G2 Engineering Unit Conversion

User's Guide

Version 2.3 Rev. 0

G2 Engineering Unit Conversion User's Guide, Version 2.3 Rev. 0
December 2013

The information in this publication is subject to change without notice and does not represent a commitment by Gensym Corporation.

Although this software has been extensively tested, Gensym cannot guarantee error-free performance in all applications. Accordingly, use of the software is at the customer's sole risk.

Gensym Corporation
52 Second Avenue
Burlington, MA 01803 USA
Telephone: (781) 265-7100
Fax: (781) 265-7101

Part Number: DOC011-830

Contents

Preface

Describes this guide and the conventions that it uses.

About this Guide

This guide describes the G2 Engineering Unit Conversion (GEUC) module. This module provides numerous built-in units and unit conversion, and allows you to create custom unit conversions and synonyms.

Audience

This guide is for G2 developers who want to customize applications, using a set of standard application programmers' interface (API) procedures and methods, and built-in classes. It assumes familiarity with the G2 procedure language.

Conventions

This guide uses the following typographic conventions and conventions for defining system procedures.

Typographic

Convention Examples	Description
g2-window, g2-window-1, ws-top-level, sys-mod	User-defined and system-defined G2 class names, instance names, workspace names, and module names
history-keeping-spec, temperature	User-defined and system-defined G2 attribute names
true, 1.234, ok, “Burlington, MA”	G2 attribute values and values specified or viewed through dialogs
Main Menu > Start KB Workspace > New Object create subworkspace Start Procedure	G2 menu choices and button labels
conclude that the x of y ...	Text of G2 procedures, methods, functions, formulas, and expressions
new-argument	User-specified values in syntax descriptions
text-string	Return values of G2 procedures and methods in syntax descriptions
File Name, OK, Apply, Cancel, General, Edit Scroll Area	GUIDE and native dialog fields, button labels, tabs, and titles
File > Save Properties	GMS and native menu choices
workspace	Glossary terms

Convention Examples	Description
c:\Program Files\Gensym	Windows pathnames
/usr/gensym/g2/kbs	UNIX pathnames
spreadsh.kb	File names
g2 -kb top.kb	Operating system commands
public void main() *gsi_start*	Java, C and all other external code

Note Syntax conventions are fully described in the *G2 Reference Manual*.

Procedure Signatures

A procedure signature is a complete syntactic summary of a procedure or method. A procedure signature shows values supplied by the user in *italics*, and the value (if any) returned by the procedure *underlined*. Each value is followed by its type:

g2-clone-and-transfer-objects
(*list*: class item-list, *to-workspace*: class kb-workspace,
delta-x: integer, *delta-y*: integer)
-> *transferred-items*: g2-list

Related Documentation

G2 Core Technology

- *G2 Bundle Release Notes*
- *Getting Started with G2 Tutorials*
- *G2 Reference Manual*
- *G2 Language Reference Card*
- *G2 Developer? Guide*
- *G2 System Procedures Reference Manual*

- *G2 System Procedures Reference Card*
- *G2 Class Reference Manual*
- *Telewindows User? Guide*
- *G2 Gateway Bridge Developer? Guide*

G2 Utilities

- *G2 ProTools User? Guide*
- *G2 Foundation Resources User? Guide*
- *G2 Menu System User? Guide*
- *G2 XL Spreadsheet User? Guide*
- *G2 Dynamic Displays User? Guide*
- *G2 Developer? Interface User? Guide*
- *G2 OnLine Documentation Developer? Guide*
- *G2 OnLine Documentation User? Guide*
- *G2 GUIDE User? Guide*
- *G2 GUIDE/UIL Procedures Reference Manual*

G2 Developers' Utilities

- *Business Process Management System User? Guide*
- *Business Rules Management System User? Guide*
- *G2 Reporting Engine User? Guide*
- *G2 Web User? Guide*
- *G2 Event and Data Processing User? Guide*
- *G2 Run-Time Library User? Guide*
- *G2 Event Manager User? Guide*
- *G2 Dialog Utility User? Guide*
- *G2 Data Source Manager User? Guide*
- *G2 Data Point Manager User? Guide*
- *G2 Engineering Unit Conversion User? Guide*
- *G2 Error Handling Foundation User? Guide*
- *G2 Relation Browser User? Guide*

Bridges and External Systems

- *G2 ActiveXLink User? Guide*
- *G2 CORBALink User? Guide*
- *G2 Database Bridge User? Guide*
- *G2-ODBC Bridge Release Notes*
- *G2-Oracle Bridge Release Notes*
- *G2-Sybase Bridge Release Notes*
- *G2 JMail Bridge User? Guide*
- *G2 Java Socket Manager User? Guide*
- *G2 JMSLink User? Guide*
- *G2-OPC Client Bridge User? Guide*
- *G2 PI Bridge User? Guide*
- *G2-SNMP Bridge User? Guide*
- *G2-HLA Bridge User? Guide*
- *G2 WebLink User? Guide*

G2 JavaLink

- *G2 JavaLink User? Guide*
- *G2 DownloadInterfaces User? Guide*
- *G2 Bean Builder User? Guide*

G2 Diagnostic Assistant

- *GDA User? Guide*
- *GDA Reference Manual*
- *GDA API Reference*

Customer Support Services

You can obtain help with this or any Gensym product from Gensym Customer Support. Help is available online, by telephone, by fax, and by email.

To obtain customer support online:

➔ Access G2 HelpLink at *www.gensym-support.com*.

You will be asked to log in to an existing account or create a new account if necessary. G2 HelpLink allows you to:

- Register your question with Customer Support by creating an Issue.
- Query, link to, and review existing issues.
- Share issues with other users in your group.
- Query for Bugs, Suggestions, and Resolutions.

To obtain customer support by telephone, fax, or email:

➔ Use the following numbers and addresses:

	Americas	Europe, Middle-East, Africa (EMEA)
Phone	(781) 265-7301	+31-71-5682622
Fax	(781) 265-7255	+31-71-5682621
Email	*service@gensym.com*	*service-ema@gensym.com*

1

Introduction to G2 Engineering Unit Conversion

Provides an overview of the G2 Engineering Unit Conversion (GEUC) module.

Introduction

The G2 Engineering Unit Conversion (GEUC) module provides a way of specifying the engineering units for entering and displaying values, as well as a large number of synonyms for those conversions in both the English and metric systems. GEUC defines a large set of built-in engineering unit conversions and synonyms for dimensions such as pressure, length, volume, volumetric flow, mass, density, temperature, power, heat transfer, and time. It also provides a mechanism for defining custom dimensions, engineering units, and synonyms.

When you create external datapoints from a CSV file, using the G2 Data Point Management (GDPM) module, for example, you specify the engineering units that the DCS system uses for datapoints, which are known as the **field units**. You can configure the units that GEUC uses for entering property values and displaying computed metrics, which are known as the **user units** or **external units**. GEUC converts all field units and external units to a set of common units that it uses for its internal calculations, which are known as **internal units**.

In addition, GEUC provides API procedures and functions that you can call to work with engineering unit conversions programmatically.

Loading GEUC

To use the GEUC module, you must load or merge in *geuc.kb*, which is located in the *g2i\kbs* directory.

2

Module Settings

Describes the G2 Engineering Unit Conversion (GEUC) module settings.

Introduction

The geuc-module-settings object inherits GFR module settings. Upon startup, GFR locates one module settings object as the active setting, which is typically the instance in the highest level module. The active module is determined when G2 is started. Several APIs take the active module settings object into account during execution.

geuc-module-settings

Manages system configurations for the GEUC module.

