

# Manual; AM702 ACCESS MODULE

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### The AM702

The Access Module AM702 is menu structured for the selection of input/output/alarm variables and selection of calibration information in the USC701. The AM702 has five operating modes:

1. In run mode one selected variable will be continuously displayed.
2. In Configure Mode The AM702 allows the user to perform changes to the configuration of the USC.
3. In Trim Mode selected parameters can be changed for a previously programmed USC701 without disruption to process operation.
4. Hot Key Mode enables the USC701 will run alternate custom program branches, complete alternate programs can be run in this way.
5. In Display Only Mode all functionality of the AM702 is disabled except for the run mode commands.

### The COA703 and User Interface Software

For more complex set-ups such as specialised linearisation or complex arithmetical functions then the PC User Interface Software should be used.

This option provides a user-friendly interface to program the USC701 and provides more tools such as data logging. Please refer to the COA703 manual for more information. The PC based software provides endless possibilities for possible USC701 applications working programs and documentation is available for free, go to [www.apcs.net.au](http://www.apcs.net.au) and select 'USC Centre' at the home page.

### The USC701

The Universal Signal Conditioner USC701 is a programmable signal conditioner that combines measurement and control functions in a single instrument and provides user selectable solutions for most signal conditioning applications.

The USC has the following functional blocks:

- Two analogue inputs that can be programmed to measure ac/dc current or voltage, resistance, potentiometer, strain gauge and temperature
- Two pulse (digital) inputs that can be programmed to measure frequency or phase and also be used as control inputs to perform hold, reset and enable.
- One isolated proportional output that can be configured as an analogue output or a pulse output.
- Two relay outputs.
- Excitation outputs.
- Digital (bus) outputs.
- Calibration & set point variables.
- Arithmetic function variables.

The configuration can be set up and altered by:

- The plug-on Access Module AM702
- The plug on Computer Adaptor COA703 with the 'USC Config 106' PC software.
- A Select switch and encoder accessible on top of the USC used to alter a number of calibration parameters.

## Using the Controls

The AM702 has a 2-line (L1 and L2) 8 character alphanumeric display.

**(L1) Upper Line** - Indicates Menu Header/Parameter or Reading

**(L2) Lower Line** - Indicates Selection/Value or Engineering unit.

*For the AM702 to change data in the USC701 the 'SELECT' switch on the top of the USC701 must be in position 0*

*If a FIELDBUS interface is fitted it will be disabled while in position 0.*

### Change Decimal Point And Brightness

*Set the 'select' switch on the top of the USC701 to position 1.*

To change the number of significant digits displayed press the 'BACK' and 'NEXT' keys.

To change the display brightness click the 'UP' and 'DOWN' keys.

### What Mode Am I In?

All AM702 modules contain the same operating software its behaviour is determined by the USC701 it is plugged into.

*Set the 'select' switch on the top of the USC701 to position 0.*

*Remember if a FIELDBUS interface if fitted some commands will be disabled while the 'SELECT' switch is in position 0*

Plug AM702 into a USC701, the display indicates "Please Wait".

After both engineering unit and value are displayed the AM702 is in **run mode** and ready to accept commands.

Press the 'ENTER' button.

- If the engineering unit on line 2 disappears and reappears with no other change in function then both the 'Trim' and 'Configuration' menus have been locked out to protect the program in the USC701. Access privileges must be changed using the PC program 'USC Config 106'. Hot keys may still be operational on the other four keys.
- If the top line of the display indicates, 'Trim' then the AM702 is in **trim mode**.
- If the top line of the display indicates 'Type' then the AM702 is in **configure mode**

### What else might Happen?

*I assume the AM702 is in run mode and the 'select' switch on the top of the USC701 is in position 0.*

Press the 'BACK' button.

1. If the display changes to "Decimal Places:" then hot keys are disabled. With hot keys disabled.
  - To display the program (Identity) stored in the USC701 press 'UP' and 'DOWN' at the same time.
  - To display AM702 version press 'UP' and 'NEXT' at the same time.
  - To display the USC701 version press 'UP' and 'BACK' at the same time.
  - For world peace press 'UP', 'DOWN' and 'NEXT' at the same time. '

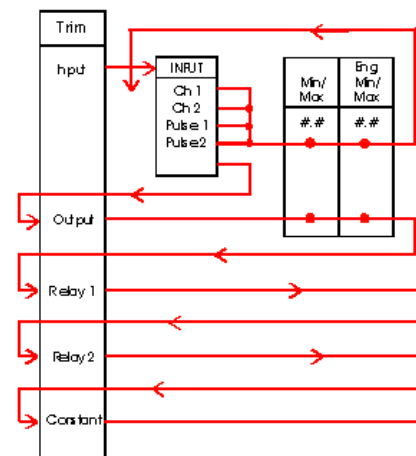
*Continued from "What else might Happen?"*

2. If nothing happens or the engineering/measurement changes significantly then **hot keys are enabled**.
  - The function of the 'UP', 'DOWN', 'BACK' and 'NEXT' keys and all possible combinations of the keys is under the control of the USC701 application.
  - If the USC701 is connected to operating equipment random key presses to determine function is not recommended.
  - To change the number of decimal points while hot keys are enabled change the selector switch on top of the USC7021 to any position other than zero.
  - To disable hot keys from tampering hands change the selector switch on top of the USC7021 to any position other than zero.

### Menu Navigation Commands

AM702 configure and trim menus follow a have predefined path and are read from left to right. The location in the menu can be determined as L1

displays the title of the current menu or setting and L2 displays the value. Pressing the UP and DOWN buttons will cycle through the available settings and pressing 'NEXT' will move on deeper into the menu. Each spot on the menu represents a value that can be changed using edit mode.



To edit a value move to the required parameter using DOWN and NEXT then press ENTER

- a) The most significant value will flash on L2; adjust value using the UP and DOWN keys  
Values scroll through; 0 1 2 3 4 5 6 7 8 9 +/- .for numeric values.
- b) When the required value is displayed use the NEXT key to cause the second significant digit to begin to flash. This value can now be changed using the UP and DOWN Keys.
- c) Repeat steps **a + b** until you have entered the total value.
- d) When total number is entered, press ENTER.

