A special class of a digital signal processing filter. Specifically determines the coefficients that are used for signal processing. |
| SCADA | See Supervisory Control and Data Acquisition |
| Schematic | Another name for a circuit diagram. |
| SCM | Acronym for Sample Conditioning Module. |
| SDRIVE | Totalflow's Serial $E^2$ PROM solid state memory chip, located on the Main Board (volatile memory, affected by a cold start), used to store configuration or station files. |
| Selectable Units | Selectable measurement units for various international and specialized application needs. |
| Self-Calibrating | A property of a DAQ board that has an extremely stable onboard reference and calibrates its own A/D and D/A circuits without manual adjustments by the user. |
| Semiconductor | Material that is nether a conductor nor insulator. Its properties can be altered by a control voltage. |
| Sensor | A device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal. |
| Sensor File | The Sensor File contains all the setup/calibration information of the unit. The Sensor File is a (.dat) file and by default is named after the base serial number proceeded by an "s", such as s00108.dat. Although the name can be overwritten, it is recommended that the default name be kept. |
| Serial I/O | A common form of data transmission, in which the bits of each character are sent one at a time over the line. |
| Serial Port | A communications interface that uses one data line to transfer data bits sequentially. On the IBM PC the serial port refers to a standard asynchronous serial interface which uses the 8250/16450/16550 family of UART's. |
| Service Life | The period of useful life (usually in hours or minutes) of a primary cell/battery before a predetermined cut-off voltage is reached. |
| Set-Point | A "level" or control point in a feedback system. |
| SFC | Sequential Function Chart (IEC supported programming language) |
| SG | Acronym for Specific Gravity. |

| TERM | DEFINITION |
|---|---|
| Short Circuit | A connection of comparatively low resistance accidentally or intentionally made between points on a circuit between which the resistance is normally much greater. Also called a "bridge" or "short" such as when solder from two tracks touch on a PC board. |
| SIG | See Signal. |
| Signal | Any communication between message-based devices consisting of a write to a signal register. |
| Signal Generator | A circuit that produces a variable and controllable signal. |
| Signed Integer | Can represent a number half the size of a “unsigned integer”, including a negative number. |
| Sink | Device such as a load that consumes power or conducts away heat. |
| Skip Days | Extra Daily records for recording events that require the start of a new day. i.e. Volume Reset, Backward Time change over the hour, and Contract Hour change. |
| SNAM | Italy’s Certification Board |
| SNR | Signal to Noise Ratio. |
| SoftCONTROL | Softing’s IEC compiler environment |
| Softing | Maker and distributor of the IEC compiler softCONTROL |
| Software | The non-physical parts of a computer system that include computer programs such as the operating system, high-level languages, applications programs, etc. |
| Solar cell | A cell that produces current under sunlight. |
| Solenoid | A coil of wire that is long compared to its diameter, through which a current will flow and produce a magnetic flux to push or pull a rod (called an armature). |
| SOS | See Speed of Sound. |
| Source | Device that provides signal power or energy to a load. |
| SP | See Static Pressure |
| Specific Gravity | The ratio of the mass of a solid or liquid to the mass of an equal volume of distilled water at 4°C (39°F) or of a gas to an equal volume of air or hydrogen under prescribed conditions of temperature and pressure. Also called *relative density*. |
| Speed of Gas | Rate at which gas travels through the pipeline. Used in flow calculations in the TotalSonic Meter. Calculations follow AGA 9 Report. |
| Speed of Sound | Rate at which sound travels through the medium. Used in flow calculations in the TotalSonic Meter. Calculations follow AGA 10 Report. |
| SPU | Signal Processing Unit (measurement transducer). |
| SQL | See Structured Query Language. |
| SRAM | See Static Random Access Memory |
| SSM | Acronym for Stream Selector Module. |
| ST | Structured Text (IEC supported programming language) |
| Static Pressure | Equals PSIA or PSIG. Referenced to atmospheric pressure versus absolute pressure in a vacuum. It is defined as the pressure exerted by a non-moving liquid or gas. In the case of a gas well this would be the natural PSI of the gas inside of the well. |
| Static Random Access Memory | The place in your computer that programs reside when running. You can access any part of the memory, and it can easily be overwritten with new values. SRAM is much more expensive and physically larger than DRAM but much faster. |
