

SF-902 CONFIGURATION FILE DESCRIPTION

Original Instructions

www.superflow.com

SF- 902
Configuration File Description

Copyright 2018 by SuperFlow Dynamometers & Flowbenches. All rights reserved. No part of this publication may be reproduced, transcribed, or translated by any means without the prior written permission of SuperFlow Dynamometers & Flowbenches, N60 W22700 Silver Spring Drive, Sussex, WI 53089 USA.

No part of the software or firmware provided with this product may be upgraded, modified, or changed by any means without the prior written permission of SuperFlow Dynamometers & Flowbenches.



Trademark Notices

SuperFlow, WinDyn, ProFilter, SF902, XConsole, XDyno, XCart, NSCR, CycleDyn, AutoDyn, FlowCom, SuperBench, ProExport, SF-110/120/260/450/600/750, SF-1020, SF1200, ProBench, SuperBench, TD-1200, TDAC, Axiline, TCRS, Hicklin, Racer's Pack, and SuperShifter are trademarks of SuperFlow Technologies Group. Other trademarks and trade names may be used in this document that refer to the entities claiming the marks and names or their products. SuperFlow Dynamometers & Flowbenches does not hold any proprietary interest in trademarks or trade names other than its own.

Please keep this manual for future reference.

This manual is intended to assist operating personnel in becoming familiar with the product and as guidance in ordering necessary parts inclusive of SuperFlow's warranty requirements. Maximum operating efficiency and life of any SuperFlow product will be attained through complete understanding of the instructions and recommendations contained within this manual.

WARNING

Services performed beyond preventive maintenance by personnel other than SuperFlow Service Technicians on any SuperFlow products during the warranty period may void the warranty.

IMPORTANT

When available, please include the model number and serial number of the product in any correspondence.

Table of Contents

- 1.0 Configuration File Description1**
 - 1.1 Overview1
 - 1.2 WinDyn Configuration File Editor.....1
 - 1.3 Channel Types2
 - 1.4 Channel Functions3
 - 1.4.1 Sensor Channels3
 - 1.4.2 Specification Channels9
 - 1.4.3 Equations12
 - 1.4.4 Interpolation Tables20
 - 1.4.5 System Channels25

1.0 Configuration File Description

1.1 Overview

The Configuration file is used to define the functions of WinDyn™ and the Next Generation Electronics (NGE) Data Acquisition System. The channel functions, control functions, and the console display are all set in the Configuration file. Once established, the file is stored on the computer hard drive and downloaded to the Data Acquisition System (memory). The Configuration file defines the basic elements of WinDyn and is required for proper operation.



Refer to WinDyn Users Guide for more information on the configuration file and how to modify it.

1.2 WinDyn Configuration File Editor

WinDyn Configuration File Editor is a simple and powerful built-in editor in many WinDyn versions. The editor can be used to edit the SF-902 system configuration (config) file discussed in this manual. To edit the system config file, simply open the editors program window by navigating to **DESIGN > SYSTEM CONFIGURATION** within WinDyn as illustrated in Figure 1.1. To open the system config file in the editor, click on the **FOLDER** icon or select **FILE > OPEN** and navigate to the directory where the config file is located.

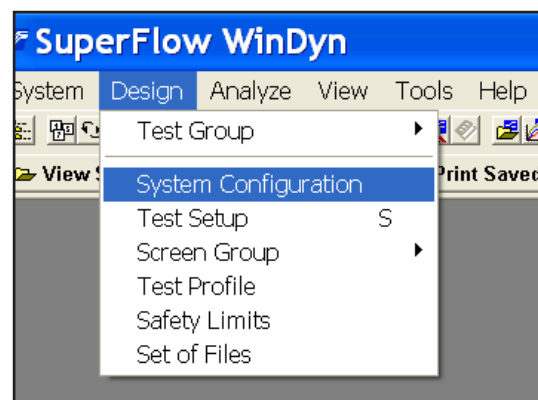


Figure 1.1: Accessing Editor

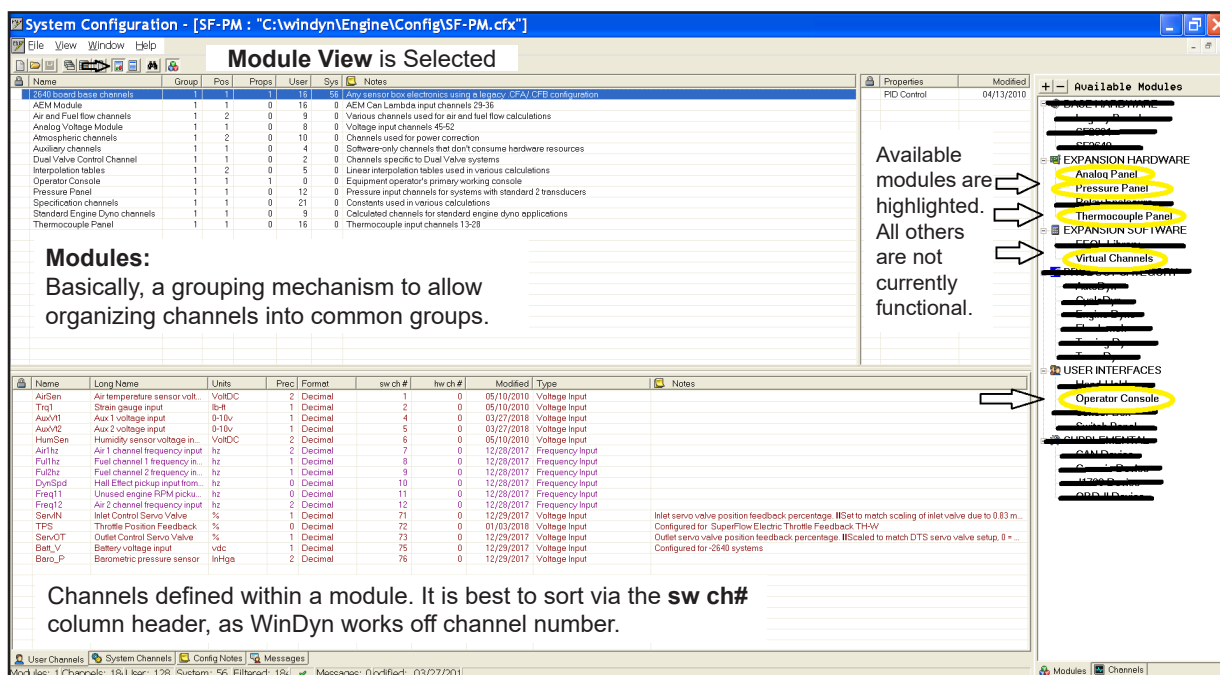


Figure 1.2: Editor Window

1.0 Configuration File Description

1.3 Channel Types

Five general channel types are available in the WinDyn system:

- **Sensor Channels:** Receive data from sensors
- **Equations:** Perform calculations using inputs from other channels
- **Specifications:** Store constants associated with a particular engine, vehicle, or test
- **Interpolation Tables:** Store nonlinear functions for calibration and calculation purposes
- **System Channels:** Contain timers and system memories

The editor identifies channel types by the following colors.

Gray	=	System	Maroon	=	Voltage Inputs
Blue	=	Equations	Purple	=	Frequency Inputs
Green	=	Specifications	Red	=	Thermocouple Inputs
Pink	=	Interpolation Tables			

1.0 Configuration File Description

1.4 Channel Functions

The channels listed in this section are in the standard default configuration file for an SF-902 dynamometer system. Actual configurations may vary based on the product and the customer application. Gaps in the numbering are undefined channels or are sensor channels used as calculated channels.

1.4.1 Sensor Channels

Sensor channels 1 through 76 input measured data and convert it to a reading. In some cases the reading is a direct reflection of the input, such as volts in to volts out. In other cases the input is converted to a different value, such as volts in to air/fuel (A/F) ratio out or frequency to rpm. Temperature channel values are determined by the type of thermocouple used.

Filters

The default system filter on 2640 boards is 6. All measured channels in released configs are set to system filter except AirSen(ch1), HumSen(ch6), and BaroP(ch76). Those channels are set to 7. System filters are controlled via commands in a test profile or via menu selection in NetDyn.

Filter Rates

1	=	20Hz corner	5	=	1.25Hz corner
2	=	10Hz corner	6	=	0.625Hz corner
3	=	5Hz corner	7	=	0.3125Hz corner
4	=	2.5Hz corner			

Channel Types

Four types of measured data channels are available in the SuperFlow Data Acquisition system for sensor inputs:

- **Frequency channels** can read any sensor device (0-15 KHz) that provides a magnetic (MAG) or Transistor-Transistor Logic (TTL) output. These channels are typically used for fuel, air, and fluid flow meters. Six frequency channels are available directly on the data acquisition, but others can be added with a frequency-to-voltage converter on an analog voltage expansion panel.