### Configuration Mode

The "Configure Mode" will completely define the function of a USC701 module. A warning message 'PC SPECIAL' is displayed if the existing programs will be lost. Configure mode cannot set all possible ranges in the USC701 nor can it understand the complex application programs that are possible. It is used to quickly program the USC701 to function as a simple signal-conditioning module making it possible to replace many variations of modules with one unit.

After selecting the PGM push-button, the 2-line display shows 'Type' on the top line.

The input range is selected followed by min and max of measured value. The engineering unit is then selected followed by min and max of engineering unit. This will scale the input into engineering units.

The flowcharts are given in the following pages.

**Configure Menu - TYPE = ac/dc signal**

- Isolator** (Convert) the measured value is that on the CH1 input terminals.
- Adder** the measured value is the addition of the CH1 & CH2 inputs.
- Average** the measured value is the average of the CH1 & CH2 inputs.
- Subtract** the measured value is the subtraction of the CH2 input from the CH1 input.
- Differential** Measures the difference in level between pins 14 and 19 and removes any common mode signal. The output is on CH1 (CH2 is disabled). This is the same as the strain gauge range except that there is no limit on the auxiliary voltage output on terminal 24.
- Multiply** the measured value is the multiplication of the CH1 & CH2 inputs.
- Divider** the measured value is the division of the CH1 input by the CH2 input.
- Maximum** the measured value is the maximum of the CH1 & CH2 inputs.
- Minimum** the measured value is the minimum of the CH1 & CH2 inputs.
- Invert** the value 1 is divided by measured value on the CH1 input.
- Exponent** the measured value on the CH1 is raised to the power of an entered value.

Select ac or dc then the required function. In the CH1 / CH2 boxes the input terminals are selected followed by **min** and **max** for the **measurement**. The engineering unit is then entered followed by **min** and **max** for the **engineering unit**. This process will directly scale the measurement into engineering units. The appropriate range is automatically selected after the user enters the min and max input values.

**Ac Ranges**

- Current input: 50mA (input ranges are: 50mA, 20mA, 7.5mA, 0.7mA).
- Low voltage input: 3V (input ranges are: 3V, 750mV, 250mV, 100mV, 20mV).
- High voltage input: 300V (input ranges are: 300V, 75V, 25V, 10Vdc).

**dc Ranges**

- Current input terminal: ±75mA (input ranges are: ±75mA, ±25mA, ±10mA, ±1mA).
- Low voltage terminal: ±4.5V (input ranges are: 4.5V, 1000mV, 300mV, 100mV, 30mV).
- High voltage terminal: ±400Vdc (input ranges are: 400V, 100V, 30V, 15Vdc).

**Measurement Rate for dc Inputs:**

The A/D converter in the USC701 measures or digitizes the input signal at either a slow or fast sampling rate. **Slow** (50Hz) sampling provides better rejection of mains frequency common mode noise.

**Fast** (1kHz) sampling provides faster update (or response) times.

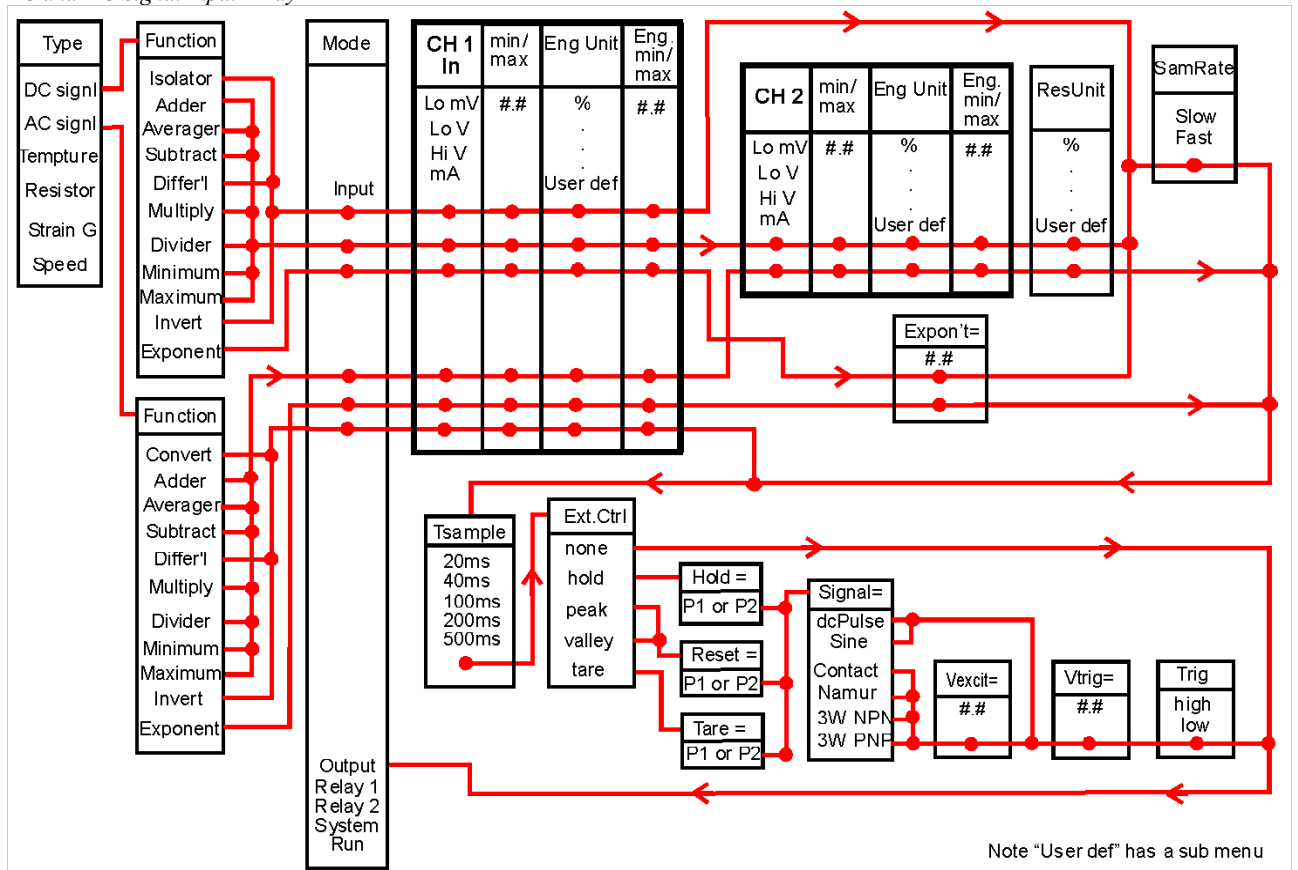
The user can also select the number of sample measurements that are averaged out before the measured variable is updated. This is selected in the **Tsample** (sample time) menu. Sample times are multiples of the period of the mains frequency in order to minimise noise. A larger sample time results in increased filtering of the input signal.

