Total Control : Peace of mind

PLC Commander Manual

For the "GC" Series

V2.00

Applicable to firmware package version 6.21

Polygon Technologies

Before attempting to connect or operate this product, please read these instructions in its entirety, **especially the guarantee conditions.**

TABLE OF CONTENTS

1. INTRODUCTION

This manual is intended to provide detailed technical specifications and explanations, to the basic user as well as the more technically-minded person.

This manual is a live document, and will be updated often with new information. Please insure that you have the latest version, by checking our website at: *http://www.gsmcommander.com*

2. FEATURES

Model	Onboard Inputs	Onboard Outputs	Expandable Inputs/Outputs	Max Number of Statements	Max number of Messages	Max Length of Messages	Setup Memory	0-100deg Temp probes supported	0-10v Analog Inputs	Battery / Power Monitor	Configuration Via USB
GC1280	2	2	32/32	128	128	128	8kb	2	1	YES	YES

| Matrix Feature Descriptions	
Onboard Inputs	The number of inputs provided on the base unit itself
Onboard Outputs	The number of outputs provided on the base unit itself
Expandable Inputs/Outputs	The maximum total number of Inputs/Outputs that can be expanded to by fitting expansion units
Max Number of Statements	A measure of the amount of complexity that can be programmed into the unit. Each statement is of the form IF <ABC happens> THEN <do something>, such as IF Input 1 goes Active, THEN send "Generator Tripped" via serial port.
Max Number of Messages	The maximum total number of messages that can be programmed into the unit
Max Number of Statements	The maximum total number of behaviour statements that can be programmed into the unit
Setup Memory	The amount of memory that is available for setup. - This is a measure of how much information the setup can contain.
0-100deg Temp Probes supported	The number of temperature probes the base unit can accept
0-10v Analog Inputs	The number of analog Inputs available
Battery / Power Monitor	The ability to detect power failures and monitor a connected battery.
Configuration Via USB	The unit is configured via software from a PC.

3. SPECIFICATIONS

Weight	200gram
Dimensions	146,2 x 85,2 x 27mm
Power Supply	10-24V DC via DC Jack or Screw Terminal It is advised that the base unit be powered from its own dedicated supply in industrial applications.
Power Consumption	~ 2.5W
Current Consumption	~ 60mA at idle (no inputs or outputs active)
Operating Temperature	-10°C to +60°C
Storage Temperature	-20°C to +80°C
Digital Inputs	Opto-isolated. Inputs draw 10-30mA, depending on voltage. Can accept any DC signals of any type, including: ➢ Dry Contacts ➢ Open Collector (NPN) ➢ Closed Collector (PNP) ➢ DC Voltage (5-18V)
Digital Outputs	2 x SPDT Relay Contact rating: 8Amp DC (10-48V) or 4amp AC (110 – 400V). Expandable to maximum of 32*
Analog Inputs	1 x Analog input 0-10V 8bit resolution
IO Connector type	Screw terminals

4. SYSTEM REQUIREMENTS

The setup software requires a PC with the following specifications:

Operating system	Win2000 / WinXP / Vista / Win7
Computer Architecture	Pentium 2 or higher IBM compatible PC
Disk space	2MB
Ports	1 x free USB port

5. DIMENSIONS
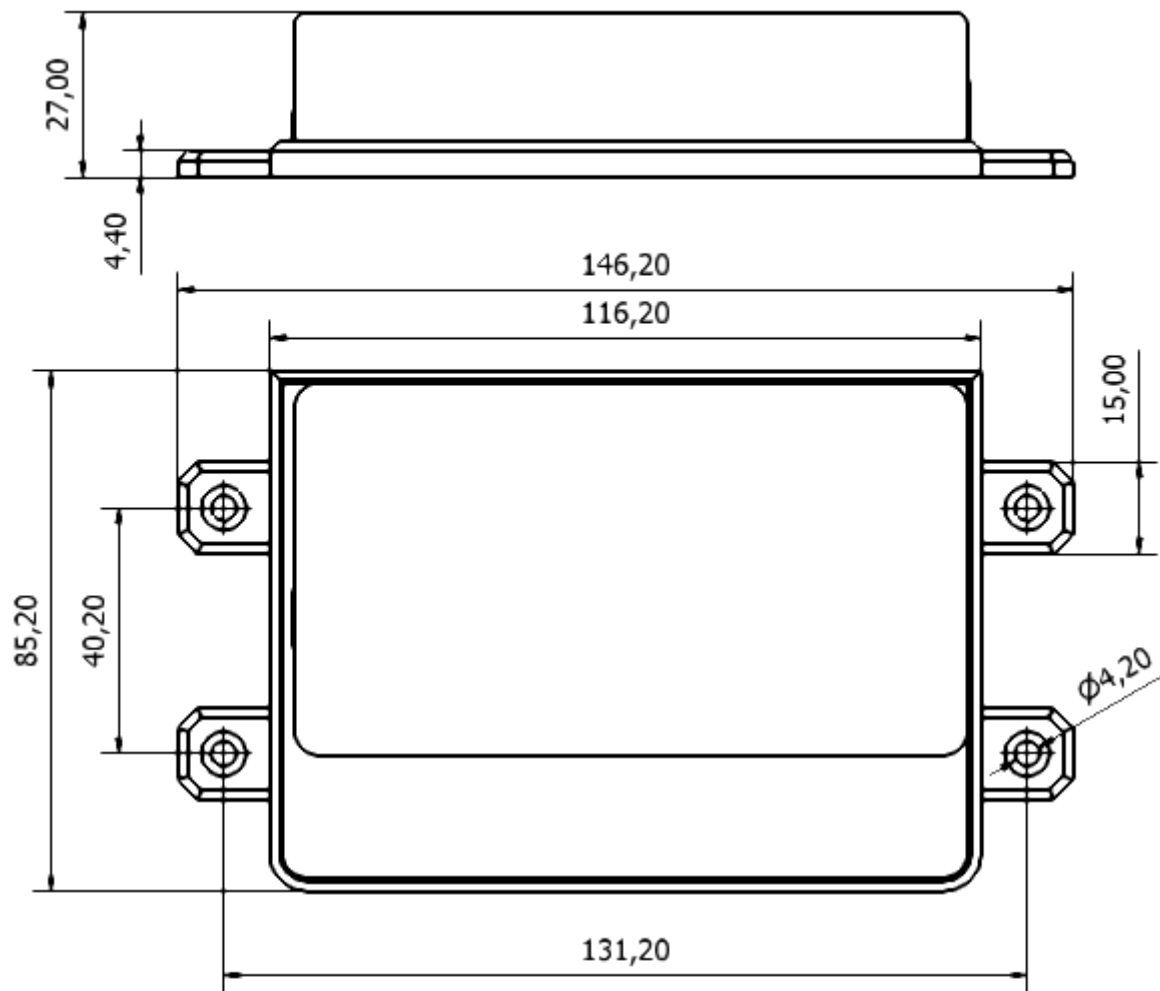
6. INSTALLATION

6.1. Power Supply

The PLC Commander has a 2.1mm DC jack connector where a power supply must be connected. The power supply should have the following specifications:

- Output Voltage: 12V nominal
- Output Current: 0.5A
- Polarity: ⊖——●——⊕

A suitable power supply is supplied with the retail product.

Please Note: It is advised to use a 14V Switching Power Supply if more than one Expansion Unit is connected to the PLC Commander.