Class Inheritance Path

gfr-module-settings, object, item

Attributes

Attribute	Description
data-directory	The directory in which to store conversion and synonym files.
Allowable values:	text
Default value:	"“
Notes:	See Configuration File.
packaged-conversion-filename	The name of the file in which built-in unit conversions are stored.
Allowable values:	text
Default value:	conversions.csv
packaged-conversion-filename-backup	The name of the backup file for built-in unit conversions.
Allowable values:	text
Default value:	conversions.old
custom-conversions-filename	The name of the file in which to store custom unit conversions.
Allowable values:	text
Default value:	custom-conversions.csv

Attribute	Description
custom-conversions-filename-backup	The name of the backup file for custom unit conversions.
Allowable values:	text
Default value:	custom-conversions.old
packaged-synonyms-filename	The name of the file in which built-in synonyms are stored.
Allowable values:	text
Default value:	synonyms.csv
packaged-synonyms-filename-backup	The name of the backup file for built-in synonyms.
Allowable values:	text
Default value:	synonyms.old
custom-synonyms-filename	The name of the file in which to store custom synonyms.
Allowable values:	text
Default value:	custom-synonyms.csv
custom-synonyms-filename-backup	The name of the backup file for custom synonyms.
Allowable values:	text
Default value:	custom-synonyms.old

Configuration File

This table describes the settings in the configuration file (*config.txt*, by default), the associated group, and the attributes in the geuc-module-settings object that they configure at startup:

Group	Configuration File Settings	GDSM Module Settings Attributes
ENGINEERING-UNITS	*GEUC-DATA-DIRECTORY= $APPLICATION-ROOT-DIRECTORY/g2i/data*	data-directory

3

Converting Engineering Units

Describes how to convert engineering units.

Introduction

This chapter describes how to:

- Work with engineering unit conversions.
- View built-in engineering unit conversion definitions.
- Define engineering unit conversion synonyms.
- Define engineering unit conversion definitions.
- Convert engineering units on demand.
- Manage engineering units.

Working with Engineering Unit Conversions

You work with engineering unit conversions in various ways in an application.

Configuring External Datapoint Units in the CSV File

You can import units from the CSV file used for configuring external datapoints, using GDPM. You configure the Datapoint Units in the column to the right of the Datapoint Type column in the CSV file. The datapoint units that you configure are equivalent to the field units that domain objects use as sensor values.

You can specify any of the built-in engineering units or a synonym. For information on determining the built-in engineering units, see Viewing Built-in Engineering Unit Conversion Definitions.

If you specify an engineering unit that does not exist, GEUC automatically creates a unit synonym definition and places it in the Undefined-Dimension category in the Unit Synonyms submenu. For more information, see Creating New Engineering Units and Synonyms.

Note Sometimes units provided in the DCS system are inaccurate, thus GEUC requires you to enter the units explicitly rather than obtaining them directly from the DCS system.

Here is part of an external datapoint configuration file, which defines field units for several datapoints in the metric system:

Datapoint	Datapoint Server Configuration				
Datapoint	Default	Datapoint	Datapoint	Datapoint	Related Process Map
Name	Update Interval	Tag Type	Type	Units	Datapoint Names
t1-dp	10 minutes	pv	float	deg C	t1.pv
t2-dp	10 minutes	pv	float	deg C	t2.pv
p1-dp	10 minutes	pv	float	kg/cm2	p1.pv
f1-dp	10 minutes	pv	float	m3/hr	f1.pv
f2-dp	10 minutes	pv	float	m3/hr	f2.pv
f3-dp	10 minutes	pv	float	m3/hr	f3.pv
a1-dp	10 minutes	pv	float	kj/m3	a1.pv

Caution When upgrading older versions of GEUC, you must add the Units column to the CSV file before creating external datapoints. Creating external datapoints from a CSV file that does not include the Units column generates an error.

Viewing Built-in Engineering Unit Conversion Definitions

When configuring engineering units for a given dimension, you choose from a list of engineering units in the given system, either English or metric. Similarly, when configuring the units for external datapoints, you specify the engineering units in a CSV file.

You can view the built-in engineering unit conversions for each dimension to see how they are defined. Each conversion definition specifies the following information:

- The dimension type, such as area, pressure, or temperature.
- The input and output units for the conversion.
- Whether the conversion defines a multiplier and/or offset.
- A multiplier and offset for the conversion.
- Input and output synonyms.

You might want to view the built-in engineering unit conversion definitions to see which synonyms are defined for the input and output units and whether you need to define additional synonyms.

For example, the area dimension defines an engineering unit conversion called square meter->square feet, which converts square meters to square feet. The input and output units define these synonyms:

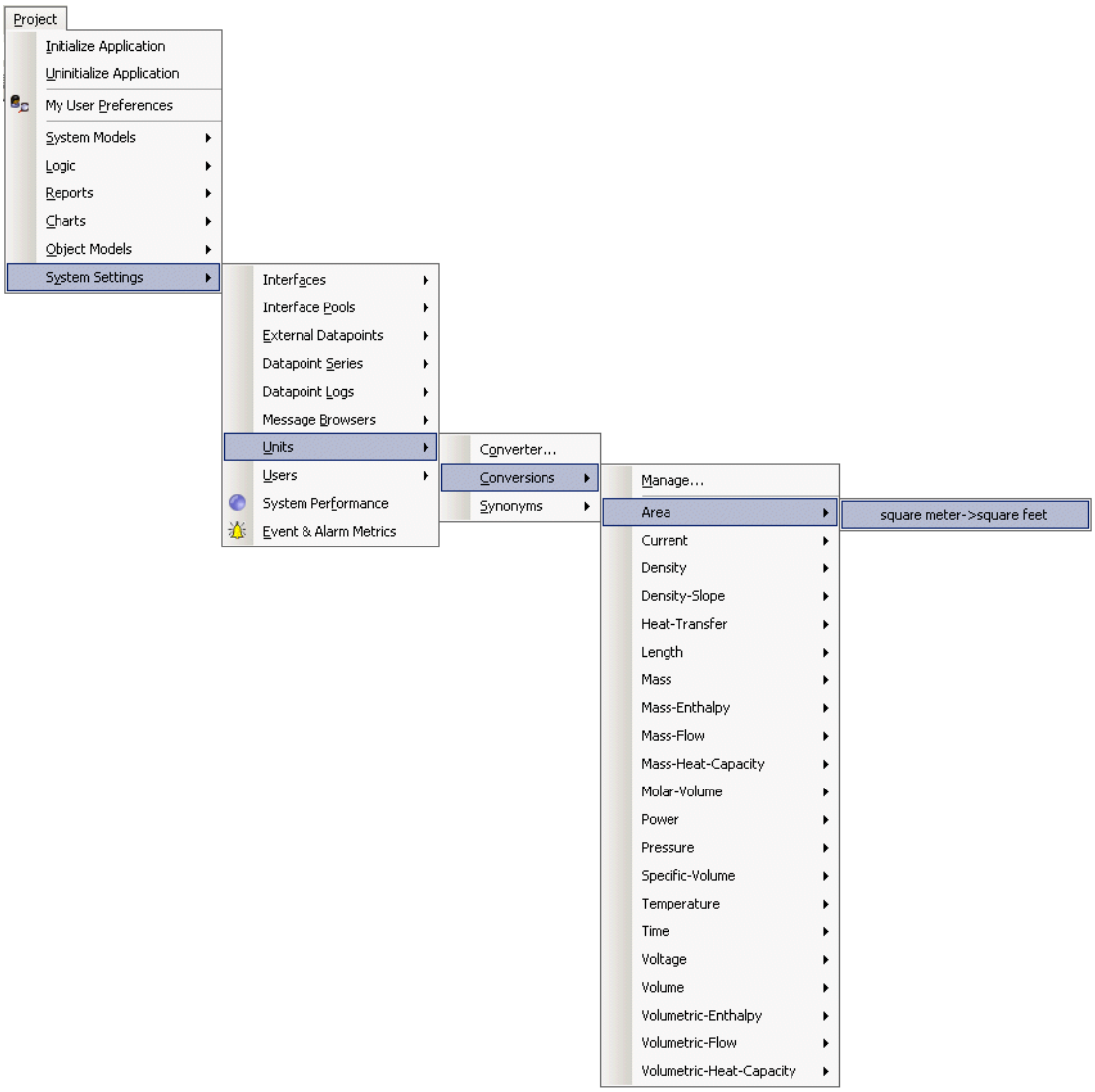
Engineering Unit	Synonyms		
square meter	m2	meter2	
square feet	ft2	foot2	feet2