For **one channel of measurement**, there is an overhead of one cycle of the sample rate after each sample time. For a 50Hz system slow overhead is 20msec, fast overhead is approximately 1msec. The update time equals sample time (20 to 500msec) plus overhead (20 or 1msec).

For **two channel of measurement**, there is an overhead of ten cycles of the sample rate after each sample time. For a 50Hz system slow overhead is 200msec, fast overhead is approximately 10msec.

The total update time for the two channels equals two sample times (20 to 500msec) plus two overheads (400 or 20msec).

AC and DC Signal Input Array



**Configure Menu - TYPE = Temperature**

For **thermocouple** input, the user can select the temperature measurement units (e.g. °C), the type of thermocouple (e.g. type K), the **minimum** and **maximum** temperature. The values for minimum and maximum for either channel must be within the equivalent degree C ranges. The appropriate range is automatically selected after the user enters the min and max input values. Standard linearization corrects the mV readings to the true temperature equivalents according to the International Temperature Scale ITS-90.

The user selects the following input measurement function:

- Function**
- T/C:** the measured value is that on the CH1 input terminals.
  - RTD:** the measured value is that on the CH1 input terminals.
  - Aver T/C:** the measured value is the average of the CH1 & CH2 inputs.
  - Aver RTD:** the measured value is the average of the CH1 & CH2 inputs.
  - Diff T/C:** the measured value is the subtraction of the CH2 input from the CH1 input.
  - Diff RTD:** the measured value is the subtraction of the CH2 input from the CH1 input.

T/C Type	°C Range	MV Input	USC701 Range
B	0...1820°C	0...13.8mV	30mV
E	-250...1000°C	-9.7...76.4mV	100mV(30mV if Tmax <425°C)
J	-210...1200°C	-8.1...69.5mV	100mV(30mV if Tmax <550°C)
K	-200...1372°C	-5.9...54.9mV	100mV(30mV if Tmax <750°C)
N	-200...1300°C	-4.0...47.5mV	100mV(30mV if Tmax <850°C)
R	-20...1760°C	-0.1...21.0mV	Range: 30mV
S	-20...1760°C	-0.1...18.6mV	Range: 30mV
T	-250...400°C	-6.2...20.9mV	Range: 30mV

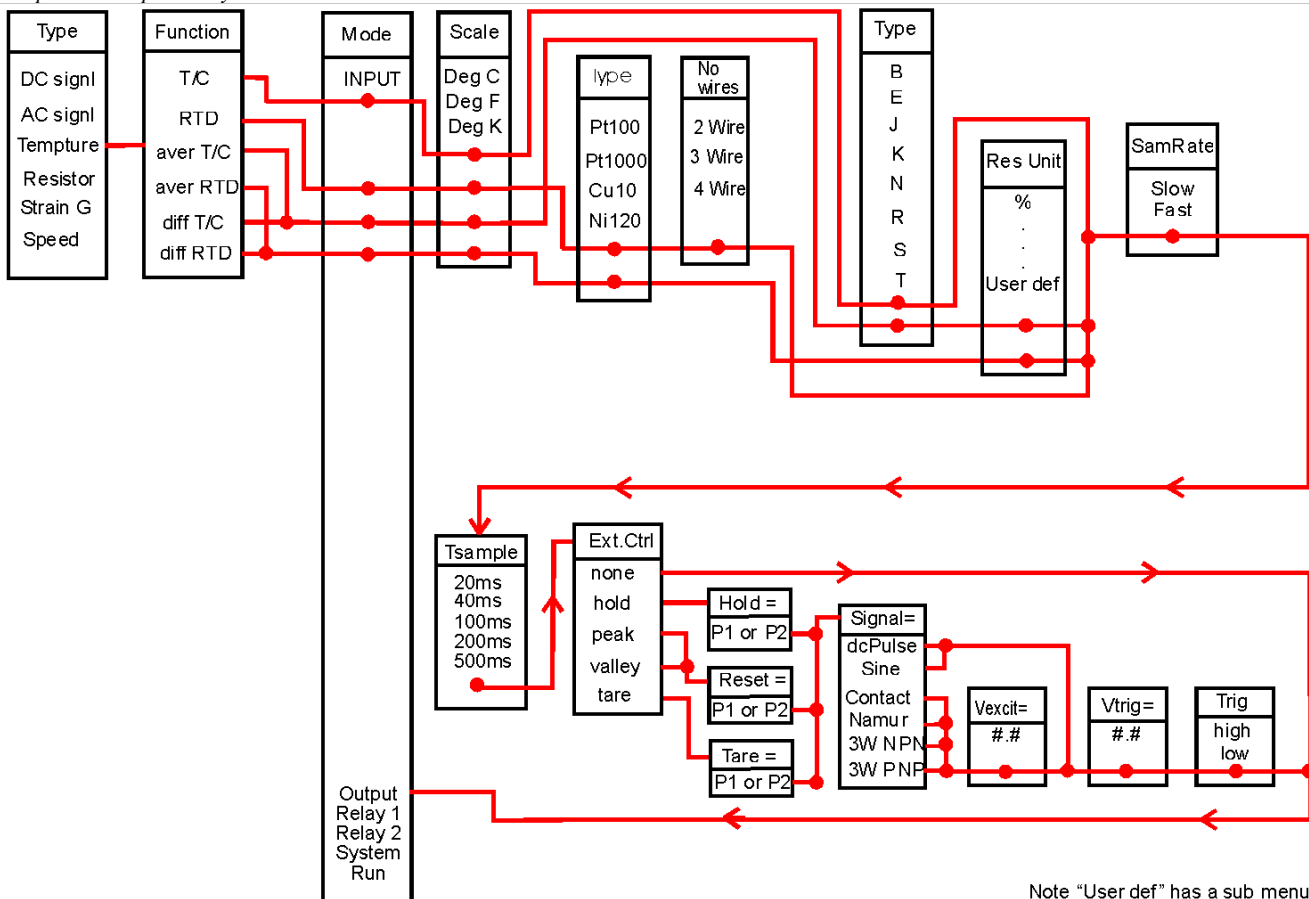
Tmax = Maximum input temperature value selected in the setup software.