IMPORTANT

- The channel name and unit of measurement for each channel shown in the channel definition tables is the default configuration as set by SuperFlow Technologies Group. The user can alter the actual name and unit of measurement through the configuration editor.
- The unit of measurement used in Equation channels is based on the formula in the channel definition. The unit of measurement for Specification channels is based on how it is used within the system. Changing the format for the unit of measurement does not change how the channel functions.
- The full range value of each sensor channel is based upon the normal range of the sensor used in that channel and by the defined unit of measurement. The default full -scale range value in the system can be overwritten by a current value calibration of the channel.

Figure 1.3: Config Frequency Channel Window

1.0 Configuration File Description

- **Thermocouple channels** can be configured for several different types of thermocouples (K, J, T, or E) and can be read in either Fahrenheit or Celsius degrees.
- **Analog voltage channels** may be used to measure any sensor device outputting analog voltage (typically 0-10 VDC). These inputs are most commonly used for pressure transducers or other auxiliary devices. Ten channels are located directly on the data acquisition system. Others are available on expansion panels (pressure and voltage).

Figure 1.4: Config Thermocouple Channel Window

Figure 1.5: Config Voltage (Pressure) Channel Window

Figure 1.6: Config Voltage Channel Window

Any of these channels may be used for any display function, in a equation channel, as a control channel, or in a test profile.

1.0 Configuration File Description

Table 1-2. Sensor Channels

Channel
1 - AirSen
Channel 1 is used to measure the voltage from the ambient air temperature sensor. The voltage is used by channel 74 to determine the air temperature. This channel has a coefficient of 1.000, no auto zero, and is filtered at 7. Changing the values for this channel is not recommended. Changing the coefficient alters the values displayed by channel 74.
2 - Trq1
Channel 2 is used to measure the torque from the strain gage mounted to the absorber. It senses the voltage from the strain gauge and converts it into torque for calculations and power measurement. The coefficient will be changed through calibration. The channel is set up for zeroing by command.
4 - AuxV1
Channel 4 is used for auxiliary voltages for expansion. It may be used for 0–10 VDC sensors. The channel is not zeroed by command. The default coefficient for the channel should be 1.000.
5 - AuxV2
Channel 5 is used to input auxiliary voltages for expansion. It may be used for 0-10 VDC sensors. Its default defined operation is identical to channel 4. The channel is <u>not</u> set up for zeroing by command.
6 - HumSen
Channel 6 is the input for the humidity sensor used to measure the humidity of the air. It is used by channel 120 to calculate relative humidity. This channel has a coefficient of 1.000, no autozero, and is filtered at 7. Changing the values for this channel is not recommended. Changing the coefficient alters the values displayed by channel 120.
7 - Air1hz
Channel 7 is used to measure the frequency from an air turbine. The coefficient for this channel is 1.000, with a maximum input frequency of 15,000 hz. It is used by channel 53 to calculate airflow volume. Changing the coefficient alters the values displayed.
8 - Ful1hz
Channel 8 is used to measure the frequency from fuel turbine #1. The coefficient for this channel is 1.000, with a maximum input frequency of 15,000 hz. It is used by channel 127 to calculate fuel mass flow. Changing the coefficient alters the values displayed.
9 - Ful2hz
Channel 9 is used to measure the frequency from fuel turbine #2. The coefficient for this channel is 1.000, with a maximum input frequency of 15,000 hz. It is used by channel 128 to calculate fuel mass flow. Changing the coefficient alters the values displayed.
10 - DynSpd
Channel 10 is used to measure the frequency of the absorber from a Hall Effect pickup. It is used by channel 125 to calculate engine speed. Changing the coefficient alters the values displayed and severely alters the dynamometer calibration. Changing the values for this channel is not recommended. The default coefficient for the channel should be 1.000.

1.0 Configuration File Description

Table 1-2. Sensor Channels

Channel
11 - Freq 11
Channel 11 is defined as an auxiliary frequency channel. The coefficient for this channel is 1.000, with a maximum input frequency of 15,000 hz. This channel is not currently used by default in any calculations or displays on an engine dynamometer. Changing the coefficient alters the values displayed.
12 - Freq 12
Channel 12 is defined as an auxiliary frequency channel. The coefficient for this channel is 1.000, with a maximum input frequency of 15,000 hz. This channel is not currently used by default in any calculations or displays on an engine dynamometer. Changing the coefficient alters the values displayed.
13 to 20 - Thermocouple Inputs 1 through 8
Channels 13 through 20 are defined as standard thermocouple inputs. Channel 13 should be used for Dyno Inlet Water Temp. Channel 14 should be used for Dyno Outlet Water Temp. The channels were each given default names but may be renamed to fit specific functions by using the Configuration Editor program. These channels are normally set up for Type K thermocouples. Type E, Type J and Type T thermocouples can be used but require different hardware. Type K thermocouples have a range of -454 to 2,300°F.
21 to 28 - Exhaust temperatures 1 through 8
Channels 21 through 28 are defined for measuring exhaust gas temperature thermocouples. They may also be used for other temperature measurements if desired. These channels are normally set up for Type K thermocouples. Type E, Type J and Type T thermocouples can be used but require different hardware. Type K thermocouples have a range of -454 to 2,300°F.
29 to 44 - AEM Wideband O2 channels
Channels 29 through 36 are CAN inputs and show values in Lambda. Channels 37 through 44 are equations to convert Lambda to AFR. These channels may be renamed to fit specific functions by using the Configuration Editor Program. "Figure 1.10" on page 12 shows the CAN Channel, AEM Channels 29-36, Edit Equation Window.
45 to 52 - Analog Voltages 1 through 8
Channels 45 through 52 are used for measuring DC voltage inputs. They are currently defined for 0–10 VDC inputs on channels 45–51. Channel 52 is normally defined for 0–20 VDC. Each channel may be recalibrated if required through the calibration menu or through changes in the Configuration Editor program. These channels are set for zeroing by command. The default coefficient for the channels should be 1.000.
61 - Fuel P1
Channel 61 is for measuring fuel pressure. The transducer has a range of 0–150 psi. This is a metal can type transducer, so it may be used with liquids. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
62 - Fuel P2
Channel 62 is for measuring fuel pressure. The transducer has a range of 0–150 psi. This is a metal can type transducer, so it may be used with liquids. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.

1.0 Configuration File Description

Table 1-2. Sensor Channels

Channel
63 - Man_P
Channel 63 is used to measure the manifold inlet pressure or vacuum. This is a metal can type transducer, so it may be used with liquids. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 113.240.
64 - Unus64
Channel 64 is an auxiliary pressure input and can be used as desired. This is a metal can type transducer, so it may be used with liquids. It has a range of 0–150 psi. The channel may be renamed to fit specific functions by using the Configuration Editor program. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
65 - Unus65
Channel 65 is an auxiliary pressure input and can be used as desired. This is a metal can type transducer, so it may be used with liquids. It has a range of 0–150 psi. The channel may be renamed to fit specific functions by using the Configuration Editor program. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
66 - Unus66
Channel 66 is an auxiliary pressure input and can be used as desired. This is a metal can type transducer, so it may be used with liquids. It has a range of 0–150 psi. The channel may be renamed to fit specific functions by using the Configuration Editor program. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
67 - Oil_P
Channel 67 is for measuring oil pressure. This is a metal can type transducer, so it may be used with liquids. The transducer has a range of 0–150 psi. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
68 - DynWtP
Channel 68 is for measuring dynamometer inlet water pressure. This is a metal can type transducer, so it may be used with liquids. The transducer has a range of 0–150 psi. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
69 - Unus69
Channel 69 is an auxiliary pressure input and can be used as desired. This is a metal can type transducer, so it may be used with liquids. It has a range of 0–150 psi. The channel may be renamed to fit specific functions by using the Configuration Editor program. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.