Note The menu choices in this and the following sections assume that enable-menus-and -toolbars-upon-startup is enabled in the grtl-module-settings object. For more information, see the *G2 Run-Time Library User? Guide*.

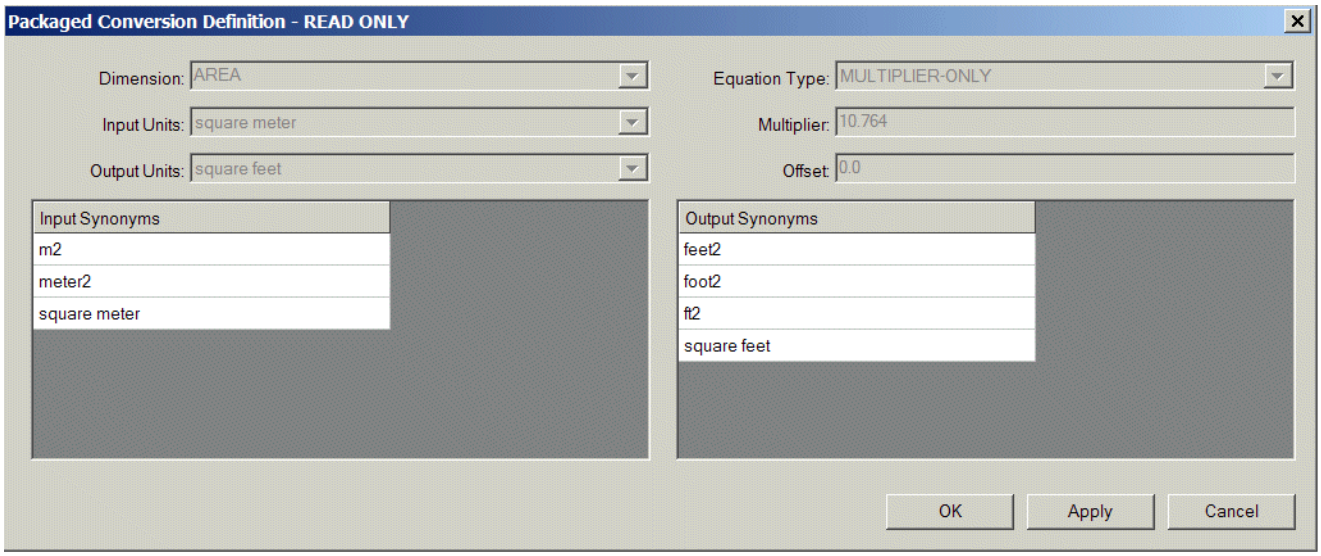
To view built-in engineering unit conversion definitions:

➔ Choose Project > System Settings > Units > Conversions, then choose the dimension and conversion definition you want to view.

For example, to view the conversion definition for the area dimension that converts square meters to square feet, you would choose:



Here is the Engineering Unit Conversion dialog for the square meter->square feet conversion definition. Notice that the conversion has three synonyms for square meter, and four synonyms for square feet. The conversion definition multiplies the input value by the specified multiplier to calculate the output value.



Defining Engineering Unit Conversion Synonyms

You can configure additional synonyms for any of the built-in engineering unit conversion definitions. You can also define new engineering units and synonyms to create new engineering conversion unit definitions.

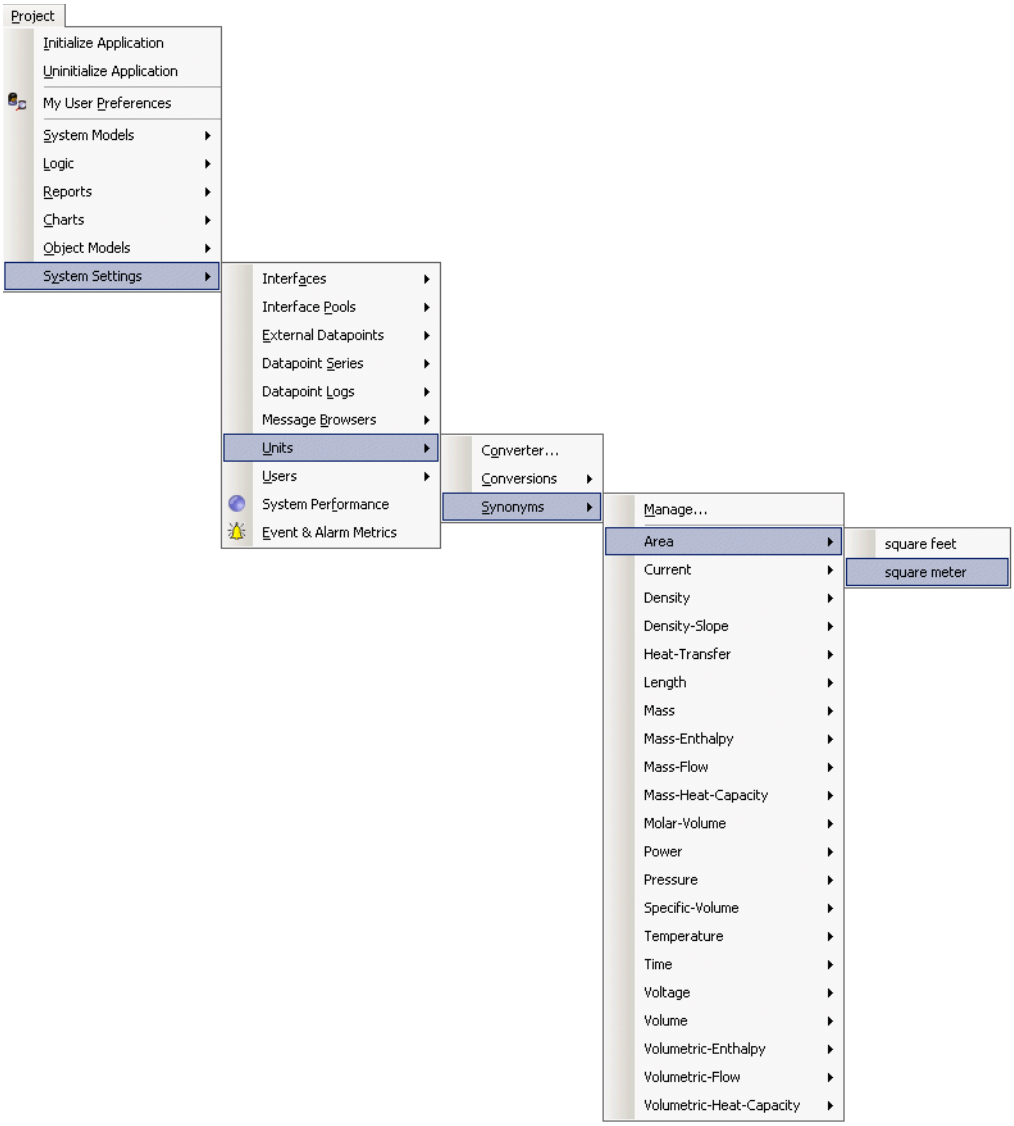
Adding New Synonyms to Existing Engineering Unit Conversion Definitions

Suppose you want to add a new synonym called meters2 for the square meter engineering unit.