For **RTD** input, the user can select the temperature measurement units (e.g. °C), the type of RTD (e.g. Pt100), and the number of wires, the **minimum** and **maximum** temperature to be measured. For average and differential RTD input, the connection must be 2-wire type. The values for minimum and maximum for either channel must be within the equivalent degree C ranges. The appropriate range is automatically selected after the user enters the min and max input values. Standard linearization corrects readings in accordance with the IEC 751 (DIN 43760).

RTD Type	°C Range	Resistance Input	mV Input max	USC701 Range
Pt100	-210...+800°C	14.1...375.5Ω	37.5	100mV(30mV if Tmax <600°C)
Pt1000	-210...+800°C	141...3755Ω	375	1000mV(300mV if Tmax <600°C)
Cu10	-190...+250°C	1.47...18.73Ω	1.9	30mV
Ni120	-100...+300°C	63.7...339.5Ω	34	100mV(30mV if Tmax <250°C)

The **MEASUREMENT RATE** and **EXTERNAL CONTROL** menus are the same as for dc signal input.

*Temperature Input Array.*



Note "User def" has a sub menu

**Configure Menu - TYPE = Resistor**

The user selects the following input measurement function:

- FN = resistor:** the measured value is that on the CH1 input terminals.
- FN = potentio:** (potentiometer) the measured value is that on the CH1 input terminals.
- FN = position:** the measured value is that on the CH1 input terminals.
- FN = diff res:** (differential resistance) the measured value is the subtraction of the CH2 input from the CH1 input
- FN = slidewire:** the measured value is that on the CH1 input terminals

For differential resistance input, the connection must be 2-wire type.

For **resistor** input, the user can select the number of wires and the **minimum** and **maximum** of the input and engineering unit.

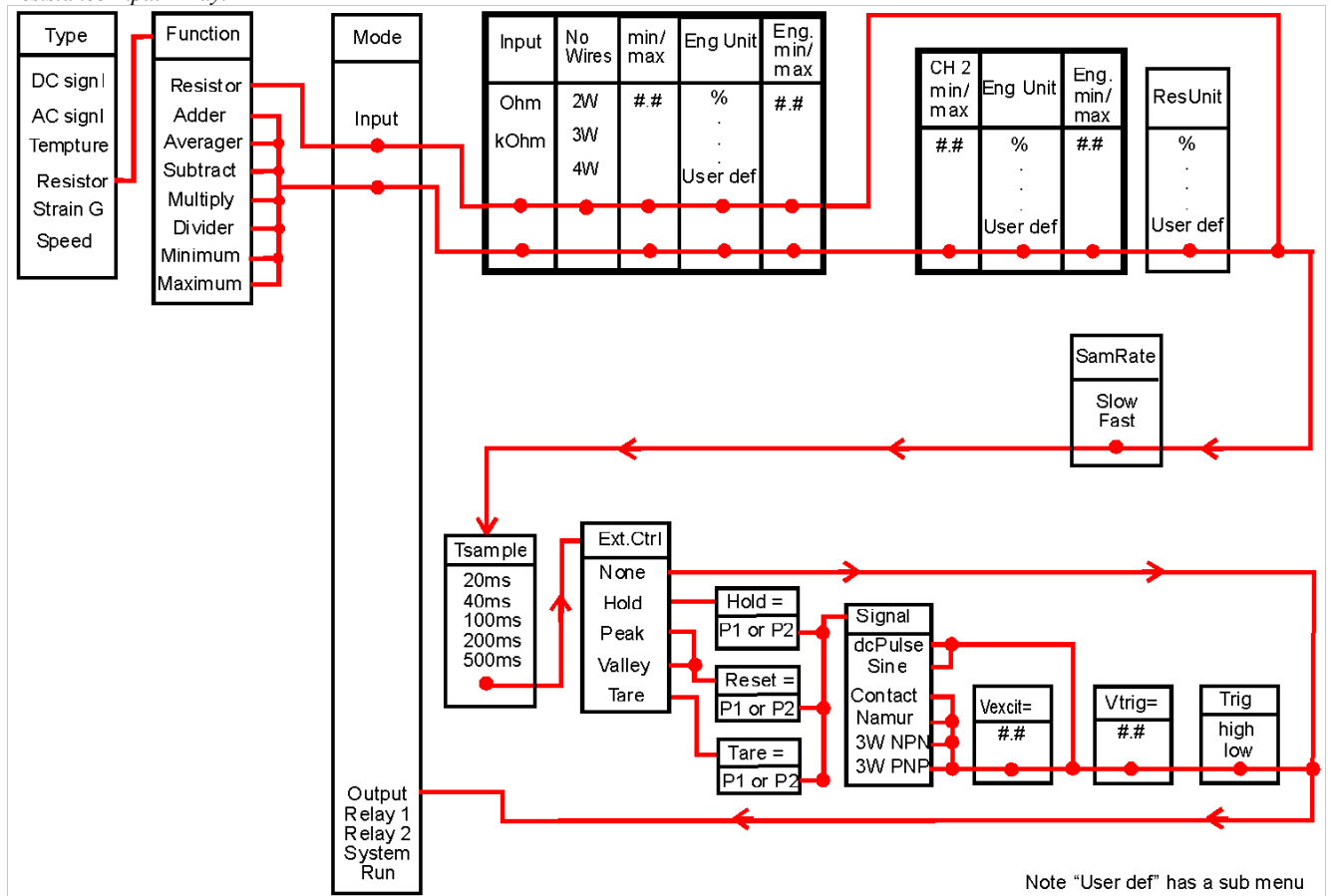
The values for minimum and maximum for either channel must be less than 22 kΩ.  
 Ranges are 22 kΩ, 10 kΩ, 3 kΩ, 1 kΩ and 0.3 kΩ.