1.0 Configuration File Description

Table 1-2. Sensor Channels

Channel
70 - Unus70
Channel 70 is an auxiliary pressure input and can be used as desired. This is a metal can type transducer, so it may be used with liquids. It has a range of 0–150 psi. The channel may be renamed to fit specific functions by using the Configuration Editor program. If required, it may be recalibrated through the calibration menu or through changes in the Configuration Editor program. Zeroing is by command. The default coefficient for the Imperial definition of the channel should be 55.4732.
71 - Not Used
Channel 71 is not currently used in the default configuration.
72 - TPS
Channel 72 is used to measure the voltage from the Woodward electric throttle actuator. It is then converted to a position percentage from 0-100% (+/-1%) to provide an indication of the throttle position. The value displays as a percentage from 0–100%, where 100% is a fully open throttle and 0% is a fully closed throttle. This channel may be calibrated to match your actual throttle position on the engine.
73 - ServOT
Channel 73 is used to measure the voltage from the outlet servo valve. It is then converted to a position percentage from 0-100% (+/-1%) to provide an indication of the servo valve position. No zeroing is required. The value displays as a percentage from 0–100%, where 100% is a fully closed valve (maximum load) and 0% is a fully open valve (minimum load). The default coefficient for the channel is -10.000 and should not be altered.
75 - Batt_V
Channel 75 is used to measure the source DC power IN on the engine control panel. It uses circuitry internal to the sensor box to connect the voltage on the engine control panel to the sensor input. A voltage divider is utilized so the voltage signal on the channel does not exceed 10.000 volts. The channel may be recalibrated if required through the calibration menu or through changes in the Configuration file. No zeroing is required. The default coefficient for the channel should be 17.750.
76 - BaroP
Channel 76 is used to measure the uncorrected or station barometric pressure. The barometric pressure transducer is located on the circuit board installed in the sensor box. SuperFlow recommends calibrating the barometric pressure sensor with an accurate barometric pressure measurement device. No zeroing is required. The default coefficient for the channel should be 8.0391.

1.0 Configuration File Description

1.4.2 Specification Channels

Channels 77 through 99 are all specifications or constants. The values shown here are defaults, and many will change for each variety of test engine.

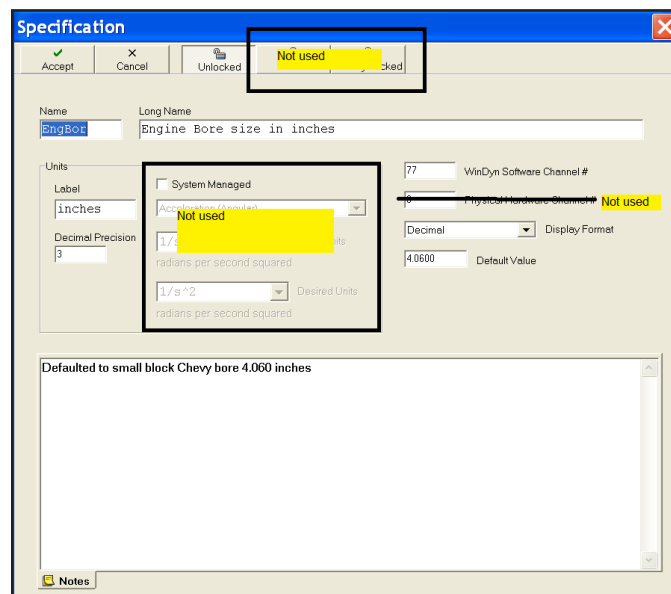


Figure 1.7: Config Specification Channel Window

Table 1-3. Specification Channels

Channel	Default Value
77 - EngBor	4.06 in
Channel 77 is for entering the bore size of the engine. Channel 77 is used by channel 126 to determine displacement.	
78 - EngStr	3.45 in
Channel 78 is for entering the stroke size of the engine. Channel 78 is used by channel 126 to determine displacement. It is also used by channel 107 to determine spark friction torque which will be used in the corrected torque calculations.	
79 - EngCyl	8
Channel 79 is for entering the number of cylinders of the engine. Channel 79 is used by channel 126 to determine displacement.	
80 - EngCyc	4
Channel 80 is for entering the cycle type of the engine, either two-cycle or four-cycle. Channel 80 is used by the calculations for volumetric efficiency in channel 109 and brake mean effective pressure in channel 111.	
81 - OvrRat	1.000
Channel 81 is used to input the ratio between the engine and the absorber. Channel 81 is used by channel 125 to calculate engine speed and by channel 121 to calculate engine torque. It is also used by channel 122 to calculate the Accel term.	
82 - Thrott	0
Channel 82 is used to determine if an electronic throttle actuator is used, 0 = NO electronic throttle, 1 = YES.	

1.0 Configuration File Description

Table 1-3. Specification Channels

Channel	Default Value
83 - PP_rev	60.000
Channel 83 is used to enter the number of pulses per revolution for the engine rpm measurement. The absorber frequency, channel 10, is combined with the pulses per revolution number in channel 83 to make the appropriate engine speed calculation in channel 125. SuperFlow's standard water brake absorbers use a 60-tooth gear on their main shaft; thus, 60 pulses per shaft revolution is standard.	
84 - Prompt	0
Channel 84 is used to turn ON/OFF prompts for test setup in the Accel.tpf. Default is 0 = Prompts OFF, 1 = Prompts ON.	
85 - FuelSG	0.750
Channel 85 is used to input the correct fuel-specific gravity. This value is used by the mass flow fuel calculations in channels 127 and 128. This value can be obtained through measurement or from the fuel supplier.	
86 - Cyc_No	3
Channel 86 is used to input the number of cycles for Break-in test.	
87 - Not Used	
Channel 87 is not currently used in the default configuration.	
88 - Not Used	
Channel 88 is not currently used in the default configuration.	
89 - Inertia	0.4
Channel 89 is defined as an estimated inertia value. This is an estimated value of the engine (typical pushrod V-8) and the water brake absorber combined. This value typically ranges from 0.4 to 0.6 and may be modified by the user. It is used with the acceleration channel 122 to compute the inertia torque and is then used in channel 121 to compute total torque. Theoretically, this value will provide a corrected power figure estimate negating the inertia affect due to rate of acceleration chosen for the test. Use 0.4 for small blocks, 0.6 for big block engines. This channel is negated when channel 91 is set to 0.	
90 - Stoich	14.7
Channel 90 is used to input the Stoichiometric value used to calculate Air to Fuel Ratio from lambda sensor. Used by channels 37-44. Typical values are 14.7 for gasoline, 14.13 for E85, and 6.5 for methanol.	
91 - InrCor	1
Channel 91 is used as a switch to turn ON=1/OFF=0 engine inertia correlation. It is defaulted to ON=1.	
92 - Not Used	
Channel 92 is not currently used in the default configuration.	
93 - Recpcl	1.000
Channel 93 is a reciprocal value used by the ProFilter feature to properly calculate engine speed increments when in ratio mode. This value is controlled by the test profile. This channel is used when setting up the ProFilter rev counter channel. The user should not alter it.	

1.0 Configuration File Description

Table 1-3. Specification Channels

Channel	Default Value
94 - Cycle	30
Channel 94 is for entering a cycle time for the Break In test profile. The default value is 30 seconds for a complete cycle. This channel is not used by any other test profile.	
95 - Lower	3000
Channel 95 is for entering the start engine speed to use in various automated tests. It may be changed from the test setup dialog. If the PROMPT channel is set to 1, the operator will be prompted during test execution.	
96 - Upper	5000
Channel 96 is for entering the stop engine speed to use in various automated tests. It may be changed from the test setup dialog. If the PROMPT channel is set to 1, the operator will be prompted during test execution.	
97 - StepTm	5.0
Channel 97 is used to enter the step time for the step type automated tests. It may be changed from the test setup dialog. If the PROMPT channel is set to 1, the operator will be prompted during test execution.	
NOTE: If running an Accel test, this value will be automatically calculated. The operator does not need to enter this value. If running a STEP test, the operator will need to enter this value.	
98 - Rate	300
Channel 98 is used to enter the requested step size or ramp increment in rpm for automated test profiles. It may be changed from the test setup dialog. If the PROMPT channel is set to 1, the operator will be prompted during test execution.	
99 - Return	3000
Channel 99 is for entering the return engine speed to use in various automated tests. It may be changed from the test setup dialog. If the PROMPT channel is set to 1, the operator will be prompted during test execution.	

1.0 Configuration File Description

1.4.3 Equations

The Equation channel is one of the most powerful features of the WinDyn software. Sensor data, specifications, interpolation tables, other equations, or any direct constant value can be combined into a mathematical calculation to produce real-time data that displays and records along with the rest of the test data. Channels 100 through 129 are dedicated equation channels. Additionally, any unused measured channel may be configured as an equation channel, although SuperFlow does not recommend creating them in channel blocks used for installed measured channels.

For instance, if a thermocouple module is installed in channels 13–28, do not make channel 25 an equation channel. However, if the thermocouple module was not installed, any or all of channels 13–28 could be used for additional equation channels. Any predefined equation channel may easily be modified using the configuration editor supplied with WinDyn.