| Status Output | Any digital output that uses “On” or “Off” conditions to determine the status of the assigned description. Changing from one to the other represents a change in the condition. |
| STP | Standard Temperature and Pressure |

| TERM | DEFINITION |
|---|---|
| Structured Query Language | IBM developed this language in the 60's as a way of accessing data from a relational database. It has a very simple syntax for simple functions but can become complex for sophisticated applications. This language is standardized by international standards bodies, and is almost universal in application. Almost all databases support SQL. The iVision RTDB supports SQL and this makes it extremely flexible within a corporate network. Authorized users throughout the organization can write SQL statements to acquire data from this database that they need for Marketing, Accounting, Engineering, or other functions. |
| Supercompressibility Factor | A factor used to account for the following effect: Boyle's law for gases states that the specific weight of a gas is directly proportional to the absolute pressure, the temperature remaining constant. All gases deviate from this law by varying amounts, and within the range of conditions ordinarily encountered in the natural gas industry, the actual specific weight under the higher pressure is usually greater than the theoretical. The factor used to reflect this deviation from the ideal gas law in gas measurement with an orifice meter is called the "Supercompressibility factor Fpv". The factor is used to calculate corrected from volumes at standard temperatures and pressures. The factor is of increasing importance at high pressures and low temperatures. |
| Supervisory Control and Data Acquisition | A common PC function in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by a PC. |
| Surge | A sudden change (usually an increase) in the voltage on a power line. A surge is similar to a spike, but is of longer duration. |
| SW VBATT | Switched Battery Voltage. Cycles power to equipment to save power. |
| Switch | An electrical device for connecting and disconnecting power to a circuit, having two states, on (closed) or off (open). Ideally having zero impedance when closed and infinite impedance when open. |
| Synchronous | (1) Hardware - A property of an event that is synchronized to a reference clock. (2) Software - A property of a function that begins an operation and returns only when the operation is complete. |
| Syntax | Comparable to the grammar of a human language, syntax is the set of rules used for forming statements in a particular programming language. |
| System Noise | A measure of the amount of noise seen by an analog circuit or an ADC when the analog inputs are grounded. |
| TankMaster | Totalflow Control System for LevelMaster Tank Units. |
| Tap | To cut threads in a round hole so that other fittings or equipment can be screwed into the hole. Also to make an opening in a vessel or pipe. |
| TBUS | Communication abbreviation for Transmit Bus. |
| TCD | See Thermal Conductivity Detector. |
| TCP/IP | TCP/IP – This is the basic communication format for the Internet, and for much of what happens on a corporate network. Virtually all networked PCs and other computers have an "IP address" having the format xxx.xxx.xxx.xxx (xxx can range from 0 to 255 in most cases). You can see the ip address of your PC by going to the start menu, selecting run, and entering cmd. A "DOS Box" will be displayed on your screen. Type ipconfig to get the ip address. When you enter a URL (e.g., www.totalflow.com) in a browser, a DNS server (on the network) resolves this into an IP address and directs your request to the machine with that address. |
| TDS32 | Totalflow DDE Server that allows Microsoft Windows applications with DDE capabilities to communicate with Totalflow's equipment. For example data can be retrieved and placed in an Excel spreadsheet. |
| Temperature Coefficient | An experimental number used to modify the calibration of a device (Totalflow transducer) to account for changes in environmental temperature. |
| Temperature, Ambient | The temperature of the air, atmosphere or other fluid that completely surrounds the apparatus, equipment or the work piece under consideration. For devices which do not generate heat, this temperature is the same as the temperature of the medium at the point of device location when the device is not present. For devices which do generate heat, this temperature is the temperature of the medium surrounding the device when the device is present and generating heat. Allowable ambient-temperature limits are based on the assumption that the device in question is not exposed to significant radiant-energy sources such as sunlight or heated surfaces. |
| Temperature, Flowing | Temperature of the flowing fluid. Usually gas and measured by an RTD. |

| TERM | DEFINITION |