To add a new synonym to an existing engineering unit conversion definition:

1 Choose Project > System Settings > Units > Synonyms, then choose the dimension and corresponding conversion unit for which you want to define a new synonym.

For example, to add meters2 as a synonym for square meter, choose:



The Synonym Definition dialog appears with the packaged synonyms for the specified unit in the list on the left.

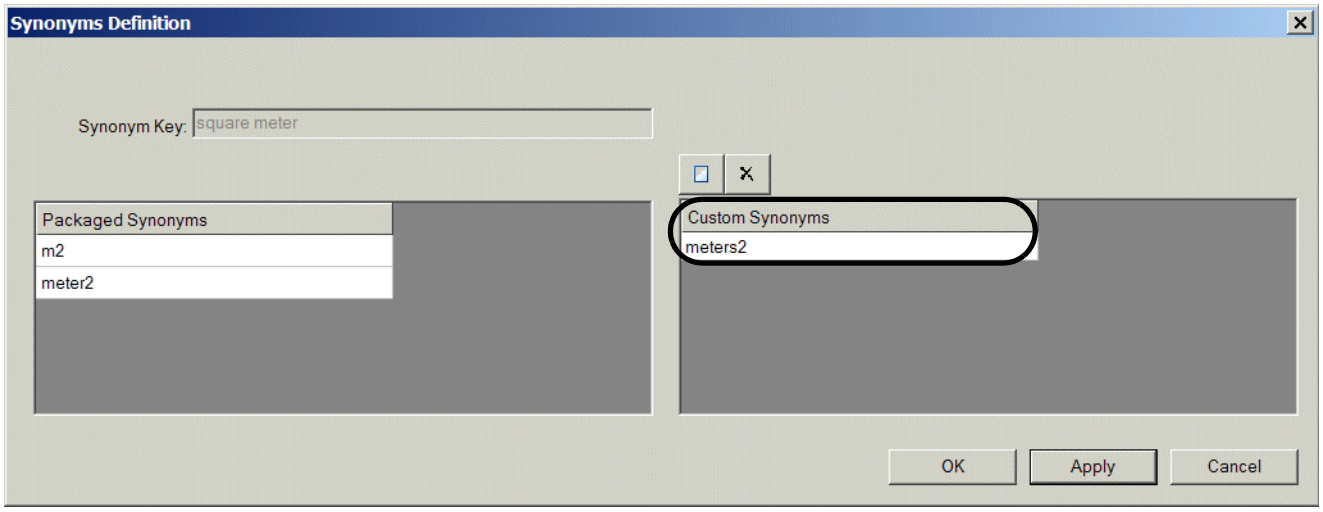
2 To create a new synonym, click the New button in the Custom Synonyms list and enter a synonym.

3 To enter additional synonyms, click in the number column of the row where you want to insert a new synonym, and click the Insert Before or Insert After toolbar button to insert a new row before or after the selected row.

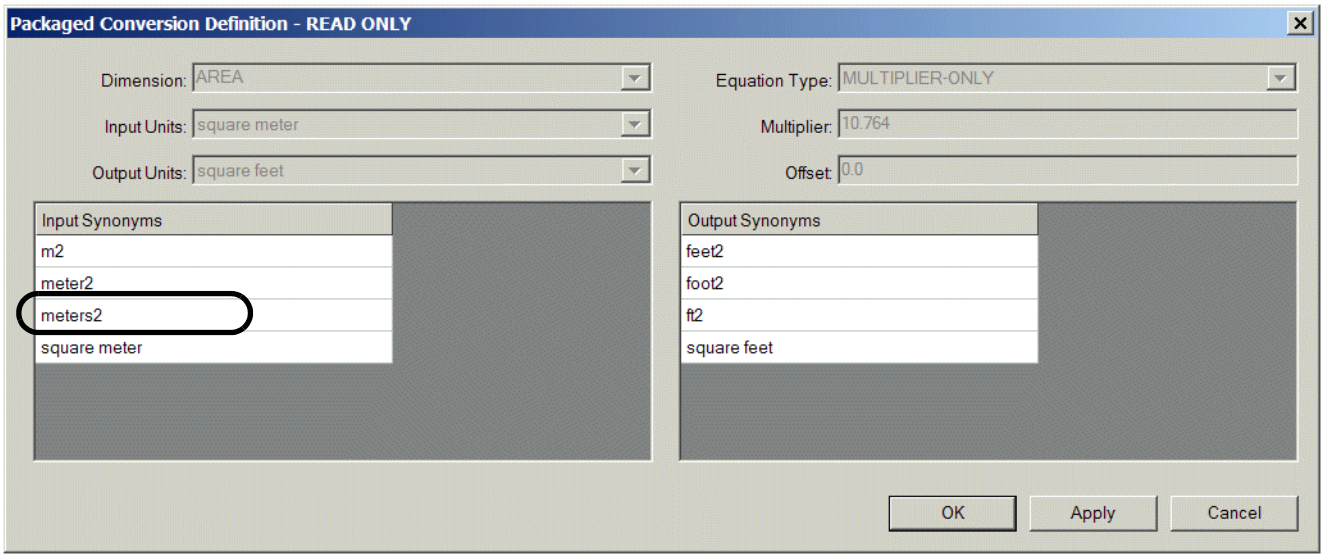
4 Enter a new synonym in the new row.

5 Click OK in the dialog, then click OK in the confirmation dialog to save the synonym to the custom synonyms file.

Here is the Synonym Definition dialog that defines meters2 as a new synonym for the square meter unit:



The new synonym now appears in the Engineering Unit Conversion dialog for the conversion definition:



Creating New Engineering Units and Synonyms

Suppose you want to create a new engineering unit conversion definition for the area dimension that converts square centimeters to square inches. You would create two new engineering units called square centimeter and square inch, each of which might define several synonyms.