The configuration editor can utilize any of the **Extended Equation Language (EEQL (.CFA))** (pronounced 'equal') variables shown on the following page when creating equations.

```
// Acceleration
// This equation calculates vehicle acceleration.
//
// EQUATION TERMS:
// 1. SAE corrected wheelpower
// 2. Measured Coastdown Losses: speed dependent losses + load dependent
//   losses (based on load during coastdown)
// 3. SAECor: SAE correction factor
// 4. (InrPwr+DynLos+AbsPwr): power thru drivetrain during accel
// 5. lerp(Speed,CstDwn): power thru drivetrain during coastdown
// 6. K Factor: Additional load dependent losses not measured during coastdown
//
return(
  SAECor*(InrPwr+DynLos+AbsPwr) //SAE corrected wheelpower
+ lerp(Speed,CstDwn) //Measured CoastDown Losses
+ (SAECor*(InrPwr+DynLos+AbsPwr) //see 'terms' #4 above
- lerp(Speed,CstDwn)) //see 'terms' #5 above
* K_Fact //K Factor
);
```

Figure 1.9: Example Equation

Figure 1.9 above shows an example of a lengthy equation with extensive comment lines. Comments may be placed on their own lines in equations, or after a function. Comments are identified by the use of the double back slashes: //

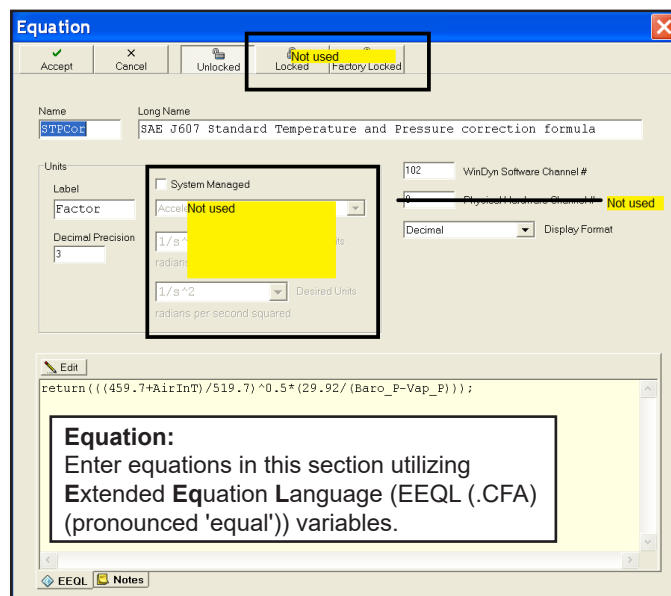


Figure 1.8: Edit Equation Channel Window

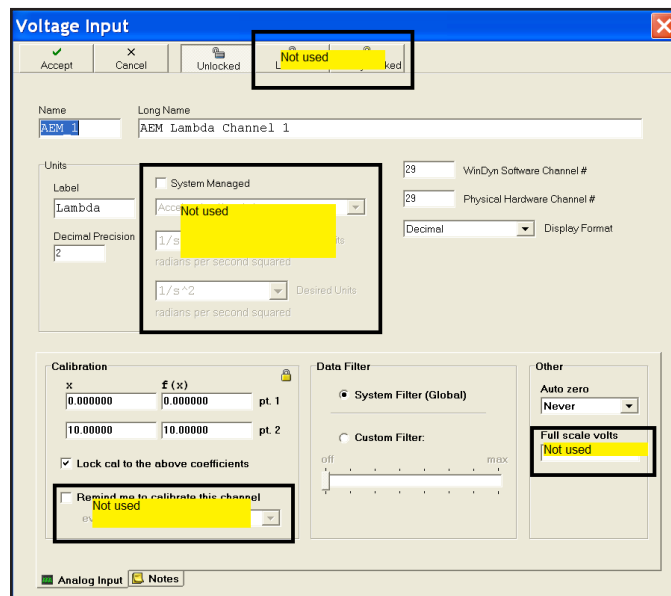


Figure 1.10: CAN Channel, AEM Channels 29-36, Edit Equation Window

1.0 Configuration File Description

EEQL (.CFA)				
(pronounced 'equal')				
Extended Equation Language				
Lexical Elements supported by .CFA files				
PUNCTUATION				
Token	Function	Description	Example	
//	Comment	Specify comment text	sin(0) //compute trig sine	
()	Precedence	Override default precedence	1+2*3 = 7 (1+2)*3 = 9	
()	Function input	Specify function input expression	abs(A+B) (A+B)^2	
;	Statement terminator	Specify end of a statement	return(A+B);	
,	Argument delimiter	Separate multiple function arguments	round(1.5,0)	
ARITHMETIC OPERATORS (BINARY)				
Token	Function	Description	Example	Result
+	Add	Adds two expressions	1+1	2
-	Subtract	Subtracts two expressions	1-1	0
*	Multiply	Multiplies two expressions	1*1	1
/	Divide	Divides two expressions	1/1	1
^	Exponentiate	Exponentiates expression	2^3	8
ARITHMETIC FUNCTIONS				
Token	Function	Description	Example	Result
ABS	Absolute value	Absolute value of expression	abs(0-1)	1
LERP	Interpolate	Linear interpolation of expression	lerp(A,Table1)	Run A thru table
ROUND	Round	Round expression to position n (0,1,2,etc.) Rounds up at >= 5, rounds down at < 5.	round(123.55,1)	123.6
TRIGONOMETRIC FUNCTIONS - Angles in degrees only				
Token	Function	Description	Example	Result
SIN	Sin	Trigonometric sine of expression	sin(90)	1
COS	Cosine	Trigonometric cosine of expression	cos(90)	0
TAN	Tangent	Trigonometric tangent of expression	tan(45)	1
ASIN	Arcsine	Trigonometric arcsine of expression	asin(1)	90
ACOS	Arccosine	Trigonometric arccosine of expression	acos(0)	90
ATAN	Arctangent	Trigonometric arctangent of expression	atan(1)	45
FLOW CONTROL				
Operator	Function	Description	Example	
RETURN	Return expression	End program and return expression	return(EngSpd*EngTrq/HPD);	
MISCELLANEOUS FUNCTIONS				
Token	Function	Description	Example	Result
RAW	Raw channel value	Value of channel (raw ADC units)	raw(EngTrq)	ADC of EngTrq
CONSTANTS				
Token	Function	Description	Value	
PI	pi	Value of pi to 15 digits of precision	3.14159265358979	
HPD	hp divisor	Divisor for horsepower calculation	5252.11312203255	
TRUE	true	boolean true	1	
FALSE	false	boolean false	0	
ON	on	boolean on	1	
OFF	off	boolean off	0	
NUMERICAL VALUES				
Token	Function	Description	Examples	
1	Number	A valid number (no decimal point)	1 12 123 1234 12345	
1.0	Number	A valid number (with decimal point)	0.01 0.1 1.0 10.0 123.123	
1.0E+1	Number	A valid number (scientific notation)	1e1 1E+1 1.0e-1 6.022E+23	
0x7F	Number	A valid number (hexadecimal)	0x7F 0X7FFF 0xABCD 0X1234ABCD	
IDENTIFIERS - Only letters, numbers, and underscores allowed. First char can't be a number.				
Token	Function	Description	Examples	
x	Identifier	A valid identifier	x tmp EngSpd AirT4	
x1	Identifier	A valid identifier	x1 tmp1 tmp2 tmp23	
_1	Identifier	A valid identifier	_x _1 NO COMM tmp_23	

1.0 Configuration File Description

The formula as it is in the configuration is shown next to the channel name in Table 1-4.

Table 1-4. Equation Channels

Channel	Units Of Measurement	Formula
3 - Delta T	deg F	return(abs(Dynoln-DynoOt));
Channel 3 is for calculating the water temperature differential across the SF-902 absorber.		
37 - AFR_1	ratio	return(AEM_1*Stoich);
Channel 37 is for calculating AFR from AEM Lambda.		
38 - AFR_2	ratio	return(AEM_2*Stoich);
Channel 38 is for calculating AFR from AEM Lambda.		
39 - AFR_3	ratio	return(AEM_3*Stoich);
Channel 39 is for calculating AFR from AEM Lambda.		
40 - AFR_4	ratio	return(AEM_4*Stoich);
Channel 40 is for calculating AFR from AEM Lambda.		
41 - AFR_5	ratio	return(AEM_5*Stoich);
Channel 41 is for calculating AFR from AEM Lambda.		
42 - AFR_6	ratio	return(AEM_6*Stoich);
Channel 42 is for calculating AFR from AEM Lambda.		
43 - AFR_7	ratio	return(AEM_7*Stoich);
Channel 43 is for calculating AFR from AEM Lambda.		
44 - AFR_8	ratio	return(AEM_8*Stoich);
Channel 44 is for calculating AFR from AEM Lambda.		
53 - Air_1c	CFM	return (lerp(Air1hz,_9in1));
Channel 53 is used to calculate airflow for air turbine #1 in cubic feet per minute (cfm). The air turbine's frequency output (channel 7) is looked up in interpolation table (channel 133) to determine the value in cfm.		
54 - WatGrn	grains	return((7000*(18.02/28.85)) * (SatVap/((Baro_P*0.4911)-SatVap)) * (Humidy/100));
Channel 54 is used to calculate water grains at current relative humidity and barometric pressure.		
55 - ADR	ratio	return((AirDen/0.0763) * 100);
Channel 55 is used to calculate air density ratio.		
56 - Air_1s	SCFM	return(Air_1c * AirDen/0.0763);
Channel 56 calculates the airflow value in standard cubic feet per minute (scfm). It uses the cfm value from channel 53 and multiplies it by the current air density (channel 119). The constant 0.0763 is the lbs/cubic foot of air at sea level.		