The appropriate range is automatically selected after the user enters the min and max input values.

The **MEASUREMENT RATE** and **EXTERNAL CONTROL** menus are the same as for dc signal input.

- Function Resistor** the measured value is that on the CH1 input terminals, two, three and four wire measurement methods are available.
- Adder** the measured value is the addition of the CH1 & CH2 inputs, two wire measurement method only.
- Average** the measured value is the average of the CH1 & CH2 inputs, two wire measurement method only.
- Subtract** the measured value is the subtraction of the CH2 input from the CH1 input, two wire measurement method only.
- Multiply** the measured value is the multiplication of the CH1 & CH2 inputs, two wire measurement method only.
- Divider** the measured value is the division of the CH1 input by the CH2 input, two wire measurement method only.
- Minimum** the measured value is the minimum of the CH1 & CH2 inputs, two wire measurement method only.
- Maximum** the measured value is the maximum of the CH1 & CH2 inputs, two wire measurement method only.

Resistance Input Array.



**Configure Menu - TYPE = Strain gauge**

The user selects the following input measurement function:

- Function**
- Strain G:** the measured value is the differential voltage across the CH1&2 input terminals.
- Loadcell:** the measured value is the differential voltage across the CH1&2 input terminals.
- Weight:** the measured value is the differential voltage across the CH1&2 input terminals.
- Torque:** the measured value is the differential voltage across the CH1&2 input terminals.

For strain gauge input, the user can select the **minimum** and **maximum** of the input and engineering unit. The strain gauge bridge is connected across an excitation voltage of 5Vdc. Only one bridge can be measured since both input channels are used in differential mode in order to measure the two output arms of the bridge.

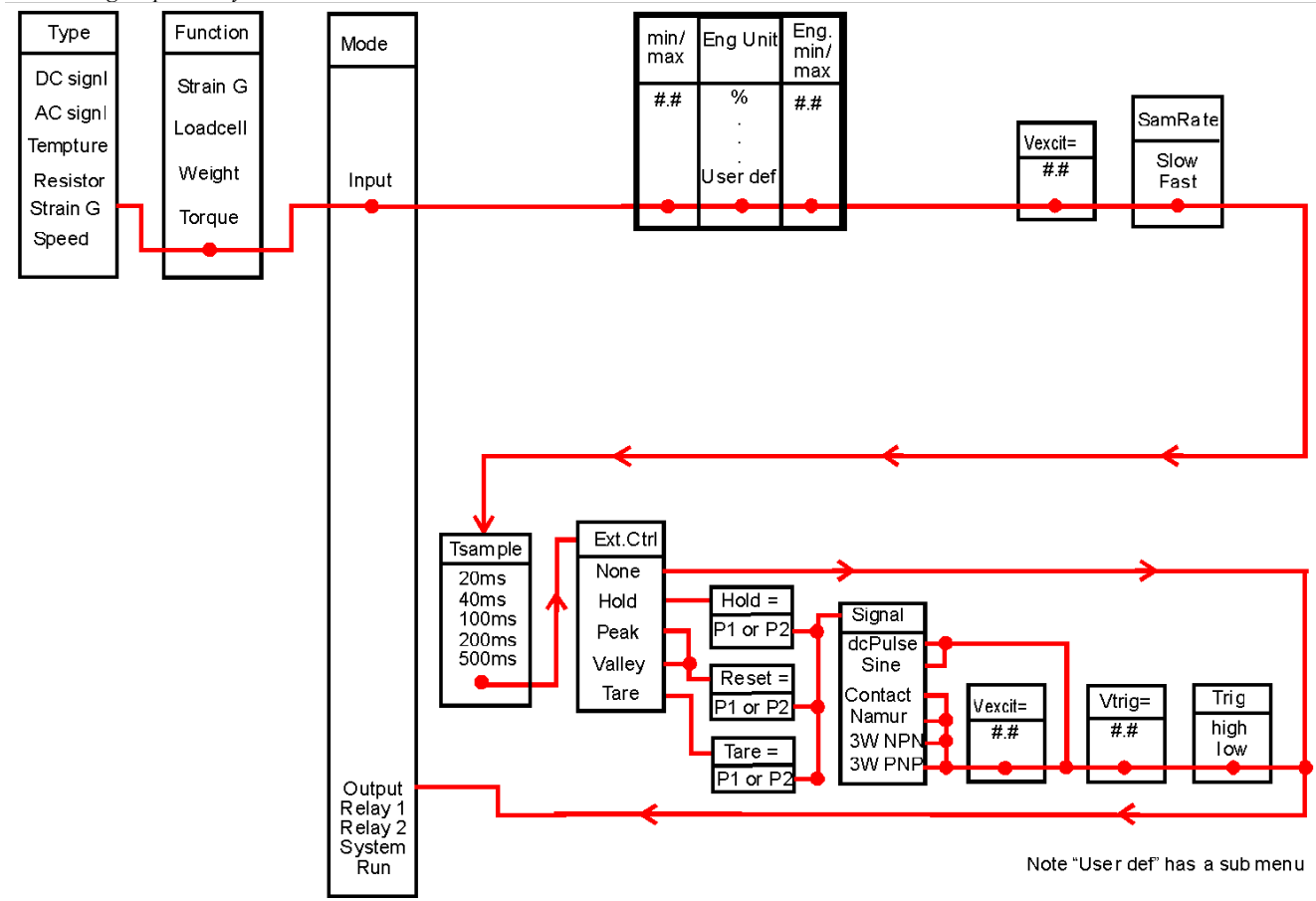
The excitation voltage can support a 50mA load. Therefore, the bridge resistance can be any value down to 100Ω minimum (e.g. three 350Ω load cells in parallel)

The values for minimum and maximum must be less than the following:  
±4.5V (input ranges are: 4.5V, 1000mV, 300mV, 100mV, 30mV)

The appropriate range is automatically selected after the user enters the min and max input values.