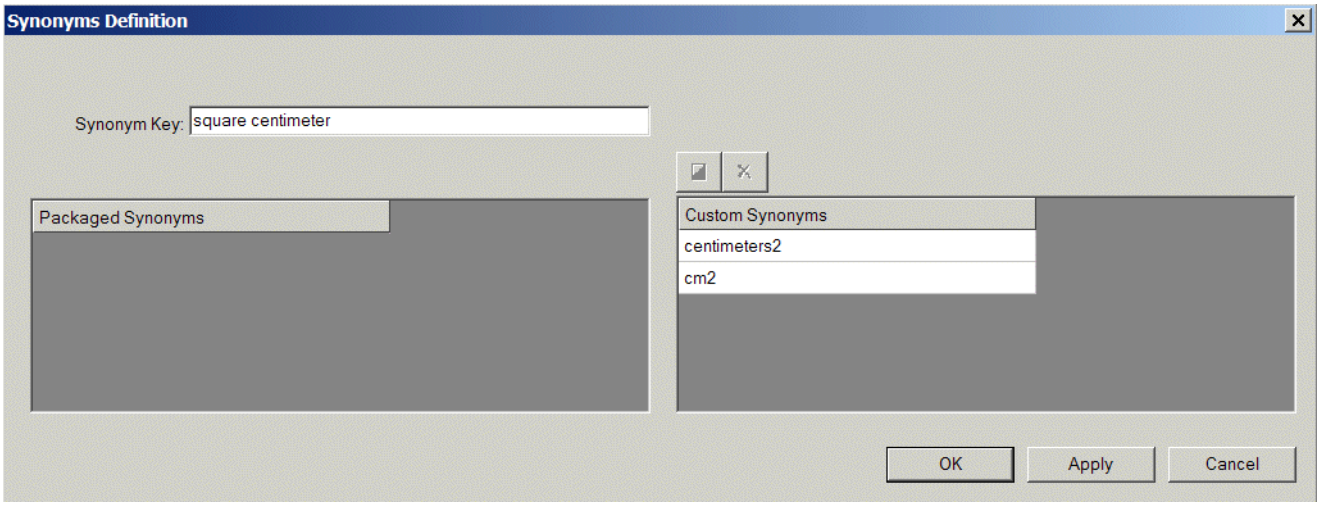
When you initially create new engineering units, they appear in the Undefined-Dimension category in the Synonyms submenu. As soon as you create a new engineering unit conversion definition that uses the new conversion units, they appear in the appropriate dimension category in the submenu.

Note Any existing unit synonyms that have not yet been used as part of an engineering unit conversion definition appear in the Undefined-Dimensions category.

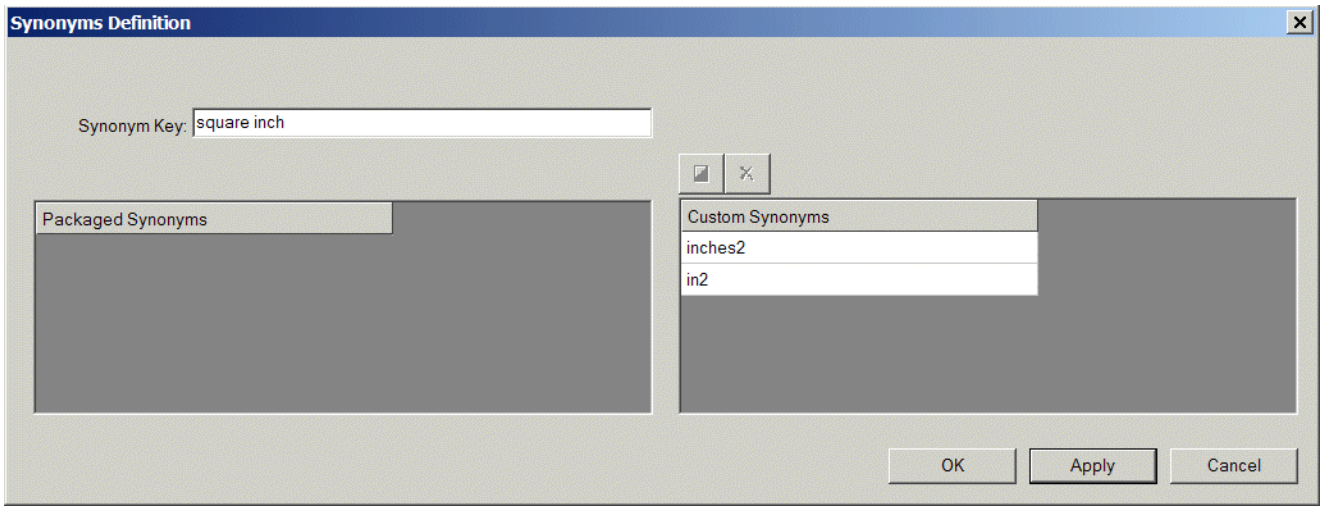
To create a new engineering unit and synonyms:

1. Choose Project > System Settings > Units > Synonyms > Manage to display the Manage dialog for all the unit synonyms.
2. Click the New button to create a new engineering unit definition.
3. Configure the Synonym Key to be most generic form of the engineering unit.
4. To create a synonym, click the New button in the Custom Synonyms list and enter a synonym.
5. Click OK in the dialog, then click OK in the confirmation dialog to save the engineering unit and its synonyms to the custom synonyms file.
6. Repeat for the input and output engineering units required for the new engineering unit conversion definition.

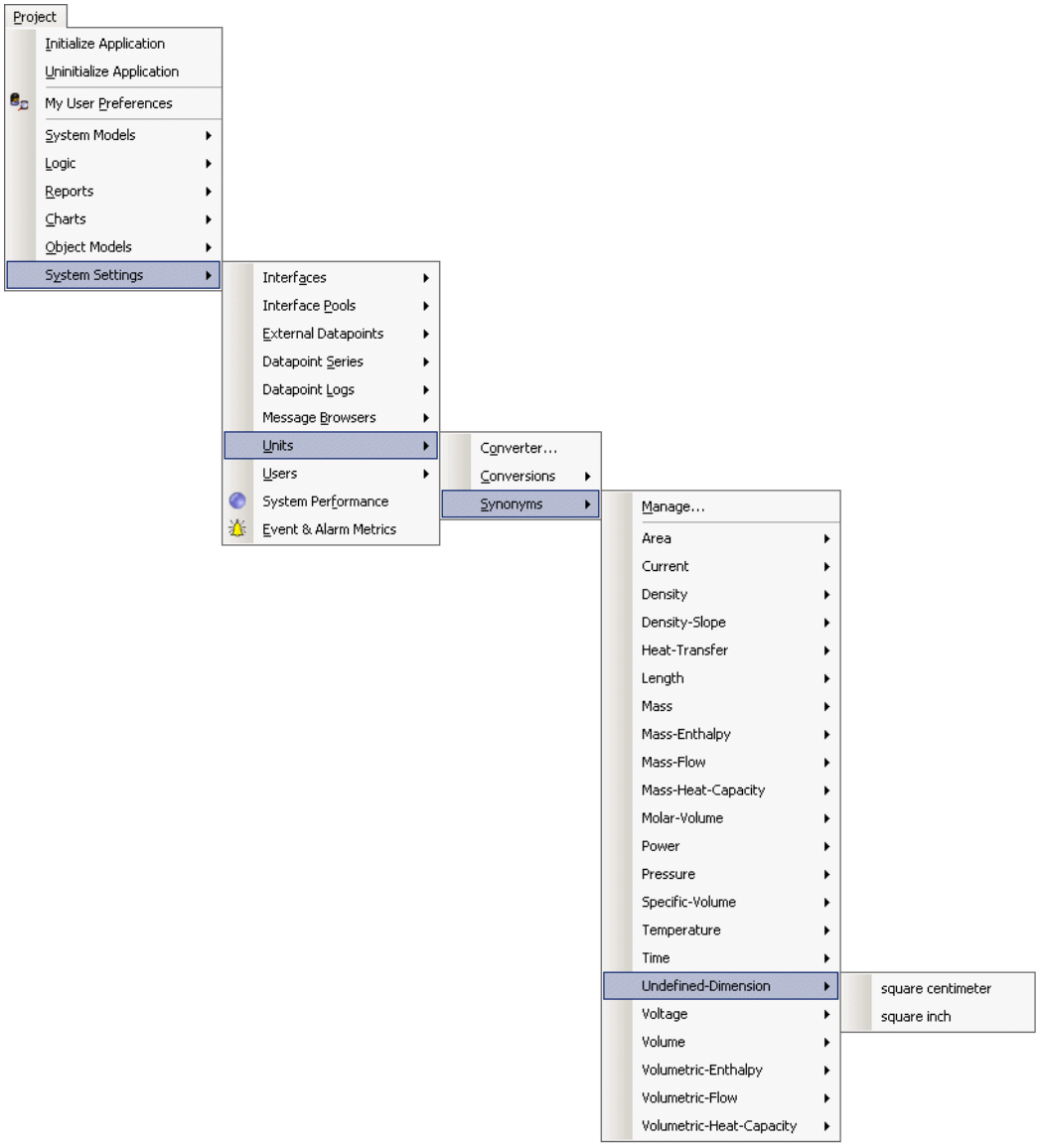
Here is the Synonym Definition dialog that defines the square centimeter engineering unit and two synonyms:



Here is the Synonym Definition dialog that defines the square inch engineering unit and two synonyms:



Initially, the new engineering units appear in the Undefined-Dimension category in the Synonyms menu, along with other engineering units that are not yet used in any engineering unit conversion definitions:



Defining Engineering Unit Conversion Definitions

Once you have defined the input and output units and their synonyms, you can define a new engineering unit conversion definition that uses those engineering units. For example, you might want to create a new engineering unit conversion definition for the area dimension that converts square centimeters to square inches.

To do this, first, you must create the engineering units and synonyms for square centimeter and square inch, as described in Defining Engineering Unit Conversion Synonyms.

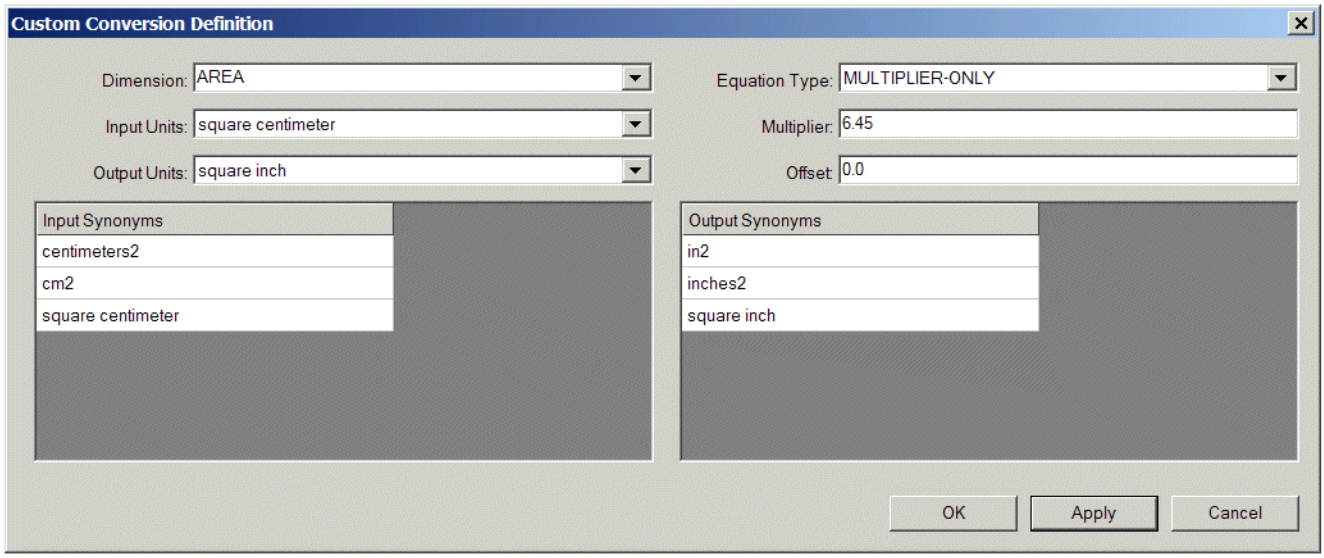
To create a new engineering unit conversion definition:

1. Choose Project > System Settings > Units > Conversions > Manage to display the Manage dialog for all unit conversions.
2. Click the New button to create a new engineering unit conversion definition.
3. Configure the Dimension Class for the engineering unit conversion definition.

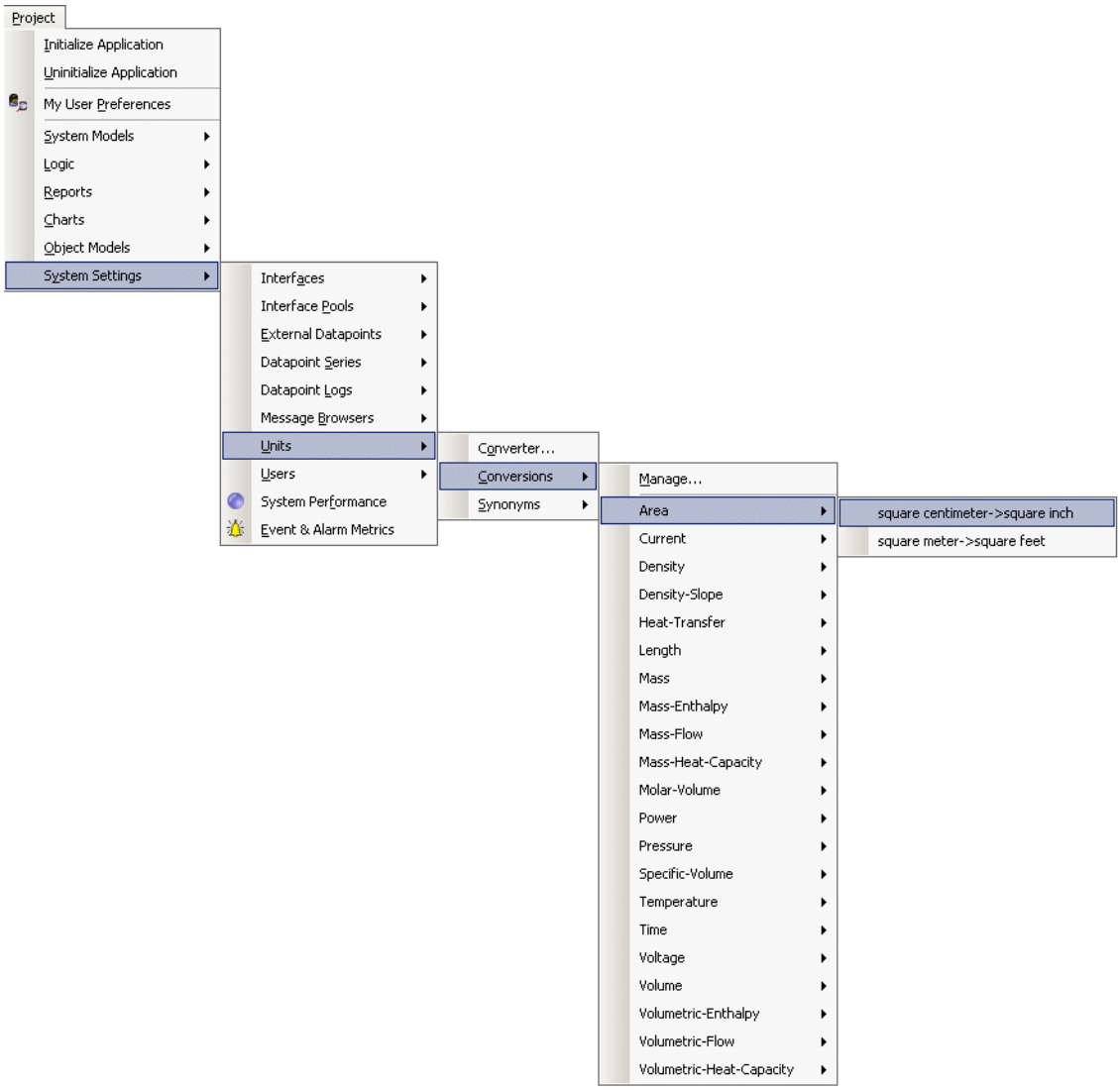
   You can configure an existing dimension, such as area, or you can create a new dimension. For example, to create an engineering unit conversion called square centimeter->square inch, you would configure the dimension to be area.
4. Configure the Input Units and Output Units for the dimension.