1.0 Configuration File Description

Table 1-4. Equation Channels

Channel	Units Of Measurement	Formula
57 - SatVap	psi	return((lerp(AirInT,VaporT)* 0.4911));
Calculates saturation vapor pressure in psi.		
74 - AirInT	deg F	return(lerp(AirSen,AirTpT));
Channel 74 displays the air inlet temperature from the thermistor used for ambient air temperature measurement. The thermistor is located inside the humidity probe and should be positioned near the intake air for the engine. The voltage is measured by Channel 1, then retrieves the temperature for that voltage from the channel 136 interpolation table. The air temperature data is used to determine power correction factors and air density.		
100 - EngPwr	hp	return(EngTrq * EngSpd/hpd);
Channel 100 is used to calculate the measured engine power delivered to the absorber. Channel 121, the engine torque channel, is multiplied by channel 125, engine speed in revolutions per minute (rpm) and divided by the HPD constant 5252.113. This is a standard horsepower equation. The Engine Power value includes estimated inertia power when channel 91 is set to 1.		
NOTE: The correction factors listed below are the default formulas provided by Superflow. WinDyn is capable of generating performance data corrected to any standard. All that is required is to change the name and formula in one of these channels. The channel names of the referenced channels (xxxPwr and xxxTrq) should also be changed to reflect the proper correction standard.		
101 - SAECor	factor	return((((459.7+AirInT)/536.7)^0.5*(29.23/ (Baro_P-Vap_P))));
Channel 101 is used to calculate the Society of Automotive Engineers (SAE) J1349 power correction factor for the engine under test. It combines the ambient air temperature from channel 74 and the barometric pressure from channel 76 with the vapor pressure of the moisture of the air from channel 118. The ^0.5 value indicates a square root function. This factor estimates what the measured torque and power would be at 77° Fahrenheit [25°C] and 29.23 inches of mercury [99 kPa] air pressure. The SAE correction factor is used by channel 115, SAE Torque, to correct the engine torque in channel 121.		
102 - STPCor	factor	return((((459.7+AirInT)/519.7^0.5*(29.92/Baro_P-Vap_P))));
Channel 102 is used to calculate the Standard Temperature and Pressure (STP) J607 power correction factor for the engine under test. It uses the ambient air temperature from channel 74, the barometric pressure from channel 76, and the vapor pressure from channel 118 to calculate a power correction factor. This factor estimates what the measured torque and power would be at 60° Fahrenheit and 29.92 inches of mercury barometric pressure [15.5°C and 101.3 kPa]. Channel 102 is used by channel 116, STP Torque, to correct the engine torque in channel 121.		
103 - Not Used		
Channel 103 is not currently used in the default configuration.		
104 - AFR	ratio	return((Air_1c*AirDen*60)/FulSum);
Channel 104 is used to calculate the air/fuel ratio. It uses the air volume from channel 53 and converts it to a mass using the air density from channel 119. The constant 60 converts the air mass value into lbs-hr. This is then divided by the total fuel mass in channel 129. Typical values for gasoline powered engines range from 8-18, with best performance typically achieved in the range 12-14.		

1.0 Configuration File Description

Table 1-4. Equation Channels

Channel	Units Of Measurement	Formula
105 - BSFC	lb/hph	return(FulSum/EngPwr);
Channel 105 is used to calculate the Brake Specific Fuel Consumption (BSFC) value. This is an efficiency rating showing the amount of fuel consumed in pounds per horsepower hour. It uses the mass fuel flow value from channel 129 and divides it by the measured (uncorrected) horsepower number from channel 100. Typical values range from an inefficient 0.60 to a very efficient 0.35. The lower the number, the better. Although many believe this number indicates a rich or lean fuel condition, it does not.		
106 - BSAC	lb/hph	return((Air_1c*AirDen*60)/EngPwr);
Channel 106 is used to calculate the Brake Specific Air Consumption (BSAC) value. This is an efficiency rating showing the amount of air consumed in pounds per horsepower hour <i>[grams per kilowatt hour]</i> . It uses the air volume from channel 53 and converts it to a mass using the air density from channel 119. The constant 60 converts the air mass value into lbs-hr. It then divides the air mass by the measured (uncorrected) horsepower number from channel 100. Typical values range from an inefficient 6.5 to a very efficient 5.0. The lower the number, the better.		
107 - SpFrTq	lb-ft	return((lerp(EngSpd*(EngStr)/6,FrTqTb))*Displ);
Channel 107 is used to calculate the spark engine friction torque value for the engine being tested. This estimated value equates to the torque required to spin the engine at a given engine speed. The value is computed using engine speed, channel 125, the engine's stroke, channel 78, and the engine's displacement, channel 126. A lookup table, 130, is used to determine the piston speed in feet per minute and an approximate friction torque factor for the given speed. These factors were derived from manufacturer testing. SuperFlow uses the friction torque value in corrected torque calculations instead of assigning a fixed mechanical loss percentage as is done by most correction factor equations. SuperFlow engineers believe the friction torque method provides greater accuracy in the final corrected power results.		
108 - MAP	kPa	return((Man_P+Baro_P)*3.386388);
Channel 108 is used to calculate manifold absolute pressure.		
109 - VolEff	%	return((EngCyc/2)*(1728*Air_1c)/(Displ*EngSpd)*100);
Channel 109 calculates the volumetric efficiency (VE) of the engine. It first determines the number of cycles in the engine power cycle, using channel 80. Then it converts the total volume of air, channel 53, into cubic inches per minute (the conversion factor 1728 is the number of cubic inches in a cubic foot). Engine displacement times engine speed is then used to determine the resultant efficiency. The value 100 converts the value to a percentage. A typical stock engine might achieve 80–90% efficiency. However, performance engines can achieve greater than 125% without turbo- or supercharging the engine. Beware of high VE numbers and high BSAC. This could indicate too much valve overlap or poor sealing valves.		
110 - MecEff	%	return(EngTrq/(EngTrq + SpFrTq) * 100);
Channel 110 calculates the mechanical efficiency (ME) of the engine. It divides the measured engine torque, channel 121, with the theoretical total torque (engine plus friction torque, channel 107) produced by the engine. The value 100 converts the value to a percentage. No engine will achieve 100% mechanical efficiency.		
111 - ElpsTm	seconds	return(Timer2);
Channel 111 uses timer 2, channel 211, to measure elapsed time in seconds during a test profile. It allows decimal precision adjustments, if desired. It is defaulted to hundredths of a second precision.		