The **MEASUREMENT RATE** and **EXTERNAL CONTROL** menus are the same as for dc signal input.

*Strain Gauge Input Array.*



**Configure Menu - TYPE = speed**

The user selects the following input measurement function:

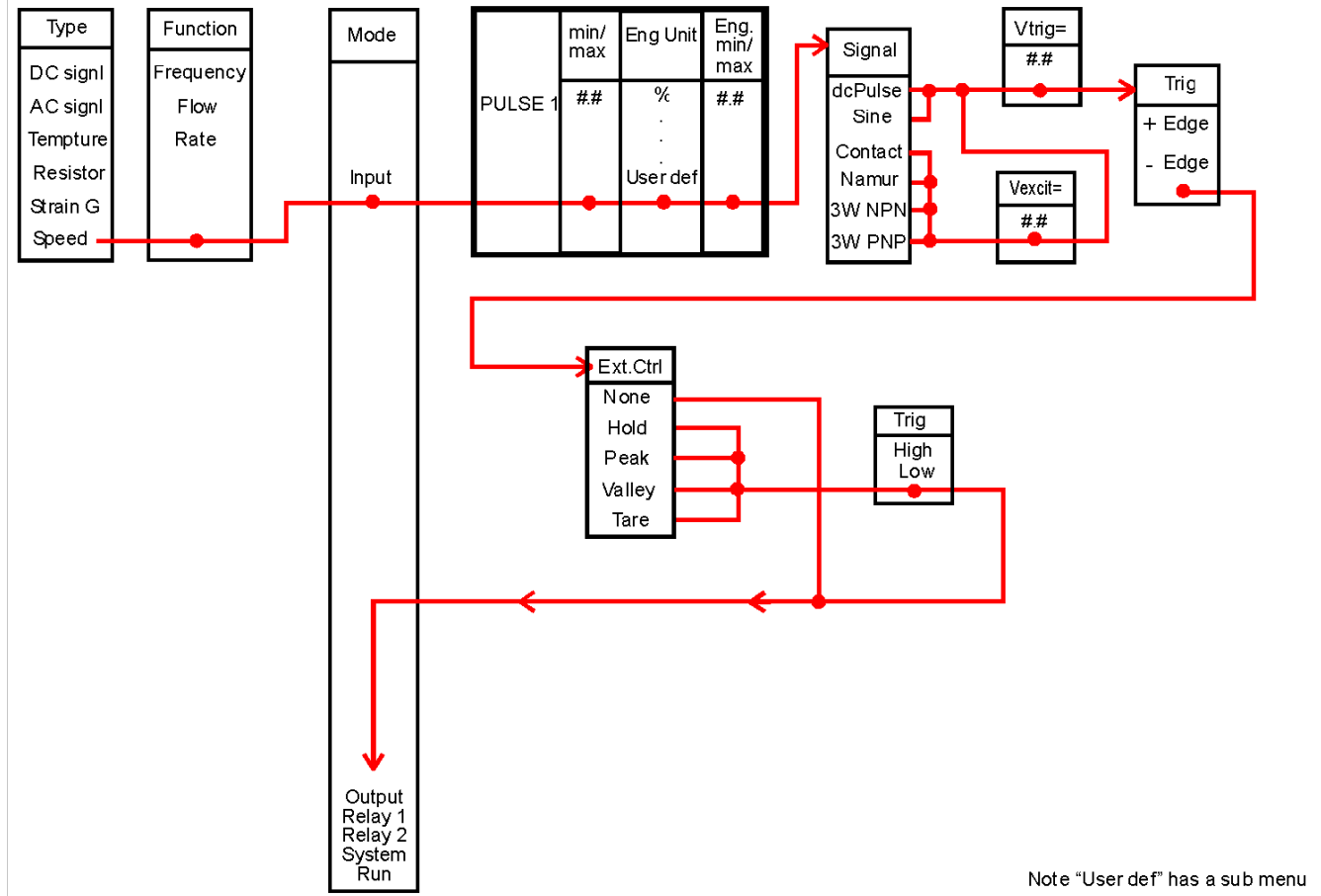
**Function**

- Frequency:** the measured value is the frequency on the P1 input terminals.
- Flow:** the measured value is the frequency on the P1 input terminals.
- Rate:** the measured value is the frequency on the P1 input terminals.

The user can then select the **minimum** and **maximum** of the input and engineering unit.

The signal type (e.g. contact) Excitation level & Voltage trigger level can then be selected:  
The default levels are the same as those used for setting the External Control signals.

Speed, Displacement or Count Input Array.



**Configure Menu - External Control Add in for All Inputs**

The **EXTERNAL CONTROL** menu allows the user to add features such as hold, peak selection and tare.

If **EXT.CTRL = Hold** is selected, then the user can set up one of the digital input channels P1 or P2 to hold the input signal. The measured value of the input when the hold is first applied is held (and not updated) while the hold signal is applied. On removal of the hold, the measurements will be up-dated.

If **EXT.CTRL = Peak (Valley)** is selected, then the user can set up one of the digital input channels P1 or P2 as a reset. Normally, the measured value of the input is updated only if a larger (smaller) input signal is measured at the input. When the reset is applied, the measured value will follow the input signal.

If **EXT.CTRL = Tare** is selected,

then the user can set up one of the digital input channels P1 or P2 to null (or reset or tare) the input signal. The measured value of the input at the time of triggering is subtracted from future measurements.

Signal type	HIGH trigger	LOW trigger	Trigger level	Default trig level	Default V excitation
Pulse	Voltage > trigger level	Voltage < trigger level	0.5* (Vmax + Vmin)	1V	0V
Contact	Contact closed	Contact open	2.5V	2.5V	8V
NAMU R prox	Target absent (1kΩ, >3mA)	Target present (8kΩ, <1mA)	2.5V	2.5V	8V
NPN prox	Transistor off	Transistor on	0.5*Vexcit	9V	18V
PNP prox	Transistor on	Transistor off	0.5*Vexcit	9V	18V

The **EXT.CTRL** signal type & trigger can be selected:

The user can enter the value for the excitation and trigger level. For NAMUR proximity sensor the excitation should be 8Vdc with a trigger level set at 2.5Vdc.