In industrial applications, it is advised that the PLC Commander be installed into its own metal housing and be powered from a separate power supply. (As opposed to sharing one with other equipment).

Please Note: While the PLC Commander has fairly rugged internal power supply circuitry, no special provision for lightning protection is made. If the PLC Commander is used in an area that is prone to thunderstorms, it is advisable to use a commercially available lightning suppressor (The same applies to inputs or outputs that are connected to wires longer than 2 or 3 meters). The guarantee does not cover damage resulting from lightning strikes! The PLC Commander can operate reliably from voltages in the range of 10 to 24V DC.

6.2. USB Port

The PLC Commander provides a USB port that connects to a PC using the supplied USB cable. This allows the PC to configure the unit.

6.3. Software Installation

The latest software is supplied on a CD with the product and is also available to download from our website for free at: *http://www.gsmcommander.com/*

The setup program will start automatically, or if the autorun feature is not enabled on your PC, you may run the "setup.exe" executable file on the CD to start the setup process. The software has been tested to work on Windows XP, Windows Vista and Windows 7.

6.4. Mounting

The PLC Commander is housed in a very durable ABS casing which has 4 protruding tabs, which allows it to be mounted firmly to any surface by means of a screw.

Please note: The PLC Commander is not water- or weatherproof. The PLC Commander must be mounted indoors, or inside an appropriate IP65-rated weatherproof enclosure. The guarantee does not cover damage resulting from water ingress!

6.5. Optically-Isolated Digital Inputs

The PLC Commander itself provides 2 signal inputs. The number of inputs can be expanded by the addition of Expansion modules, up to a maximum of 32 inputs. Each of these inputs have 4 terminals associated with them:

+ – Internal positive supply (12V)

IN + – Positive input

IN – – Negative input

–   – Internal negative supply (Zero volts)

To connect a switch or contact to an input, simply connect the switch between the + and IN+ terminals, and a wire between the – and IN– terminals. The reverse is just as suitable, i.e. that you connect a wire between + and IN+ and place the switch between – and IN–.
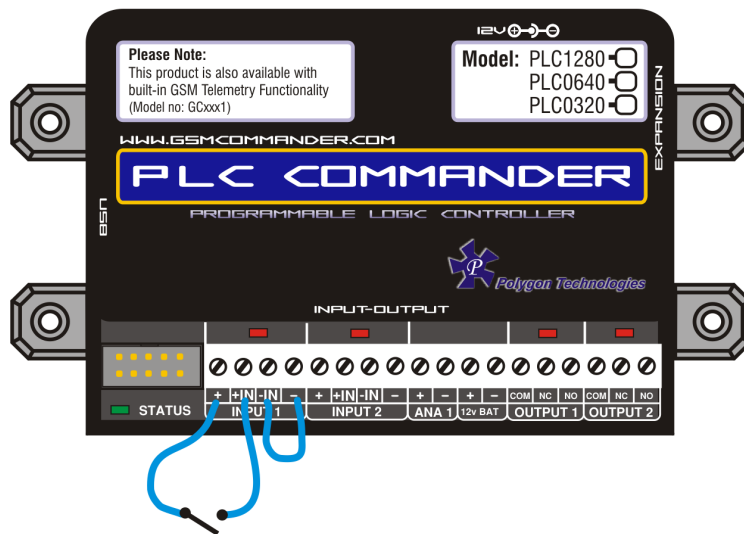
You may need an input to activate when power is supplied from some other unit. A good example will be a burglar alarm that applies power to the wires going to the siren. In such a case, it will be a simple matter of connecting the positive wire to the IN+ input, and the negative wire to the IN– input.
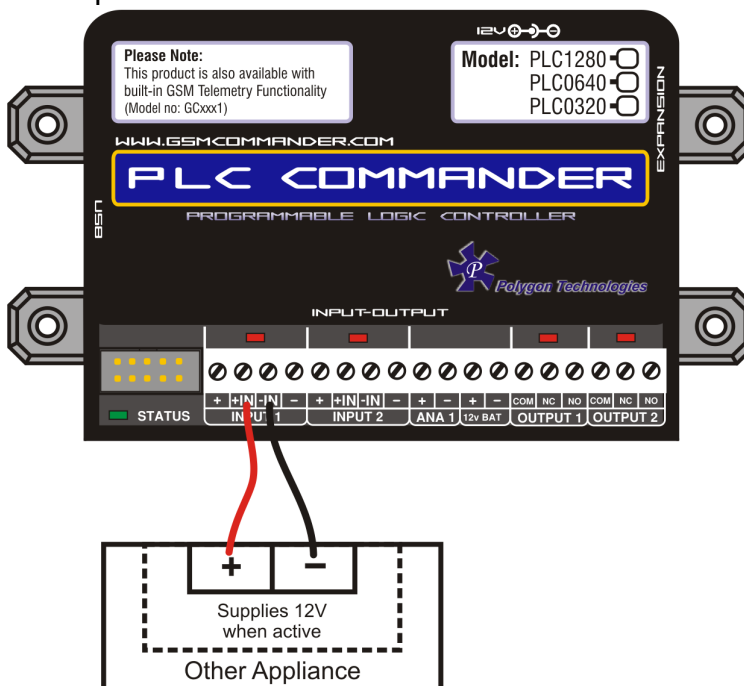
Please keep in mind that these inputs are designed for 5V to 18V operation. If you require to connect a voltage above 18V to these terminals, you should connect a resistor in series with the input, as shown below.
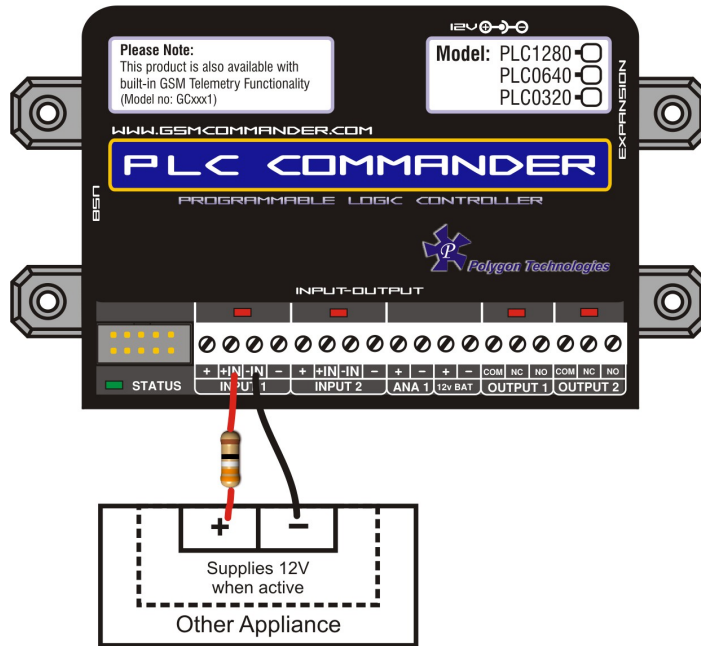
| Input Voltage range	Required Series resistor:
18V - 25V	560 ohm
25V - 32V	2200 ohm

The **+** and **–** terminals are connected to the input power supply of the PLC Commander, and are provided to make it easy to connect dry contacts to the PLC Commander. If the power supply is 12v, the voltage at the **+** and **–** terminals will be slightly less at about 11.2v (due to an internal series diode for reverse polarity protection). The **+** and **–** terminals are internally fused by a resettable fuse, which will reset itself after a cool-down period.