1.0 Configuration File Description

Table 1-4. Equation Channels

Channel	Units Of Measurement	Formula
112 - SAEPwr	CHp	return((SAETrq * EngSpd)/5252.113);
The standard horsepower equation is used with the SAE corrected torque channel 115 and the engine speed channel 125 to calculate the “corrected” engine power for the test engine. This channel is for estimating what the power would have been at 77°F [25°C] air temperature and 29.23 in.Hg [99kPa] barometric pressure in dry air.		
113 - STPPwr	CHp	return((STPTrq * EngSpd)/5252.113);
The standard horsepower equation is used with the STP corrected torque channel 116 and the engine speed channel 125 to calculate the “corrected” engine power for the test engine. This channel is for estimating what the power would have been at 60°F [15.56°C] air temperature and 29.92 in.Hg [101.3kPa] barometric pressure in dry air.		
114 - BoostP	0-150p	return(Man_P*0.4911);
Converts manifold pressure in In/Hg to psi.		
115 - SAETrq	Clb-ft	return((EngTrq + SpFrTq) * SAECor - SpFrTq);
Channel 115 derives a corrected torque value in lbs-ft from the engine torque channel 121 and the estimated friction torque calculated in channel 107. These two values are added together to compute the total torque produced by the engine; then the SAE correction factor from channel 101 is applied. Finally, the estimated friction torque is removed before the resultant corrected engine torque value is produced. This value is then used to produce a corrected horsepower figure for the engine.		
116 - STPTrq	Clb-ft	return((EngTrq + SpFrTq) * STPCor - SpFrTq);
Channel 116 derives a corrected torque value in lbs-ft from the engine torque channel 121 and the estimated friction torque calculated in channel 107. These two values are added together to compute the total torque produced by the engine; then the STP correction factor from channel 102 is applied. Finally, the estimated friction torque is removed before the resultant corrected engine torque value is produced. This value is then used to produce a corrected horsepower figure for the engine.		
117 - DenAlt	Feet	return(148300*(460+AirInT-17.34782*Baro_P+6.582028*Vap_P)/ (4.956534*(460+AirInT)-17.34782*Baro_P+6.582028*Vap_P));
Channel 117 produces a value in estimated density altitude used by engine tuners.		
118 - Vap P	InHg	return((lerp(AirInT,VaporT) * Humidy/100);
Channel 118 calculates the vapor pressure in the air under the current test conditions. Interpolation table 137 contains the vapor pressure for 100% relative humidity at different air temperatures. The formula provides the vapor pressure from the table for the air temperature measured in channel 74 (Air Temp). That number is multiplied by channel 120, the percent relative humidity to obtain the actual vapor pressure. In channels 101 and 102, the vapor pressure is subtracted from the barometric pressure to determine the net barometric pressure to be used in the power correction factors. Vapor pressure is the true measure of water vapor content of the air. Relative humidity cannot be used directly because it varies with air temperature.		
119 - AirDen	lb/cft	return(0.0763 * BaroP/29.92 * 520/(460+AirInT));
Channel 119 is used to calculate the air density under the test conditions. Air density is measured in pounds per cubic feet of air. The constant 0.0763 is the lbs/ cubic foot of air at sea level. Channel 119 uses the barometric pressure from channel 76 and the air temperature from channel 74 to calculate the actual air density under test conditions.		

1.0 Configuration File Description

Table 1-4. Equation Channels

Channel	Units Of Measurement	Formula
120 - Humidy	%	return(((HumSen-0.655)/2.54*100)/(1.093-(0.0012*AirInT)));
Channel 120 takes the humidity sensor voltage input from channel 6 and combines it with the air temperature to determine the percent relative humidity of the air during the test. This data is then used by channel 118 to determine the vapor pressure in the air for power correction.		
121 - EngTrq	lbs-ft	return((Trq1/OvrRat)+(InrCor*((0.70+(Inrtia*8))*Accel/114.59)));
Channel 121 derives an uncorrected torque value in lbs-ft from the strain gauge measurement in channel 2. If a ratio is used between the engine and the absorber, channel 2 is divided by the ratio in channel 81 to produce the correct engine torque value. The remainder of the equation derives an inertia torque value to be added to measured torque for inertia correlation. If InrCor (channel 91) is set to 0, that portion of the equation is turned off.		
122 - Accel	RPM/s	return(Mem5*OvrRat);
Channel 122 derives the rate of acceleration in rpm/second. This is an embedded series of calculations performed by the firmware and recorded in memory channel 5. Channel 122 is used to select the precision of the channel and to rename it. This value is used in channel 121 to compute the inertia torque. The OvrRat (channel 81) value adjust the accel computation if a ratio is used between the engine and the absorber.		
123 - BMEP	psi	return(EngTrq/Displ * EngCyc/2 * 75.4);
Channel 123 is used to calculate an estimated Brake Mean Effective Pressure (BMEP) for the engine. The measured engine torque from channel 121 is divided by the engine displacement and then multiplied by the engine type (cycles) from channel 80. The constant, 75.4, is then applied to produce a result in pounds per square inch (psi). Typical values for race engines are greater than 175 psi.		
125 - EngSpd	RPM	return(DynSpd/PP.rev * 60 * ovrRat);
Channel 125 is used to calculate the engine speed in revolutions per minute (rpm). It uses the frequency from the absorber pickup, channel 10, divided by the number of pulses per revolution from channel 83. The result is multiplied by 60 to obtain an rpm value. This value is then multiplied by a ratio, channel 81, if one is used between the engine and the absorber.		
126 - Displ	ci	return((EngBor/2)^2*3.1416*EngStr*EngCyl);
Channel 126 is used to calculate the displacement of the engine in cubic inches. It uses the engine bore, channel 77; the engine stroke, channel 78; and the number of engine cylinders, channel 79; to do this. The ^2 value represents an exponential function, and the constant 3.1416 is <i>Pi</i> . The engine displacement is used in calculating friction torque, BMEP, and volumetric efficiency.		
127 - Fuel1M	lbs/hr	return(Ful1hz*3600*8.3378*FuelSG/10/2471);
Channel 127 is used to calculate fuel flow from the #1 fuel flow turbine. The fuel turbine frequency from channel 8 is used. The result is a flow value in gallons per hour. This number is then factored with the fuel-specific gravity from channel 85 to obtain a value in pounds per hour. The constant 8.3378 is the weight of a gallon of water at 60 degrees F. A typical gasoline powered engine will consume between 0.4 and 0.6 pounds of fuel per horsepower hour.		
NOTE: The equation above uses the default value for the FlowScan flow turbine (2471). This value will be replaced with the actual calibration value for the specific flow turbine.		

1.0 Configuration File Description

Table 1-4. Equation Channels

Channel	Units Of Measurement	Formula
128 - Fuel2M	lbs/hr	return(Ful2hz * 3600 * 8.3378 * fuelSG/10/2471);
Channel 128 is used to calculate fuel flow from the #2 fuel flow turbine. The fuel turbine frequency from channel 9 is used along with FlowScan calibration value. The result is a flow value in gallons per hour. This number is then factored with the fuel-specific gravity from channel 85 to obtain a value in pounds per hour. The constant, 8.3378, is the weight of a gallon of water at 60 degrees F. A typical gasoline powered engine will consume between 0.4 and 0.6 pounds of fuel per horsepower hour.		
NOTE: The equation above uses the default value for the FlowScan flow turbine (2471). This value will be replaced with the actual calibration value for the specific flow turbine.		
129 - FulSum	lbs/hr	return(Fuel1M+Fuel2M);
Channel 129 is used to calculate the combined fuel flow in pounds per hour from channels 127 and 128. This channel is used in the air/fuel ratio calculation in channel 104 and in the BSFC calculation in channel 105.		

1.0 Configuration File Description

1.4.4 Interpolation Tables

Interpolation tables store non-linear functions for calibration and calculation purposes. They are typically used as calibration tables for air turbines, parasitic inertia tables for chassis dyno rolls, and correction factor tables. This feature is used to linearize a sensor or basically perform calculations from a set of arbitrary data. Tables can be defined with fixed interval or variable interval input values. The interpolation tables are located in channels 130 through 139.

Interpolation Channel 130 - SpFrTq

Channel 130 is an interpolation look-up table to estimate friction torque. The Input(x) is piston speed in feet per minute. The Output f(x), is a torque factor used in the equation in channel 107. Altering this table will affect the corrected torque calculations in channels 115 and 116.