## Configure Menu - OUTPUT and System

### Output Menu

#### Select mA or Volts

If selected the user must then enter the calibration values for output minimum and maximum, limit values for output minimum and maximum, and the engineering minimum and maximum equivalent to the output minimum and maximum.

The output mA must be in the range 0...22mA.

The output V must be in the range 0...20V.

If temperature is the input variable, then the user may set 4mA output to equate to 0°C and 20mA to equate to 100°C.

OUT min = 4; OUT max = 20; ENG min = 0; ENG max = 100.

Lim min is the lowest allowed at the output. In this example, if the Lim min = 0, then as the temperature drops below 0°C then the mA output will drop until the mA reaches 0. If the Lim min had been set to 4, then as the temperature drops below 0°C then the mA output will not drop below 4mA.

#### Select Frequency

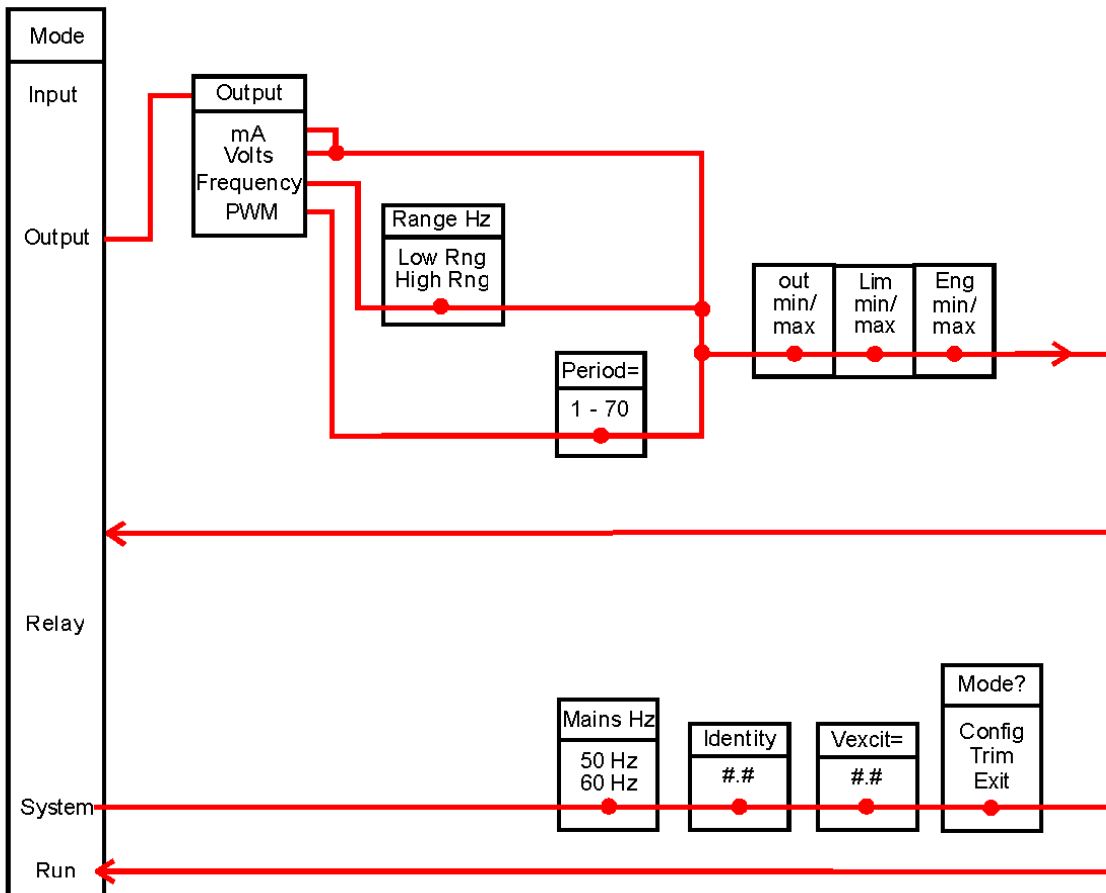
If selected the user has to relate frequency to Engineering units (as discussed for mA).

The minimum span is 20Hz; the maximum span is 10kHz.

The output is an open collector transistor.

The user then enters the calibration values for output minimum and maximum, limit values for output minimum and maximum, and the Engineering minimum and maximum equivalent to the output minimum and maximum.

#### Output, System and Run Array.



### Select PWM

Pulse width modulated is used for applications where a fixed time interval is divided into an ON/OFF ratio dependent upon the input signal level.

The output is an open collector transistor.

The user enters the pulse period (1...70 msec), OUT min %, out max% then 'Lim min' and 'Lim max' in percent. These values are then related to the input measurement in engineering units 'Eng min' and 'Eng max'.

### System Menu

The mains frequency affects the A-D converter switching frequency to reduce beat effects in the measurement.

Identity is a user name to identify the USC701 and has no effect over its operation.

Vexcit is the voltage level on terminal 24 of the USC701.

Mode selects which menu will load when the user presses 'ENTER' while in run mode.

USC701 modules previously programmed with 'USC Config 106' retain the following flags:

- If hot keys are enabled AM702 cannot disable it.
- If trim menu is disabled AM702 cannot enable it
- If configuration trim menu is disabled AM702 cannot enable it.

## Configure Menu - MODE = RELAY

Each relay can be set for ON-OFF control or PWM.

For **ON/OFF** relay types, the **ACTION** definitions are:

(The **High Set** value must be greater than the **Low Set** value and both are in Engineering units).