|---|---|
| Terminal Mode | Man-Machine interface tool used as and engineering interface with equipment. |
| Termination | Placement of a connector on a cable. |
| Termination Panel | A circuit board with screw terminals or other connector system that allows convenient connection of field signals to a data acquisition or communication system. |
| TF.NET | Totalflow network used to access iVision/web data. |
| TFIO Module | Totalflow Input/Output module (i.e. quad AO) |
| Thermal Conductivity Detector | Universal detector that shows a response to all compounds. An electrical component that changes resistance based on the components ability to conduct heat. In chromatography, two TCDs are used, 1)as a reference detector and 2) as the sensor detector. The reference detector is exposed to only the carrier gas and the Sensor detector is exposed to the sample. |
| Thermistor Bead | See Thermal Conductivity Detector. |
| Thermocouple | A temperature sensor created by joining two dissimilar metals. The junction produces a small voltage as a function of the temperature. |
| Thermowell | A closed-end tube designed to protect temperature sensors from harsh environments, high pressure, and flows. They can be installed into a system by pipe thread or welded flange and are usually made of corrosion-resistant metal or ceramic material depending upon the application. |
| Therms Master | Totalflow application for Gas Analyzer. |
| Tolerance | The allowable percentage variation of any component from that stated on its body. |
| Totalflow | Product line of ABB Inc. Maker and distributor of the X Series Flow Computers (XFC) and Remote Controllers (XRC). |
| TotalSonic MMI | TotalSonic's Man Machine Interface software program. May also be called MEPAFLOW 600. |
| Transducer | A device for converting energy from one form to another, specifically the measurement of pressure differential in natural gas gate stations. I.e. Pressure to voltage or current. |
| Transfer Rate | The rate, measured in bytes/s, at which data is moved from source to destination after software initialization and set up operations; the maximum rate at which the hardware can operate. |
| Transient | An abrupt change in voltage, of short duration (e.g. a brief pulse caused by the operation of a switch). |
| Transistor | A three leaded device (Collector, Base, Emitter) used for amplifying or switching. Also called a bi-polar transistor to distinguish it from Field Effect Transistor etc. |
| Transmitter | A device that converts audio, video or coded signals into modulated radio frequency signals which can be propagated by electromagnetic waves (radio waves). |
| Tranzorb | Transient Voltage Suppression device. |
| TRB | Tank Request Block Editor. When requesting storage space after adding a LevelMaster application, the file is saved as a *.trb file. |
| Tube | Cylinder for transporting or storing liquids: any long hollow cylinder used to transport or store liquids. |
| Tuned Radio Frequency | An amplitude modulated (AM) receiver with one or more stages of radio frequency before the detector. |
| TXD | Communication abbreviation for Transmit Data. |
| UDINT | Unsigned Double Integer |
| Unsigned Integer | Can represent a number twice the size of a "signed integer", but cannot represent a large negative number. |
| Upload | This refers to a Totalflow procedure in which any file(s) located in the on-board memory of a Totalflow Host is copied to a file created on a laptop PC. |
| UPS | Un-interruptible power supply. A power conditioning unit placed between the commercial power service and the protected device. The UPS uses line power to charge batteries, which, in the case of a power failure, can drive electronic circuitry to produce the appropriate AC requirements for some time period. |
| Upstream | Oil and natural gas exploration and production activities; plus gas gathering, processing and marketing operations. |

| TERM | DEFINITION |
|---|---|
| Upstream Pipeline | The first pipeline to transport natural gas en route to an inter-connect point for delivery to another pipeline. See DOWNSTREAM PIPELINE. |
| USX | Provider of the RTOS used by the X Series product line |
| VAC | Volts of alternating current. |
| Vacuum | A pressure less than atmospheric pressure, measured either from the base of zero pressure or from the base of atmospheric pressure (PSIA). |
| Valve | A mechanical device for controlling the flow of fluids and gases; types such as gate, ball, globe, needle, and plug valves are used. |
| Valve Control | This feature provides automatic feedback control of Differential Pressure (DP), Static Pressure (SP), and Flow Rate for the purpose of positioning a flow valve to maintain a desired value of DP, SP, or Flow Rate. |
| VAS32 | Totalflow's Voice Alarm System. A software program that receives and transmits alarm notifications via cell, telephone or pager systems. |