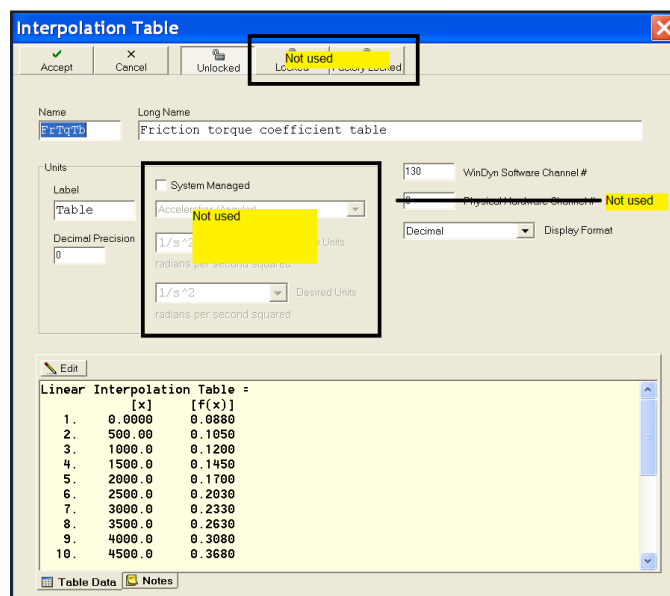


Figure 1.11: Edit Interpolation Channel Window

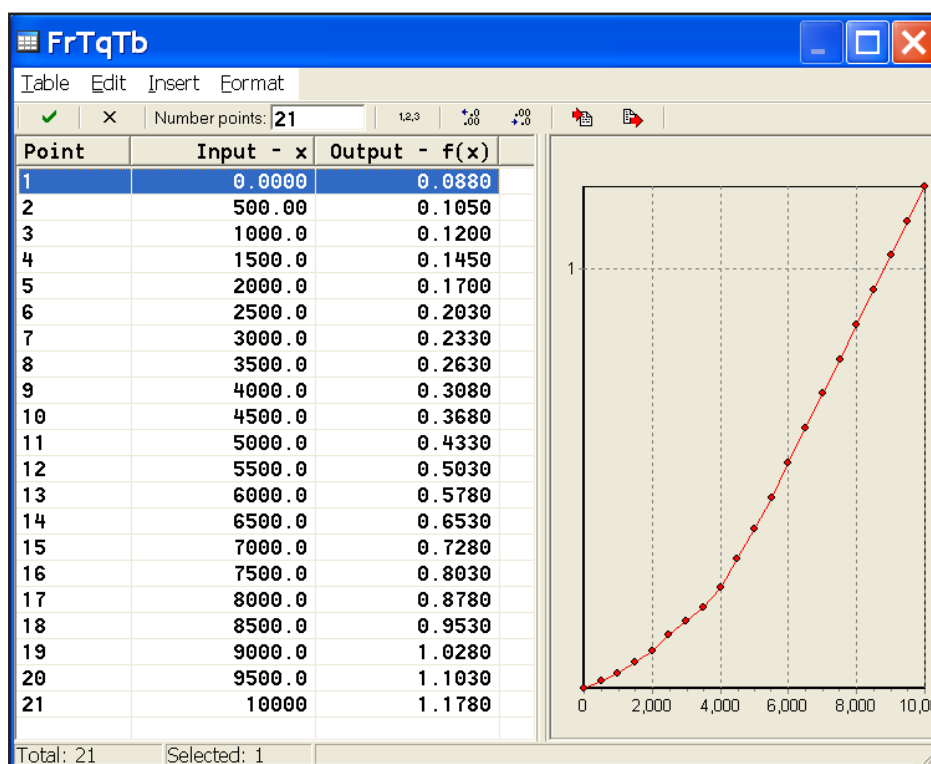


Figure 1.12: Channel 130 Values

1.0 Configuration File Description

Interpolation Channel 133 - 9inch1

Channel 133 is an interpolation look-up table containing calibration values for the nine-inch air turbine used as air turbine #1 (frequency channel 7). The values in the table are examples and must be replaced by those accompanying your nine-inch air turbine. The table is used in channel 53 to determine airflow in cfm when using the nine-inch turbine. The Input(x) is a frequency in hertz, and the Output f(x) value is in cubic feet per minute (cfm).

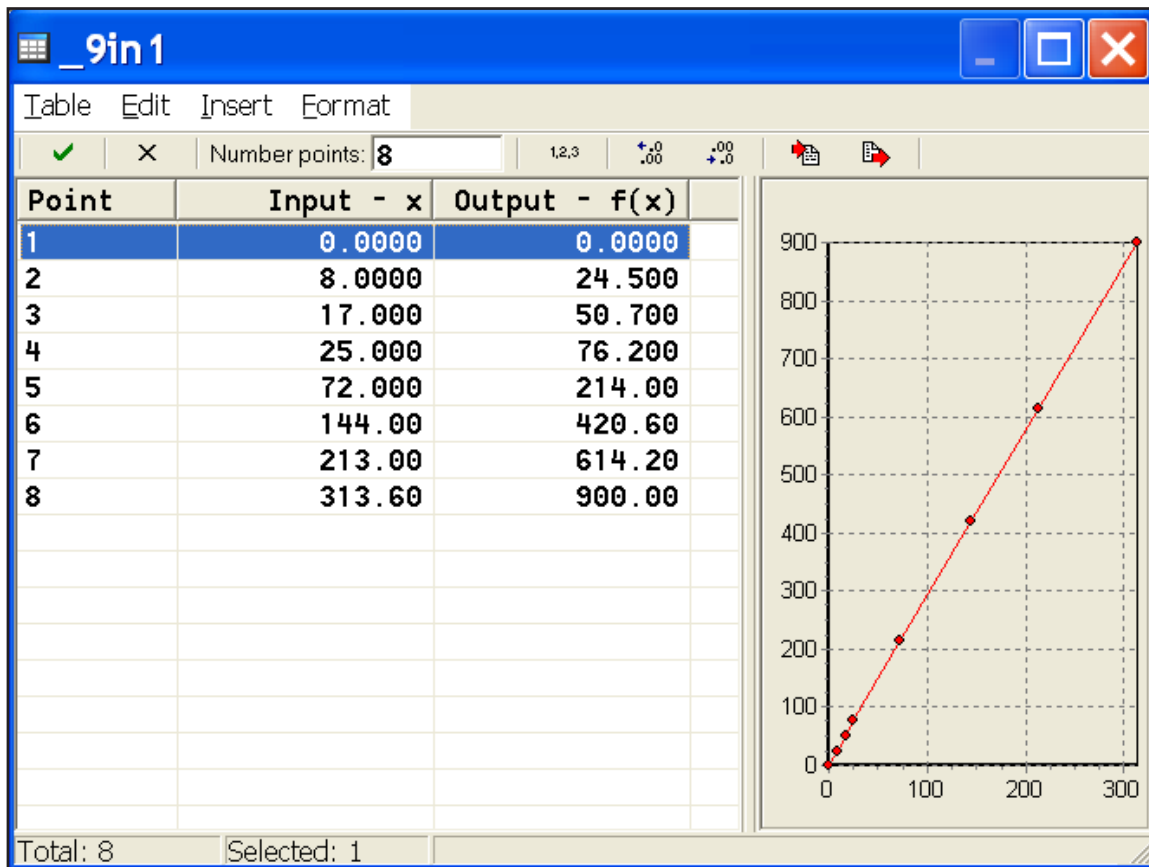


Figure 1.13: Channel 133 Values

1.0 Configuration File Description

Interpolation Channel 136 - AirTpT

Channel 136 is an interpolation look-up table to convert the voltage from the air temperature sensor in channel 1 into actual temperature for channel 74.

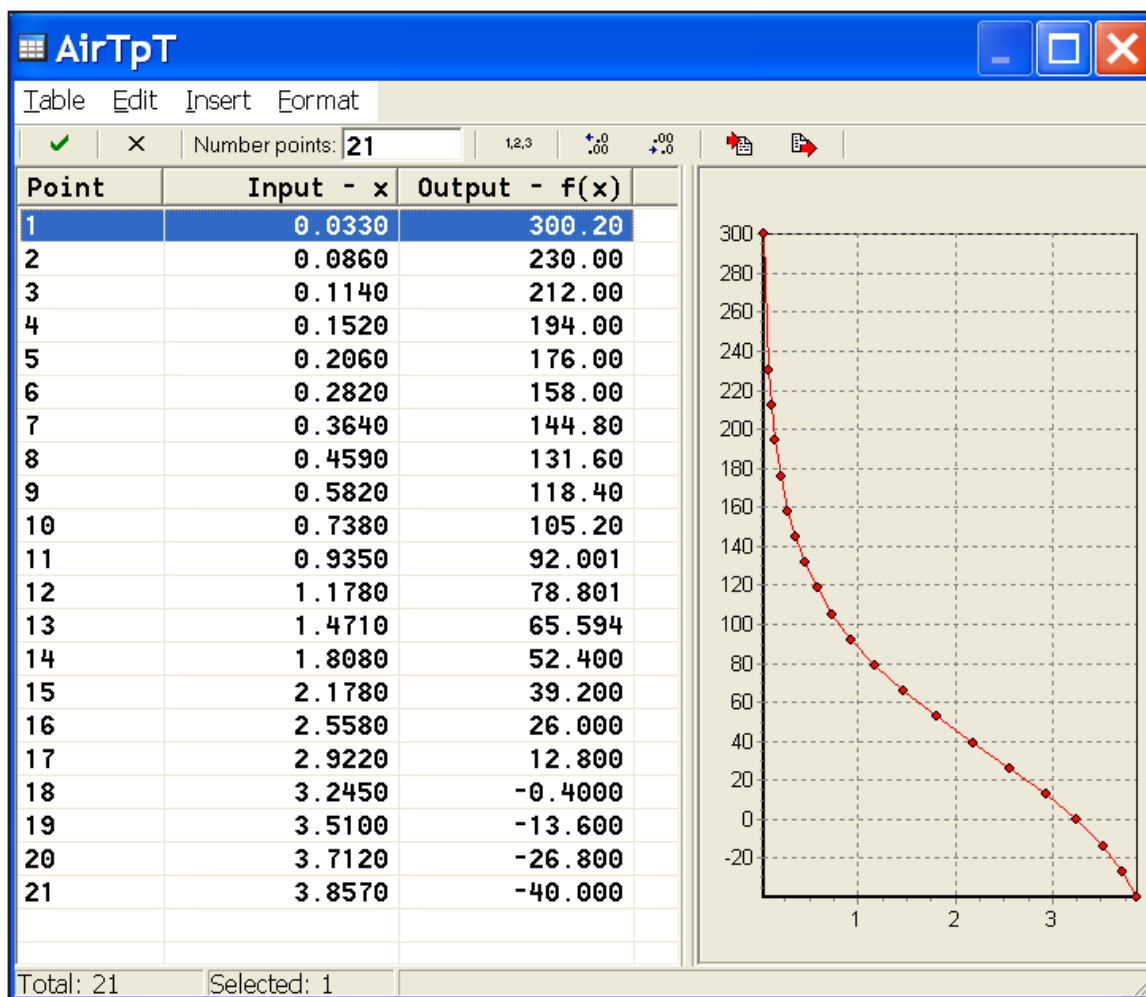


Figure 1.14: Channel 136 Values

1.0 Configuration File Description

Interpolation Channel 137 - VaporT

Channel 137 is an interpolation look-up table to determine the vapor pressure at 100% relative humidity (saturation vapor pressure) for the dry bulb temperature. The input is in temperature units in deg. F. The output is in vapor pressure units, inHg. This table is used in channel 118.