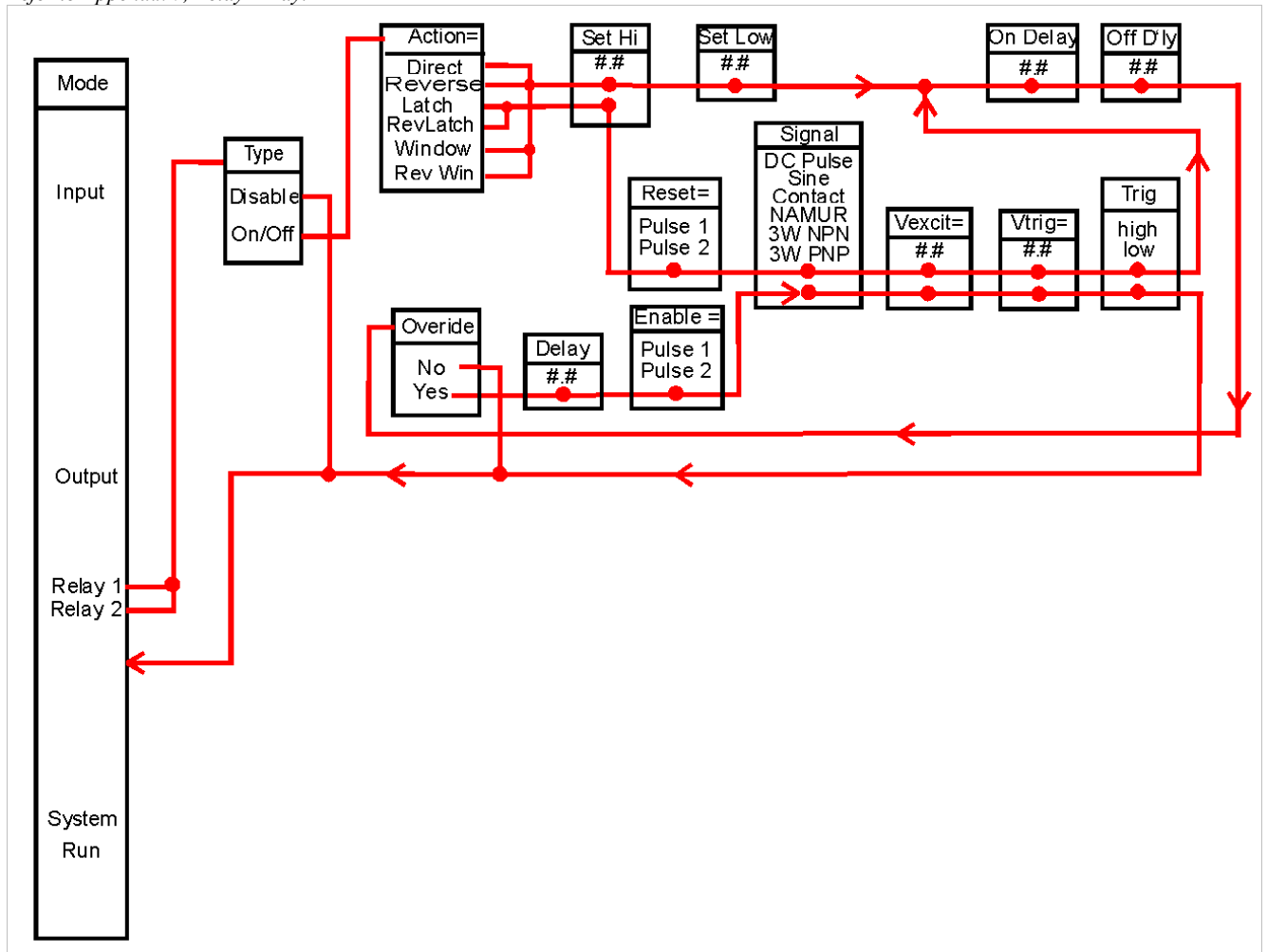
- Direct:** the relay is energised when the input exceeds the **High Set** value, and is de-energised when the input drops below the **Low Set** value.
- Reverse:** the relay is energised when the input drops below the **Low Set** value, and is de-energised when the input rises above the **High Set** value.
- Window:** the relay is energised when the input is between the **High Set** and **Low Set** values, and is de-energised when the input rises above the **High Set** value or drops below the **Low Set** value.
- Rev Win:** the relay is de-energised when the input is between the **High Set** and **Low Set** values, and is energised when the input rises above the **High Set** value or drops below the **Low Set** value.
- Latch:** the relay is energised when the input exceeds the **High Set** value, and is de-energised by the **Reset** external control.
- RevLatch:** the relay is energised when the input drops below the **High Set** value, and is de-energised by the **Reset** external control.

For the first 4 choices, the user then sets high and low set points. For latch action, the set point is entered and then reset channel and signal type is selected (this includes trigger and excitation levels). Care must be taken that the digital channel selected has not been previously assigned to a conflicting measurement.

**Delays** can then be set for the contacts – on delay, off delay, and over-ride delay.

If over-ride delay is selected, then reset channel and signal type is selected (this includes trigger and excitation levels). Care must be taken that the digital channel selected has not been previously assigned to a conflicting measurement.

Refer to Appendix 7, Relay Array.



## Trim Mode

The “Trim Mode” is used to change selected parameters for a previously programmed USC701.

Input, output, relays and equation constants can be selectively trimmed in an operating USC701 without disruption to output function. The “Trim Mode” can be used in conjunction with the “USC Config 106” program to create a customized user interface for each USC701.

For each of the trim menus to operate they must have been previously configured by the AM702 in configuration mode or the PC interface “USC Config 106”.

The PC interface has the additional feature of disabling any part of the trim menu and prevent the AM702 from entering configuration mode.

The AM702 trim menu sections.

<p><b>Trim</b>            Comment</p> <p><b>Input</b>            Temperature ranges and inputs using linearization tables are automatically disabled.</p> <p><b>Output</b>           All functions are available.</p> <p><b>Relay 1</b>          On/Off with the six common actions are available.</p> <p><b>Relay 2</b>          On/Off with the six common actions are available.</p>	<p><b>Constant</b>        Can only be set up for use using the PC interface. All constants used in the equation are available for edit. The only error checking is that the values are numeric.</p> <p><b>System</b>           the display mode menu is used to switch between configure mode and trim mode if it has not been previously disabled by the PC interface.</p> <p><b>Run</b>                return to run mode.</p>
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Trim Menu Array