| VBATT | Battery Voltage. The voltage output from the battery source. |
| VDC | Volts of direct current. |
| VDE | Verband der Elektrotechnik Elektronik Informationstechnik [Association for Electrical, Electronic & Information Technologies] |
| Vent | A normally sealed mechanism which allows for the controlled escape of gases from within a cell. |
| Virtual Memory | A method of making disk storage appear like RAM memory to the CPU, thus allowing programs that need more RAM memory than is installed to run in the system. This technique is slow compared to "real" memory. |
| VOG | Velocity of Gas. |
| Volatile Memory | A storage medium that loses all data when power is removed. |
| Volt | The unit of voltage or potential difference.. One thousand volts = 1kV. |
| Voltage | Electrical pressure, the force, which causes current to flow through a conductor. Voltage must be expressed as a difference of potential between two points since it is a relational term. Connecting both voltmeter leads to the same point will show no voltage present although the voltage between that point and ground may be hundred or thousands of volts. |
| Voltmeter | A meter for reading voltage. It is one of the ranges in a multimeter. |
| Volume Calculation Period | The specified length between reading and calculating volume data. |
| VOS | Velocity of Sound. |
| Warm Start | A rebooting technique which will clear most operational errors, without damaging either the data or configuration files. This causes the equipment to boot from the RDRIVE, which is a solid state memory chip. |
| Watt | Symbol W. The unit of power. One watt is the product of one volt and one amp. Power (W) = Current (I) X Energy (E). (E = Volts) |
| Wavelength | The distance between two points of corresponding phase in consecutive cycles |
| Web Page | All the text, graphics, and sound visible with a single access to a Web site; what you see when you request a particular URL. |
| Web Server | The hardware and software required to make Web pages available for delivery to others on networks connected with yours. |
| Web Site | A collection of electronic "pages" of information on a Web server |
| Well, Development | A well drilled in order to obtain production of gas or oil known to exist. |
| Well, Disposal | A deep well in which to inject waste chemicals, etc., such as a well to dispose of salt brine from the solution mining of salt dome gas storage caverns. |
| Well, Exploratory | A well drilled to a previously untested geologic structure to determine the presence of oil or gas. |
| Well, Gas | A well which produces at surface conditions the contents of a gas reservoir; legal definitions vary among the states. |
| Well, Marginal | A well which is producing oil or gas at such a low rate that it may not pay for the drilling. |

| TERM | DEFINITION |
|---|---|
| Well, Stripper | Non-associated gas well capable of producing no more than 90 Mcf/day at its maximum rate of flow. |
| Well, Wildcat | An exploratory well being drilled in unproven territory, that is, in a horizon from which there is no production in the general area. |
| Wellhead | The assembly of fittings, valves, and controls located at the surface and connected to the flow lines, tubing, and Casing of the well so as to control the flow from the reservoir. |
| Wheatstone Bridge | Circuit design using two TCDs to measure components in chromatography. |
| WINCCU | Windows Central Collection Unit. Windows version of software to process, archive and manipulate data collected from the Totalflow products. |
| Witness | In the field, where hydrocarbons are changing hands and actual cash register transactions being performed, it is not uncommon for one party or the other to request / require a representative or company employee be present during calibrations and or routine maintenance. Often this arrangement is contractually linked. |
| Wobbe Index | Calculated from the energy content, or a higher heating value of the gas, and the relative density of the gas ($Btu/RD^{1/2}$). |
| Working Voltage | The highest voltage that should be applied to a product in normal use, normally well under the breakdown voltage for safety margin. See also Breakdown Voltage. |
| World Wide Web | An Internet service facilitating access to electronic information - also known as the Web, WWW, or W3. |
| X Series | Totalflow's new extendable equipment series featuring technology that is expandable and flexible for ever changing needs. |
| XFC | See Flow Computer, X Series. |
| XFC-195 Board | The main electronic board used in X Series flow computers. The XFC-195 Board mounts on the inside of the enclosure's front door. |
| XIMV | See Multivariable Transducer. |
| XIMV | External Integral Multivariable Transducer |
| XRC | See Remote Controller, X Series. |
| XRC | X Series Remote Controller. Also see Remote Controller, X Series. |
| Y | Expansion factor. |
| Zero Gas | Gas at atmospheric pressure. |