If you do something stupid and the fuse goes, simply disconnect the power from the PLC Commander, and wait a few minutes. The fuse will reset itself and all should be well again. (Unless the internal fuse got really fried in the process, in which case the PLC Commander requires repair)

On the expansion modules, the exact same circuitry is used, but the same in-line fuse is connected to all the **+** terminals. Therefore, is the fuse goes, all **+** terminals will lose power.

Here is a schematic of the input circuit used on the PLC Commander:
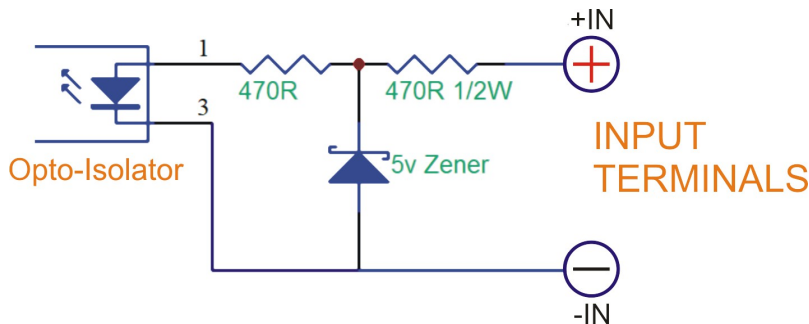
Drawing power for external hardware from the power terminals on the input:
One should not attempt to draw more than 50-100mA in total from the power terminals at the inputs on the PLC Commander. For each expansion unit, the same applies.

2 x 8A Relay output

The PLC Commander itself provides 2 x 8A Relay outputs. The number of outputs can be expanded by the addition of Expansion modules, up to a maximum of 32 outputs. Each of these inputs each have 3 terminals associated with them:.

Each of these inputs each have 3 terminals associated with them:
COM – Common Terminal
N/C – Normally Closed Terminal
N/O – Normally Open Terminal

When the output is off, the **COM** and **N/C** terminals will be internally connected to each other.
When the output is on, the **COM** and **N/O** terminals will be internally connected to each other.

Note that there are small LED indicators next to the output terminals, that will show if the output is ON or OFF. (if the LED is on, then the output is also on)In the picture below, the output is connected so that the lamp will light up when the output is on.
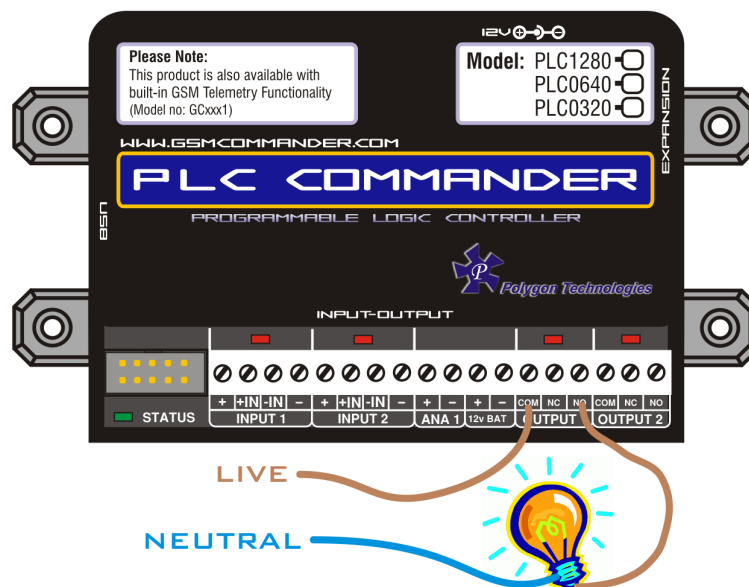
This output can be used to control devices and appliances, and is rated for 8A DC. It may be used to control most types of electrical loads, excluding AC motors above 500W.
Here are some examples of things you CAN directly switch on and off using the outputs on the PLC Commander:

· Gate motors and any other motor less than 500W
· Mains Lights (energy savers, incandescents, halogens) (maximum 750W)

Here are some examples of things that you can NOT directly switch on and off using the outputs on the PLC Commander:

· Ovens, Heaters, kettles
· Pumps and motors above 500W

Please note: Keep in mind that if required, the above loads can easily be switched on and off using an externally connected relay or contactor.

6.7. Temperature Sensor

One can connect 2 temperature sensors to the PLC Commander (at the expansion port via a temperature interface module) to measure temperature and allow the PLC Commander to perform certain tasks if the temperature falls above or below a certain point. The sensor provides an accuracy of 1°C.

The temperature sensor (with 2m, 4m or 8m lead) and temperature interface is available from **Polygon Technologies.**

6.8. Analog Input
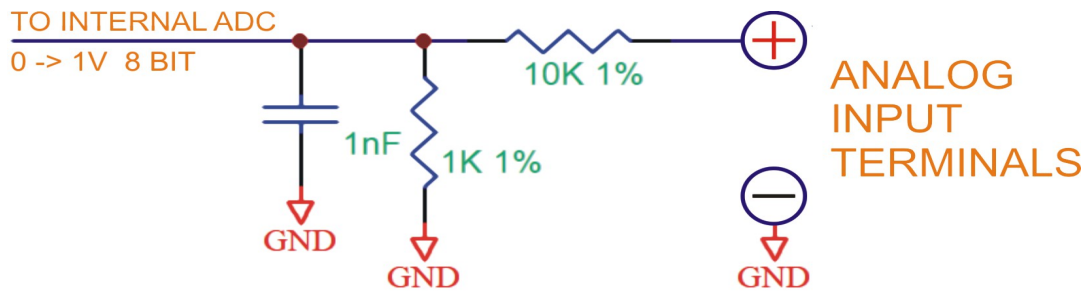
The PLC Commander provides a single 0-10V analog input, which can be used to measure incoming voltages from sensor devices. Using an appropriate resistor, one can also connect 4-20mA sources to the PLC Commander. (See application note under section 18)

What makes this input so special, is that the PLC Commander can interpret the analog value on your behalf. It is perhaps the best to explain this at the hand of a good example.

Suppose you have a water tank, with a level sensor that is connected to the analog input of the PLC Commander. The sensor is such, that when the tank is empty, the voltage is 1.2v, and when the tank is full, the voltage is 7.8v. The configuration software allows you to request the current reading in a scaled format. You would thus tell the software that 7.8v should correspond to 5000 litres, and 1.2v should correspond to 0 litres, and leave the rest of the calculations to the PLC Commander. You can now receive a message from the Commander, detailing the actual contents of the tank in litres, instead of just a raw value. (Which you would otherwise have had to convert back to "real" numbers yourself).

Please note that this feature assumes a linear relationship between the input voltage and the desired output units. Thus, this will not work very well for a cylindrical tank that is mounted on its side, as the voltage from the level sensor is not linearly proportional to the actual contents of the tank.