   In the example, the Input Units would be square centimeter and the Output Units would be square inch.
5. Configure the Equation Type to be one of the following:
   - multiplier-only — Specifies a Multiplier only.
   - offset-only — Specifies an Offset only.
   - multiply-first — Specifies both a Multiplier and Offset, where the multiplication operation happens before the offset.
   - offset-first — Specifies both an Offset and a Multiplier, where the offset operation happens before the multiplication.
6. Depending on the value of Equation Type, configure the Multiplier and Offset to be the values to use for multiplying and offsetting the input value to calculate the output value.
7. Click OK in the dialog, then click OK in the confirmation dialog to save the engineering unit conversion to the custom conversions file.

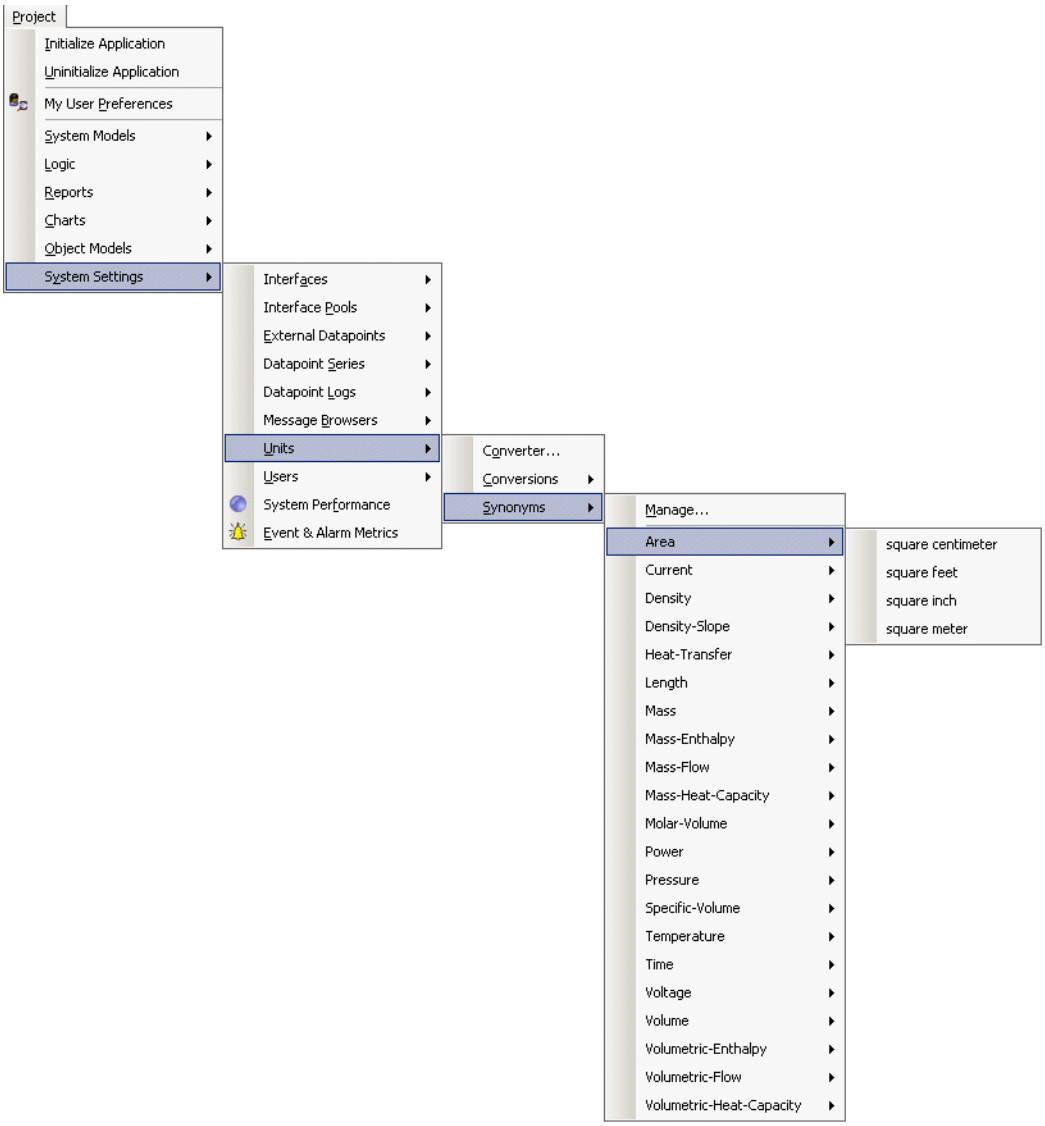
Here is the engineering unit conversion definition for square centimeter->square inch, which converts square centimeter to square inch, using a multiplier. Once you initially accept the dialog, the custom synonyms for the input and output units all appear in the dialog.



The engineering unit conversion definition appears in the menus under the area dimension along with the built-in conversion definition:



Now that the custom engineering units have been used in an engineering unit conversion definition, they appear under the appropriate dimension in the menus, in this case, area. They no longer appear under the Undefined-Dimension category.



Converting Engineering Units on Demand

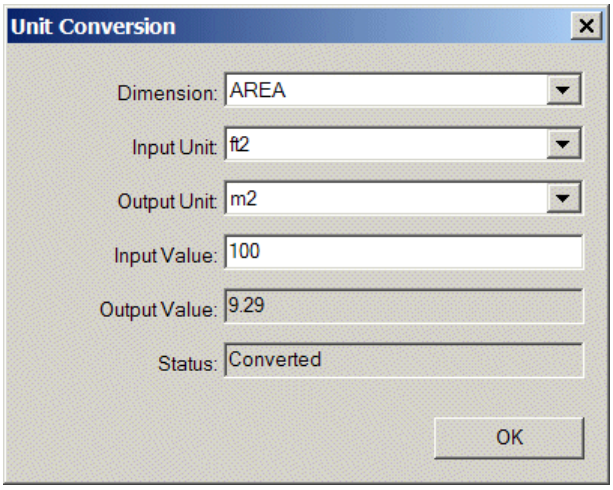
You can perform engineering unit conversions on demand through the Engineering Unit Converter dialog. You might want to do this to verify a unit conversion before choosing the units.

To convert engineering units on demand:

1. Choose Project > System Settings > Units > Converter.
2. Choose the Dimension type.
3. Configure the Input Units and the Output Units.
4. Enter an Input Value in the input units and press Return.

The converted value in the output units appears with a status value of converted with a status of converted. The converted value also updates automatically if you change the Input Units and Output Units for a given Input Value.

Here is the Engineering Unit Converter dialog that shows the unit conversion from ft2 to m2:



Managing Engineering Units

You manage engineering unit conversions and synonyms separately.