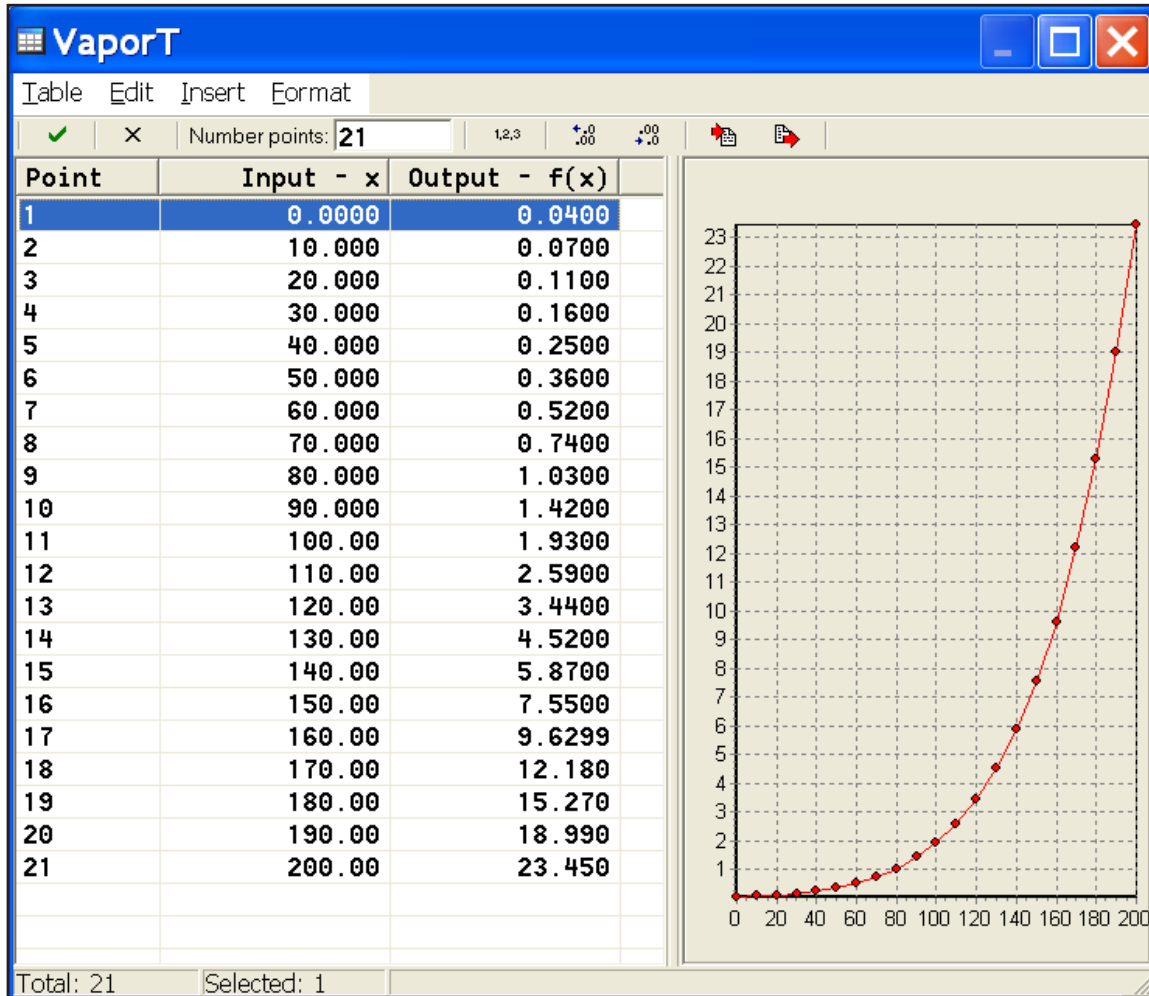


Figure 1.15: Channel 137 Values

1.0 Configuration File Description

1.4.5 System Channels

System channels are pre-programmed channels that supply important information to WinDyn. The following descriptions lists the system channels and their functions. System Channels can be read and displayed in the same manner as data channels and can be used as operators in calculated channels. System channels cannot be modified or used for closed loop control.

Table 1-5. System Channels

Channel	Name	Description
200	Time_H	Displays the current hour from the system clock* (see note below)
201	Time_M	Displays the current minute from the system clock
202	Time_S	Displays the current second from the system clock
203	SecDay	Displays the number of seconds since midnight
204	TsTime	Not used.
205	RnTime	Not used.
207	SetPt1	Channel 207 is the load set point used by the absorber control system. A value in this channel indicates the control set point being used. The value changes depending upon the control channel being used. If control is manual, then the value represents a percentage of load from 0-100%. If the control is to engine speed, then the value indicates an rpm control point from 0–20,000 rpm. If the control is to torque, then the value represents a control point from 0 to 2500 lb-ft.
208	SetPt2	Channel 208 is the throttle set point used by the optional electronic throttle control system. A value in this channel indicates the control set point being used. The value changes depending upon the control channel being used. If control is manual, then the value represents a percentage of throttle from 0-100%. If the control is to engine speed, then the value indicates an rpm control point from 0-20,000 rpm. If the control is to torque, then the value represents a control point from 0 to 2500 lb-ft.
210	Timer1	Channel 210 is a system timer channel. This channel is typically used in test profiles to indicate the total time a test is running. It uses tenths precision.
211	Timer2	Channel 211 is a system timer channel. This channel is typically used in test profiles to indicate ramp time or the time during which the data is collected during a test. It uses thousandths precision.
212–218	Timer3 to Timer9	Used by the autotest to monitor timing functions. The timers are not user accessible. See the Test Profile editor in the WinDyn Users Guide for details
219	SpcGv2	Not used in current SuperFlow systems
220–222**	Memry0 to Memry2	Not used in current SuperFlow engine dynamometer systems
223	Memry3	Channel 223 is used to hold the total number of data lines recorded.

* WinDyn will synchronize the computer clock with the clock in the data acquisition system. The system time/ date channels (200-203 & 232-235) are linked to the computer clock when WinDyn connects with the system.

1.0 Configuration File Description

Table 1-5. System Channels

Channel	Name	Description
224	Memry4	Not defined for current SuperFlow engine dynamometer systems. May be used in test profile programming. May be displayed.
225	Memry5	Channel 225 is acceleration in rpm/second. It is used by Channel 122 to calculate acceleration.
226–227**	Memry6 to Memry7	Not used in current SuperFlow engine dynamometer systems.
228**	Memry8	Not used in current SuperFlow engine dynamometer systems.
229**	Memry9	Not used in current SuperFlow engine dynamometer systems.
230	Memr10	Channel 230 used to hold the total number of data lines recorded.
231	LineNo	Channel 231 is a system channel which indicates the line number of the data line recorded in a test data file (.sfd). It can also be used when recording raw data at 100 times per second as a 1/100th second timer channel.
232	Year	This channel specifies the year when a data line is recorded in a test. This information is a permanent record of the test execution date and cannot be changed.
233	Month	This channel specifies the month when a data line is recorded in a test. This information is a permanent record of the test execution date and cannot be changed.
234	Day	This channel specifies the date when a data line is recorded in a test. This information is a permanent record of the test execution date and cannot be changed.
235	DayWk	This channel specifies the day of the week when a data line is recorded in a test. This information is a permanent record of the test execution date and cannot be changed. Day of week (0-7 = Sun-Sat)

** Memory 2, 6, 7, 8, and 9 have special functions due to MEM95=2 in TPF's. They report PID information about the control system.

NOTE: On some systems, channels 140-171 may be defined as thermocouple inputs or CAN channel inputs. They will have hard coded definitions which cannot be modified by the end user.