FULL (5000 litre)
Sensor Gives 7.8v

EMPTY (0 litre)
Sensor Gives 1.2v

The user is also able to define the message to precede, and the message to follow the analog value.
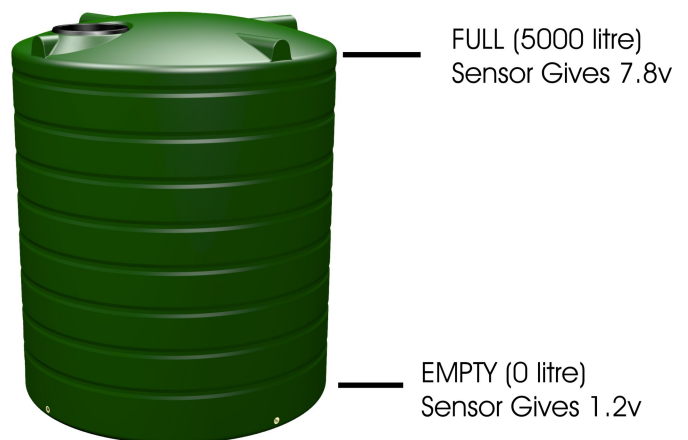
Please Note: The input is NOT isolated, and must be used with care.

The output of the circuit above feeds to an Analog-to-Digital converter with a reference voltage of 1V, and a resolution of 8 bits. The full-scale input voltage to the PLC Commander is therefore 10V. The range of the analog input can easily be increased by the addition of a resistor in series with the analog input.

Below are some examples of resistor values, and the resultant input ranges.

1.0K Ohm > 12.0V
3.3K Ohm > 14.3V
6.8K Ohm > 17.8V
10K Ohm   > 21.0V

The Configuration software assumes no series input resistor, when defining behaviour statements for the analog input.

The software shows both a voltage and a "counts" value when selecting trip points for the analog input. The "counts" value is a variable from zero to 255 (8 bits). If you have connected a 3.3K Ohm resistor in series, and you want to select a trip point at, say, 12V, you will ignore the voltage shown by the configuration software, and simply select the correct counts value of 215. ((12 / 14.3)*256)

6.9. Battery Input

The PLC Commander provides connections for an external rechargeable 12v battery. Under normal circumstances, the PLC Commander will trickle-charge the battery at a current of about 60mA. In the case of a power failure, the PLC Commander then starts drawing power from the battery to continue operating.

In the case of a power failure, the PLC Commander can continue operating from the external battery. The unit can be configured to perform certain tasks (like sending a warning message) if the battery voltage falls below a certain point, and can also perform tasks in the case of a power failure.

In cases where the PLC Commander is used in conjunction with a large system with its own battery (such as UPS systems), the battery terminals of the PLC Commander can be safely connected to the large (12V) battery, and the PLC Commander can then monitor the battery voltage for you (only while power is NOT supplied to the power input connector).

Also, in cases where the user may want to connect other hardware directly to the battery, be aware that this will probably drain the battery, since the charging current from the PLC Commander is so low. Other hardware should rather be connected to the power terminals provided at the inputs. (See section on inputs for more information on this).

Internal to the PLC Commander, the Battery terminal is wired with a 50ohm resistor between the + Batt terminal and the positive power supplied to the PLC Commander. There is a diode in parallel with this resistor (cathode facing to the battery) to allow the PLC Commander to draw power from the battery under power-fail conditions.

A resettable fuse has now also been added to give the Battery terminal added protection against voltage spikes and short circuits.

Suitable batteries are available from **Polygon Technologies**.

6.10. Expansion

The PLC Commander supports comprehensive expansion by means of the PLC Commander Expansion unit, which provides an additional 5 inputs and 5 outputs similar to the ones found on the PLC Commander itself. A total of 6 Expansion units may be daisy chained to provide a maximum of 30 outputs and 30 inputs in addition to those on the PLC Commander itself.

12V DC Jack and Battery Input on Expansion Unit
Each Expansion unit has both a 12V DC jack and battery input, so that it could also be powered by a separate power supply and battery. Applying power to the Expansion unit either through the DC jack or battery terminal is optional. The Expansion unit can draw power via the ribbon cable, but under certain conditions it is better to supply a separate 12V source and battery to the expansion unit.

These conditions are:
  ➢ When the ribbon cable run becomes very long (>5m)
  ➢ If you are going to connect more than one expansion unit
  ➢ If you expect to draw power from the input on the Expansion unit
  ➢ If you expect most of the inputs and outputs on the expansion to likely be active at once

The Expansion unit will automatically detect if power is applied at either of the it's 12V inputs (DC jack and battery) and thus stop drawing power via the ribbon cable. So to ensure that the Expansion unit functions properly in mains power failure conditions, it is advised that you connect a 12V battery to it's battery terminals together with it's main 12V power supply.

Interface Ribbon cable
Supplied with each Expansion unit is a short (10cm) ribbon cable for interface purposes, but this ribbon can also be very long. We have tested up to 10m, but we generally recommend a maximum cable run of 7-8m. Please contact us if you need a longer ribbon cable.

The ribbon cable connectors are mounted such that pin 1 on the one end connects to pin 10 on the other, Pin 2 connects to pin 9 etc.

It is important to connect the Expansion port on the PLC Commander to the IN connection on the expansion unit. An additional Expansion unit must be connected with its IN connection to the OUT connection of the "upstream" Expansion unit.

6.11. Dimensions of Expansion Unit
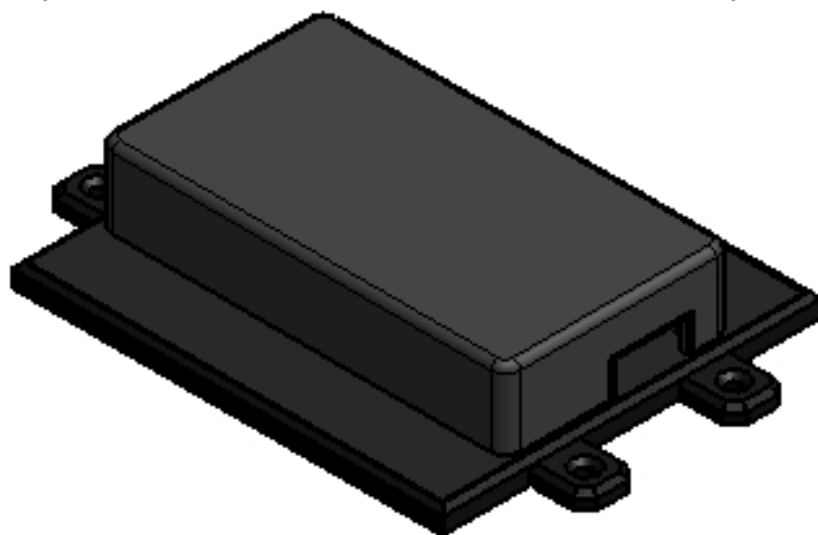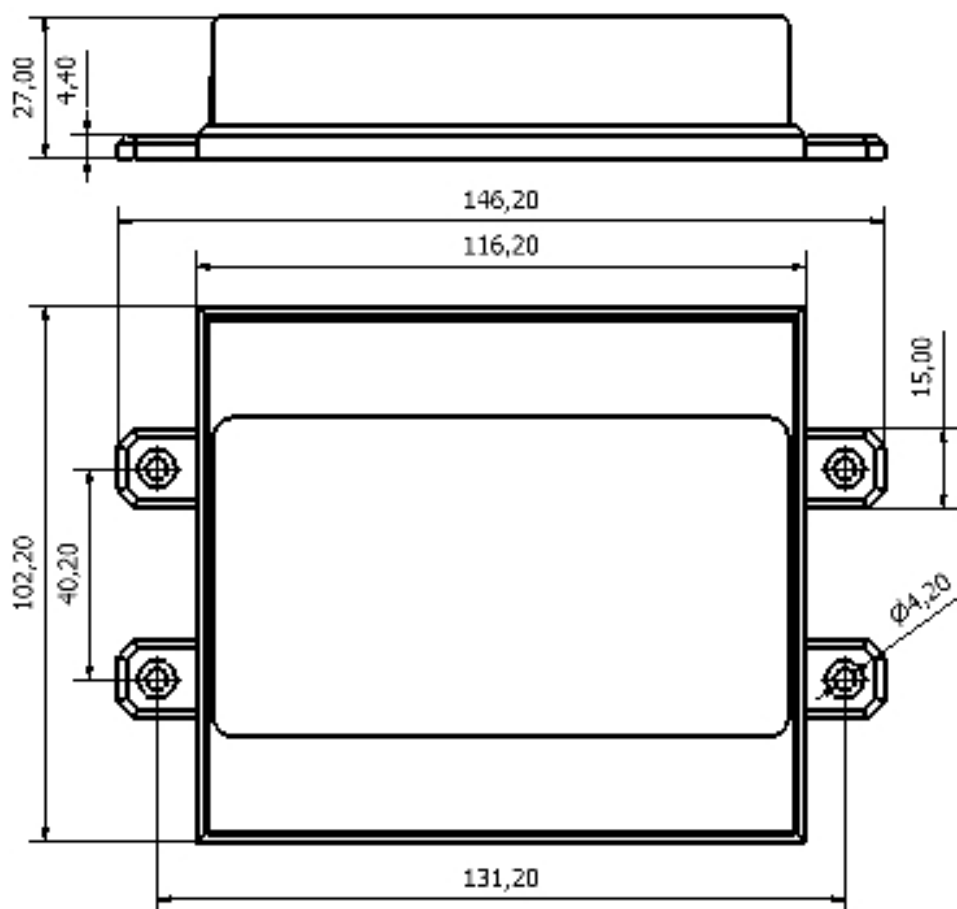
6.12. Status LEDs