Managing Engineering Unit Conversions

To manage engineering unit conversions:

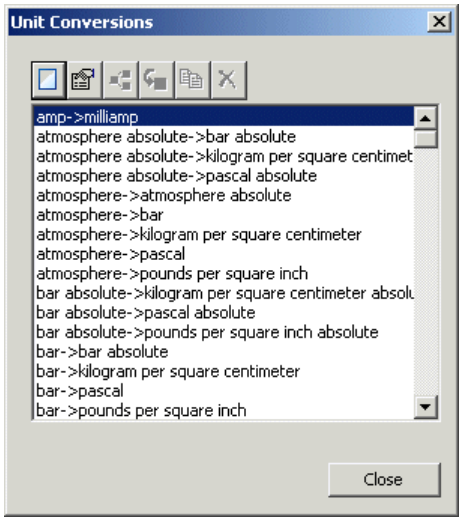
1 Choose Project > System Settings > Units > Conversions > Manage.

All engineering unit conversion classes appear in the submenu, and all built-in and custom engineering unit conversions appear in the submenus for each conversion class.

2 To configure the properties of a unit conversion, choose one from the appropriate category in the Unit Conversions submenu.

3 To display a dialog for managing all unit conversions, choose Manage.

Here is the Unit Conversions Manage dialog:



Managing Engineering Unit Synonyms

To manage engineering unit conversions:

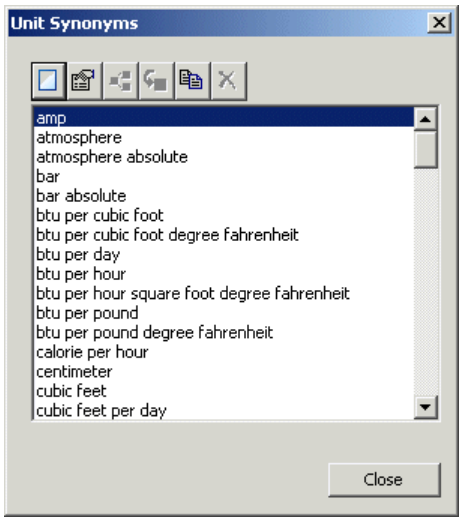
1 Choose Project > System Settings > Units > Synonyms > Manage.

All engineering unit conversion classes appear in the submenu, and all built-in and custom engineering unit synonyms appear in the submenus for each conversion class.

2 To configure the properties of a unit synonym, choose one from the appropriate category in the Unit Synonyms submenu.

3 To display a dialog for managing all unit synonyms, choose Manage.

Here is the Unit Synonyms Manage dialog:



4

Customizing Engineering Units

Describes how to customize engineering units.

Introduction

You can use the following API procedures and functions to work with engineering unit conversions programmatically your application. They provide the ability to:

- Convert values from one engineering unit to another for a given dimension.
- Convert from internal to external units, and from external to internal units for a given dimension.
- Get the internal units of a given dimension in either the metric or English system.
- Get the units for a given parameter of a sensor or controller.

Dimension Types

GEUC defines built-in engineering units for a number of dimension types, which it uses for displaying engineering units. The dimension types categorize the units that the various parameters and metrics require.

In the API procedures and functions that follow, the *dimension-type* is one of these symbols:

pressure
length
area
volume
volumetric-flow
volumetric-heat-capacity,
volumetric-enthalpy
mass
mass-flow
mass-heat-capacity
mass-enthalpy,
density
density-slope
specific-volume
temperature
power
heat-transfer,
time
molar-volume
voltage
current

Dimension Units

GEUC allows you to configure the units of a given dimension for entering parameters and displaying metrics for domain objects, in a given unit system. For example, if the unit system is metric and you are configuring the units for the process-pc of the Heater Efficiency derived sensor of a heater, you can choose from the following metric units:

kilojoule per cubic meter degree celsius	kj/m3-C	kj/m3-deg C
joule per cubic meter degree celsius	j/m3-C	j/m3-deg C

kilocalorie per cubic meter degree celsius	kcal/m3-C	kcal/m3-deg C
calorie per cubic meter degree celsius	cal/m3-C	cal/m3-deg C

Similarly, if the unit system is english, you would choose from these units:

btu per cubic foot degree fahrenheit	btu/ft3-F	btu/ft3-deg F

In the API procedures and functions that follow, the dimension units that you specify as arguments should be one of the built-in synonyms, as a text. These are either input or output units, or internal or external units, depending on the API.

Note that spaces are stripped from the units, so the spaces you enter do not matter.

Note If you enter a dimension unit that is not one of the built-in synonyms, GEUC automatically creates the specified unit synonym and places it in the Undefined-Dimensions category in the Unit Synonyms dialog. Typically, undefined synonyms constitute typographical errors in the API procedure code.

Conversion Status

The API procedures that convert engineering units all return the following status values, as a text, to indicate whether the conversion was successful:

Status	Description
converted	A conversion definition was found and the input value was successfully converted.
undefined	A conversion definition was not found because of an unrecognized *dimension-type*, *input-units*, or *output-units*. This status can mean that either a conversion has not been defined, or that the user is supplying an input or output synonym for an existing conversion that is not yet recognized and needs to be added to the appropriate synonym definition. Check the API call for correct units, or create custom synonyms or custom conversion definitions, as needed.

Status	Description
unrecognized equation type	The equation type for the conversion definition was not recognized as one of the following symbols: MULTIPLIER-ONLY MULTIPLY-FIRST OFFSET-ONLY OFFSET-FIRST For custom conversions, modify the Equation Type. For built-in conversions, contact Gensym support.
missing eu organizer	The GEUC organizer object is missing. This error can occur only if a user or procedure specifically deletes the packaged organizer object. Report occurrences of this status to Gensym support.
no sequence	The requested dimension could not be matched in the GEUC conversion organizer object. Check the API call for the correct dimension. The API automatically creates an empty custom conversion definition, which you can edit through the manager.
zero multiplier	The Multiplier for the requested conversion is zero, which would create a divide-by-zero error if executed. For custom conversions, update the Multiplier parameter and retry the unit conversion. For built-in conversion, contact Gensym support.
procedure abort	A serious programming error occurred. Send G2 Logbook error messages to Gensym support for analysis.
abort	A serious programming error occurred. Send G2 Logbook error messages to Gensym support for analysis.

API Procedures

geuc-convert-engineering-units
(*dimension-type*: symbol, *input-value*: quantity,
input-units: text, *output-units*: text)
-> *output-value*: quantity, *status*: text

Converts an input value to an output value of a given dimension, given the input and output units.

Argument	Description
dimension-type	The dimension type, as a symbol. See Dimension Types.
input-value	The input value to convert.
input-units	The input units to use for the conversion, as a text.
output-units	The output units to use for the conversion, as a text.

Return Value	Description
output-value	The converted output value in the given output units.
status	The status of the conversion. See Conversion Status.

geuc-load-custom-conversion-objects-from-file
( )

Loads the custom conversion from the file. The file is automatically loaded upon startup. Use this API to reload the file.

geuc-load-custom-synonym-objects-from-file
( )

Loads the custom synonyms from the file. The file is automatically loaded upon startup. Use this API to reload the file.

geuc-reload-conversions-and-synonyms
(*directory*: text, *packaged-conversions-and-synonyms*: truth-value)

Loads conversions and synonyms from the specified directory. This API always loads the custom files. If *packaged-conversions-and-synonyms* is true, it also loads the packaged conversions and synonyms. If the *directory* argument is empty, it loads them from the current directory in the GEUC module settings.

Index