The PLC Commander has 1 LED to show the current status of the PLC Commander. The green LED, labeled "STATUS", shows the status of the PLC Commander as a whole.

The following table shows how one can determine the current status:

GREEN LED (STATUS)

➢ Solid On

                                                                        : Busy Booting

➢ on for 500ms, off for 500ms (slow flash)

                                                                        : All OK

➢ on for 100ms, off for 500ms, on for 100ms, off for 500ms, on for 500ms, off for 500ms (2 short and 1 long flash)

                                                                        : Setup is corrupt

7. CONFIGURATION

7.1. Configuration via PC

The following is required to configure the PLC Commander:

➢ A PC running Windows XP / Vista / Windows 7

➢ Setup utility installed on the PC *(Available on the CD supplied with the product)*

➢ USB cable *(Provided)*

➢ Power supply *(See 6.1)*

Follow these steps:

Step 1:
Connect PLC Commander to PC via the supplied USB cable

Step 2:
Connect power to the PLC Commander

Step 3:
Run the Utility (Start > All Programs>PLC Commander V6 > Configure PLC Commander)

The software will show this screen when started. Here you can select whether you would like to start a new setup (via the Wizard), or whether you would prefer opening an existing setup from a file on your PC, or retrieve the setup currently on the PLC Commander

7.2. Software Tabs

The **PLC Commander Setup Utility** software has been designed to make the configuration process of the PLC Commander as easy and user-friendly as possibly.

With this in mind the software has been divided into the following tabs:

- Messages
- Behaviour Statements
- Settings
- Status
- IO Names
- Security

7.2.1. Messages Tab

This tab allows the user to program the PLC Commander with the messages they wish the PLC Commander to respond to and respond with via the serial port.

7.2.2. Behaviour Statements Tab

This tab allows the user to program the PLC Commander with a number of trigger conditions. *(See chapter 8)*

7.2.3. Settings Tab

This tab allows the user to change following settings of the PLC Commander:

- Temperature Probe Configuration
- Default Baudrate
- Show Debug Comms

7.2.4. Status Tab

This tab allows the user to monitor the status of PLC Commander (while connected to PC) with regards to:

- Power Status
- Temperature Status
- Current Battery Voltage (if a battery is connected)
- Current Analog Value
- Date / Time
- Inputs/Outputs Status

7.2.5. IO Names Tab

This tab allows the user to rename the inputs and outputs to something that means a little more.

Please Note: These IO Name changes will be stored in the setup that is saved to file, but will **NOT** be stored in the setup that is saved to the PLC Commander

7.2.6. Security Tab

This tab allows the user to password protect tabs from being accessed as well as the option to save a new setup to the PLC Commander. This feature comes in handy when an installer doesn't want the end-user to be able to make changes under certain tabs.

8. IF-THEN BEHAVIOUR STATEMENTS

The PLC Commander is configured by defining a number of behaviour statements. Each statement takes the form of an IF-THEN pair. You are thus able to select certain trigger conditions that will cause desired actions to be performed. Any combination of IF and THEN parts can be assembled into complete statements using the configuration software. The PLC Commander can accept up to 128 separate behaviour statements.

One is also able to select time and input/output constraints for any IF-THEN statement pair, so that a statement will only be allowed to trigger at certain times of day, and on certain days of the week or only if certain input/output conditions are met.

8.1. Supported IF Conditions

8.1.1. IF a Message is Received

A statement containing this IF condition, will trigger on the arrival of a message

The user has the following option:

• From Serial port Containing a Specific Message *("Serial Port" refers to the connection labeled "RS232")*

Thus, if you have a trigger condition like this one:

IF a Message is received, containing "Apple" from the Serial Port, THEN <ACTION>,

The statement will trigger on arrival of any of the following messages:
"Apple"
"APPLE"
"The Red apple"
You will notice that trigger text strings are NOT case sensitive. Both "Apple" and "APPLE" will work fine.

It is also important to note that you can trigger multiple statements with different Trigger texts, in the same message. For example, if you have the following two statements:

IF a Message is received, containing "Apple" from the Serial Port, THEN <ACTION>,
IF a Message is received, containing "eat" from the Serial Port, THEN <ACTION>,

These statements will both be triggered if "I eat an Apple" is received.

8.1.2. IF Input

A statement containing this IF condition, will trigger if the selected input changes according to specification.

The user can choose between the following seven options.

• Goes Active (Trigger on rising edge)

• Goes Inactive (Trigger on falling edge)

• Changes State (Trigger on rising or falling edge)

• Goes Active, remaining Active for longer than

- Goes Inactive, remaining Inactive for longer than

- Is Active (Trigger on high level)

- Is Inactive (Trigger on low level)

Thus, if the user chooses "Goes Active", then as soon as the specified input changes from inactive to active, the statement will trigger. The same applies to the remaining options, provided their conditions are met.

The user is also able to specify a "Lockout Time" for this statement, which is the time that, after the statement has triggered, it will not allowed to trigger again until this time has elapsed.

If the user selects a "Lockout Time" of zero, the statement will only trigger once (will trigger again when the trigger condition has changed and becomes true again, with the last two options being an exception).

8.1.3. IF Logic Expression

A statement containing this IF condition, will trigger if the specified logic conditions are met. This allows the user to specify interesting combinations, like input 1 AND input 2 must be active before action is taken.

The logic options available includes:

AND   : ALL the selected signals become active or ANY of the selected signals become inactive

OR   : ANY of the selected signals become active or ALL of the selected signals become inactive

XOR   : ANY UNEVEN number of the selected signals become active or ANY EVEN number of the selected signals become active.

8.1.4. IF Variable

A statement containing this IF condition, will trigger if selected variable meets the specified requirements.

The user can choose between the following two options:

- Check if Above Threshold

- Check if Below Threshold

Thus, if the user chooses "Check if Above Threshold", then as soon as the specified variable goes above the specified threshold, the statement will trigger. The same applies to the other option, provided it's condition is met.

The user is also able to specify a "Lockout Time" for this statement, which is the time that, after the statement has triggered, it will not allowed to trigger again until this time has elapsed.

If the user selects a "Lockout Time" of zero, the statement will only trigger once (will trigger again when the trigger condition has changed and becomes true again).

8.1.5. IF Analog Input

A statement containing this IF condition, will trigger if the analog voltage measured at the terminals meets the specified requirements.

The user can choose between the following four options:

- Check if Above Threshold

- Check if Below Threshold

- Check if Inside Window

- Check if Outside Window

Thus, if the user chooses "Check if Above Threshold", then as soon as the analog voltage measured at the terminals goes above the specified threshold, the statement will trigger. The same applies to the remaining options, provided their conditions are met.

The user is able to specify a "Lockout Time" for this statement, which is the time that, after the statement has triggered, it will not allowed to trigger again until this time has elapsed.
The user is also able to specify a "Hold Time" for this statement, which is the time that the trigger condition must continuously be true before it will be allowed to trigger.

In other words, if you select a "Lockout Time" of 10 minutes, a "Hold Time" of 5 seconds, and choose "Check if Above Threshold" of 5V, the statement will trigger as soon as the voltage goes above 5V, and remains above 5V for 5 seconds. It will then start checking the input again after 10 minutes and trigger once more if the voltage is above 5V for 5 seconds.

If the user selects a "Lockout Time" of zero, the statement will only trigger once (will trigger again when the trigger condition has changed and becomes true again).

8.1.6. IF Temperature

A statement containing this IF condition, will trigger if the temperature measured at the probe meets the specified requirements.

The user can choose between the following four options:

• Check if Above Threshold

• Check if Below Threshold

• Check if Inside Window

• Check if Outside Window

Thus, if the user chooses "Check if Above Threshold", then as soon as the temperature measured at the probe goes above the specified threshold, the statement will trigger. The same applies to the remaining options, provided their conditions are met.

The user is able to specify a "Lockout Time" for this statement, which is the time that, after the statement has triggered, it will not allowed to trigger again until this time has elapsed.

The user is also able to specify a "Hold Time" for this statement, which is the time that the trigger condition must continuously be true before it will be allowed to trigger

In other words, if you select a "Lockout Time" of 10 minutes, a "Hold Time" of 5 seconds, and choose "Check if Above Threshold" of 30°C, the statement will trigger as soon as the temperature goes above 30°C, and remains above 30°C for 5 seconds. It will then start checking the temperature again after 10 minutes and trigger once more if the temperature is above 30°C for 5 seconds.

If the user selects a "Lockout Time" of zero, the statement will only trigger once (will trigger again when the trigger condition has changed and becomes true again).

Please Note: To use this option, you need to have a temperature probe connected to the expansion port of the PLC Commander via a temperature interface module. Also make sure that the correct type of probe is selected in the "Temperature Probe Configuration" box under the "Settings" tab in the software.

8.1.7. IF Power Failure Detected

A statement containing this IF condition, will trigger if the power supplies to the 2.1mm DC jack power connector on the PLC Commander is interrupted.

The user is able to specify a "Lockout Time" for this statement, which is the time that, after the statement has triggered, it will not allowed to trigger again until this time has elapsed.

The user is also able to specify a "Hold Time" for this statement, which is the time that the trigger condition must continuously be true before it will be allowed to trigger.

If the user selects a "Lockout Time" of zero, the statement will only trigger once (will trigger again when the power is restored and fails again).

Please Note: To use this option, the user needs to have a 12V battery connected to the BATT terminals on the PLC Commander. The PLC Commander will operate from the battery in the case of a power failure.

8.1.8. IF Power Restored

This statement is the inverse of 15.1.9.

8.1.9. IF Battery Voltage < X

A statement containing this IF condition, will trigger if the battery voltage goes below a preset threshold level.

The user is able to specify a "Lockout Time" for this statement, which is the time that, after the statement has triggered, it will not allowed to trigger again until this time has elapsed.

If the user selects a "Lockout Time" of zero, the statement will only trigger once (will trigger again when the voltage goes above and below "X".

Please Note: To use this option, the user needs to have a 12V battery connected to the BATT terminals on the PLC Commander.

The PLC Commander will operate from the battery in the case of a power failure. While the PLC Commander is powered, the battery will be trickle-charged by the PLC Commander. It is therefore important to note that the battery level will only be checked while a power-failure is in progress.

8.1.10. IF time elapsed > X

A statement containing this IF condition, will trigger every X seconds or minutes.

8.1.11. IF Date/Time = X

A statement containing this IF condition, will trigger on a specific time every day within a specified range of dates, or on every selected day of the week.

The user can choose between the following three options:
• Everyday
• Day-of-Week
• Specific Date Range

8.1.12. IF Startup

A statement containing this IF condition, will trigger as soon as the unit has finished booting up.

8.1.13. IF Statement X Triggers

A statement containing this IF condition, will trigger if the referred-to-statement has triggered. Thus this type of statement actually monitors the triggering behaviour of another statement.

8.2. Supported THEN Actions

8.2.1. THEN Change Output

A statement containing this Action, will change the selected output according to specified actions.

The user can choose between the following five actions:
• Activate for a time
• Activate for a time – Pause – Activate for a time
• Activate (Leave Activated)
• De-Activate (Leave De-Activated)
• Change State

If the user chooses:

➢ "Activate for a time", it will Activate the selected output for the selected number of seconds specified.

➢ "Activate for a time – Pause – Activate for a time", it will Activate the selected output for the selected number of seconds specified. The output will remain off for a selected period, after which it will again activate for the selected number of seconds.

➢ "Activate (Leave Activated)", it will Activate the selected output and leave it activated. The inverse applies to "De-Activate (Leave De-Activated)".

➢ "Change State", it will either change the state of the selected output, meaning that it will active it if it was de-activated and vice versa.

8.2.2. THEN Send Message

A statement containing this Action, will send a message via Serial port.

The user can choose between the following fourteen options:
• Plain Message
• Input/Output Status
• Temperature (Probe A)
• Temperature (Probe B)
• Temperature (Probe A and B)
• Temperature (Avg of Probe A and B)
• General Status
• Power Status
• Analog Input Status *(Able to define own scale and unit)*
• Global Input Status
• Variable Value Message

If the user chooses:

➢ "*Plain Message*", it will send a predefined message either via the Serial port.

➢ "*Input/Output Status*", it will send a predefined message via the serial port (one for active and one for inactive) regarding the status of the selected input or output either via the Serial port.

➢ "*Temperature (Probe A)*", it will send a predefined message preceding the temperature value of Probe A via the Serial port. The same applies to "*Temperature (Probe B)*" and "*Temperature (Probe A and B)*"

➢ "*Temperature (Avg of Probe A and B)*", it will send a predefined message preceding the average temperature value of Probe A and Probe B either via the Serial port.

➢ "*General Status*", it will send a general status message via the Serial port containing the following information: date & time, signal strength, firmware version, serial number, status of mains power.

➢ "*Power Status*", it will send a message either via the Serial port containing the status of mains power
➢ (e.g. Power is ON) .

➢ *"Analog Input Status"*, it will send a message via the Serial port containing the status of the analog input. The user is able to specify the maximum and minimum value as well as the unit. The user is also able to define the message to precede, and the message to follow the analog value.

➢ *"Global Input Status"*, it will send a message either via the Serial Port containing the status of the inputs. (only inputs 1-12 are displayed)

➢ "*Variable Value Message*", it will send a message either via the Serial port containing the value of the selected variable. The user is able to define the message to precede the variable value.

The user also has the option to attach the time and date to each message as well as append a carriage return(CR) and line feed(LF) character.

See Section 13 to find out more about the Serial port.

8.2.3. THEN Enable/Disable Statements

A statement containing this Action, will enable or disable up to a maximum of 8 selected behaviour statements such that it will be allowed to trigger if it is enabled and not be allowed to trigger if it is disabled.

8.2.4. THEN Set Multiple Outputs to Pattern

A statement containing this Action, will change the status of multiple outputs to a certain state.

8.2.5. THEN Change Variable

A statement containing this Action, will change the selected variable according to specified actions.

The user can choose between the following five actions:
- Increment variable
- Decrement variable
- Clear variable
- Set variable to a specific value

8.2.6. THEN Reset device

A statement containing this Action, will reset the PLC Commander.

9. MULTIPLE ACTIONS TO A SINGLE IF CONDITION

It is often required to have more than a single action to be executed for a single Trigger condition. For instance, if your home alarm is triggered, you may want to activate an output (that in turn switches on a loud alarm or perhaps pulls the trigger on a rigged-up shotgun).

The PLC Commander will always execute all statements that are eligible to trigger due to a certain event, in other words, the first statement that is triggered, does not void or "eat up" the event.

So to take our example, we will have a set of statements like:

Statement 1: IF input 1 becomes Active, THEN send General Status Message via Serial Port

Statement 2: IF input 1 becomes Active, THEN Increment Variable A

Statement 3: IF input 1 becomes Active, THEN Activate Output 1 for 10 minutes

If input 1 becomes active, all the above statements will trigger, and their associated actions will take place. (The action for the first statement will be executed first)

Alternatively, "IF Statement X Triggers" could have been used. *(See 8.1.13)*

10. MESSAGE PARAMETERS

The PLC Commander support the use of parameters in predefined messages. This allows the user to insert and refer to certain values in message.

The following is a list of all available parameters together with their descriptions:

- **\t or \T** – Current time (HH:MM:SS)
- **\d or \D** – Current date (DD/MM/YYYY)
- **\a or \A** – Current analog input reading (0-255)
- **\n or \N** – Unit's serial number
- **\f or \F** – Unit's current firmware version
- **\b or \B** – Battery voltage (in volts)
- **\p or \P** – Current power status of mains
- **\1** – Temperature probe A reading (in °C)
- **\2** – Temperature probe B reading (in °C)
- **\i or \I** – Current status of inputs (32-bit hexadecimal bitmap)
- **\o or \O** – Current status of outputs (32-bit hexadecimal bitmap)

For example:
"Serial no \n's analog value is \a counts" *will send "Serial no 100641-12345's analog value is 125 counts"*

11. VARIABLES

The PLC Commander supports 5 variables (A,B..E), whose values can each go upto about 16 million. These variables can be incremented, decremented and otherwise manipulated via behaviour statements. The value of a variable can be sent via serial port, and can also be used to trigger another statement.

12. TIMED OPERATIONS

The PLC Commander supports time constraints, which can be setup for any statement. Time constraints will prevent a statement from triggering outside of the preselected times and days of the week. The PLC Commander can also be configured to trigger a statement at a certain time on a certain date or group of days.

The current time and date can be set by clicking on the tab **"Set to PC time"** in the software interface under the **"Status Tab"**.

The PLC Commander will not allow any time constrained statement to trigger if the time has not yet been set.

13. SERIAL PORT

The PLC Commander is configured via USB from a PC. The PLC Commander also provides a serial functionality, that can be used for various functions, described later in this manual.

Both the USB and Serial ports are internally connected to the PLC Commander microprocessor.

Signaling levels: **RS232**

Connector: **RS232/Audio** (10pin IDC Header)

Please Note: Configuration via the software is ONLY possible through the USB port and configuration messages sent via the Serial port will ONLY get a response via the Serial port.

The pin-out is as follows:

Pin 1   : MIC+ (Can connect to condenser MIC calls)
Pin 2   : MIC– (Can connect to condenser MIC calls)
Pin 3   : SPR– (can be connected to an external audio system)
Pin 4   : SPR+ (can be connected to an external audio system)
Pin 5   : RS232 RX to PLC Commander(Input)
Pin 6   : RS232 TX from PLC Commander(Output)
Pin 7   : Not used (Do NOT Connect)
Pin 8   : +5V
Pin 9   : GND
Pin 10   : +12V from input supply

Making your own Serial cable for connection to a PC:

-PIN5 on PLC Commander's RS232 PORT TO PIN3 on Female DB9 (PLC Commander's RX)
-PIN6 on PLC Commander's RS232 PORT TO PIN2 on Female DB9 (PLC Commander's TX)
-PIN9 on PLC Commander's RS232 PORT TO PIN5 on Female DB9 (Ground)

Below is the schematic:
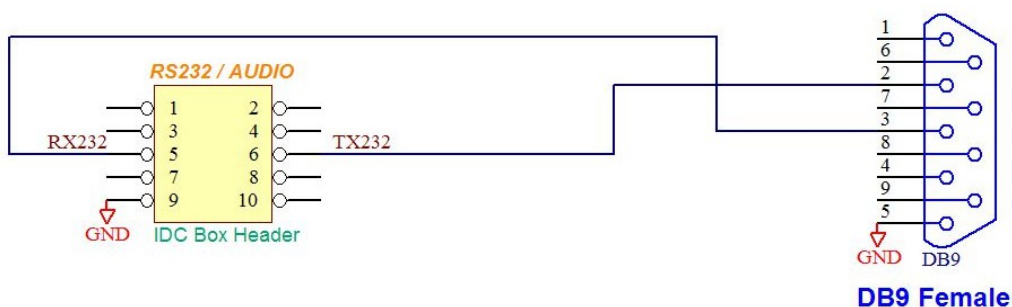
13.1. RS232 Configuration

It is **important** that any user software that connects via the RS232 connection on the PLC Commander, connects using the following default Serial parameters:

Baudrate: 38400
Data Bits: 8
Stop bits: 1

Parity: none

Flow-control: none

Please Note: The default baudrate won't work if it has been changed and saved into non-volatile memory. *(See section 13.2.2 to find out more)*

13.2. Serial Functionality

Please Note: All configuration messages **ARE** case sensitive.

13.2.1. Accessing Inputs and Outputs

The user can change outputs and read inputs via the the Serial Port.

To set an output, Send `*OUTON#` The PLC Commander will respond with `?`. Now send two digits corresponding to the output you want to set. if you want to set output 1, then send `01`. Likewise, if you want to set output 13, send `13`. In a similar way, you can clear outputs by sending `*OUTOFF#`

To read the inputs, simply send `*READIN#`. The PLC Commander will respond by sending a hexadecimal representation of all the digital inputs. It will be of the form `INPUTS=0x00000004`. (In this example, Input 3 is set and the rest are cleared)

13.2.2. Customizing Baudrate

The user can request the PLC Commander to change the serial Baudrate to any of the following values:

> 1200 (Send `*BAUD1#` - Expect the following reply: `OK (BR=1200)`
> 2400 (Send `*BAUD2#` - Expect the following reply: `OK (BR=2400)`
> 4800 (Send `*BAUD3#` - Expect the following reply: `OK (BR=4800)`
> 9600 (Send `*BAUD4#` - Expect the following reply: `OK (BR=9600)`
> 19200 (Send `*BAUD5#` - Expect the following reply: `OK (BR=19200)`
> 38400 (Send `*BAUD6#` - Expect the following reply: `OK (BR=38400)`
> 57600 (Send `*BAUD7#` - Expect the following reply: `OK (BR=57600)`

Right after sending the reply, the PLC Commander will re-initialize the serial port to the requested baudrate. Note that per default, this setting is volatile (if the PLC Commander is reset for any reason, this functionality will revert to the default baudrate of 38400).

To save the current baudrate value into non-volatile memory, send `*BSAVE#` at the baudrate requested, the PLC Commander will reply with: `OK (SAVE).` Upon startup, the PLC Commander will read the value from non-volatile storage and set its baudrate accordingly.

13.2.3. Other uses

> The PLC Commander can send out a preselected message on the serial port in reaction to a chain of events. See Section 8.2.2 for more detail. This is very handy for connection to peripherals like serial displays and printers.

14. FIRMWARE UPDATES

Step 1:

Download the "setup.exe" executable file from our website *(http://www.gsmcommander.com)*

Step 2:

Run the executable file

Step 3:

Connect PLC Commander to PC via the supplied USB cable

Step 4:

Connect power to the PLC Commander
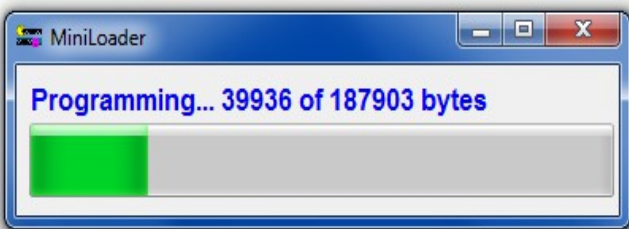
Step 5:

Run the Utility (Start > All Programs > PLC Commander V6 > Update Firmware)

Screen 1:

The loader utility will show this screen when started.

Screen 2:

The loader utility will now show this screen, which means the firmware is being updated. The green LED, labeled **"STATUS"** on the PLC Commander, will start flashing.

On completion the loader utility will close and the unit will start up automatically or if you so wish you can disconnect the power.

15. LOW POWER / BATTERY OPERATION

By the use of current limiting resistors on the inputs of the PLC Commander and Expansion Units, the PLC Commander can operate more efficiently in terms of current consumption.

This is particularly important when the PLC Commander is powered by means of a battery connected to a solar panel or any other alternative source of power generation.
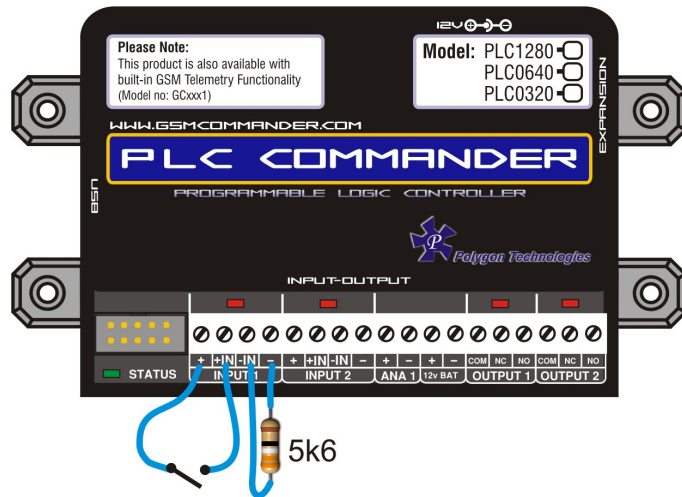
To connect a switch or contact to an input, simply connect the switch between the + and IN+ terminals, and a **5k6** resistor between the – and IN– terminals. The reverse is just as suitable, i.e. that you connect a **5k6** resistor between + and IN+ and place the switch between – and IN–. This will decrease each input's current consumption (when active) from 18.7mA to 1.8mA.
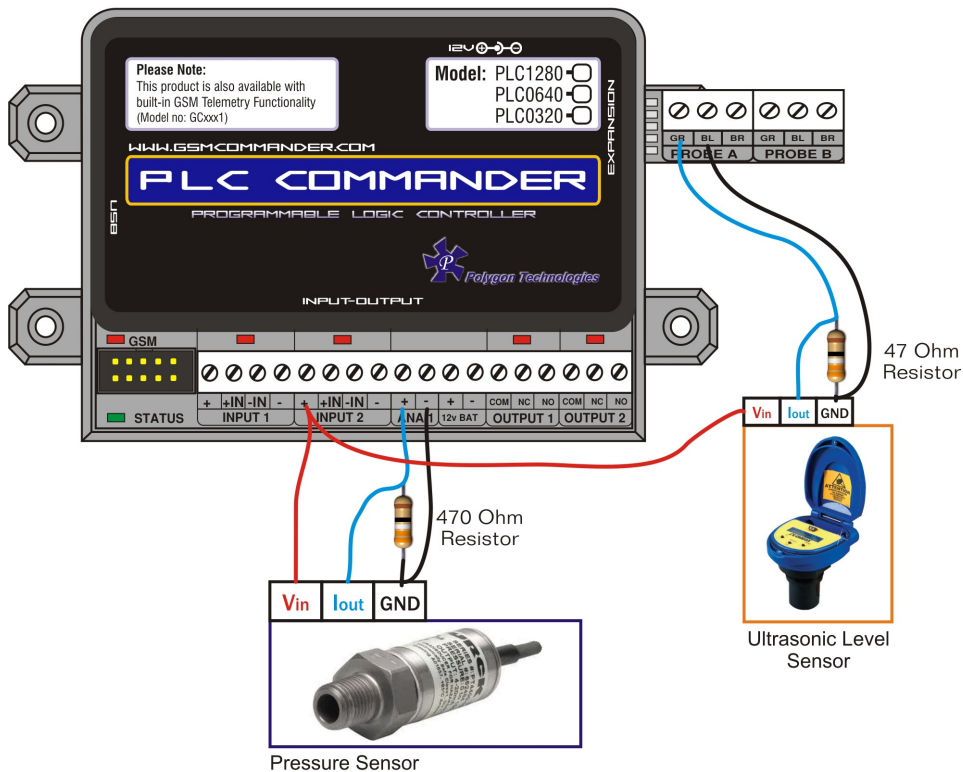
Similarly a **1k** resistor can be connected to all the inputs of the Expansion Unit(s) to decrease each input's current consumption (when active) from 17.4mA to 6.4mA.

Please Note: The above results were obtained by connecting a 14V switching power supply to the PLC Commander.

16. 4-20MA ANALOG APPLICATION NOTE

Goal:

To connect a 4-20mA sensor to your PLC Commander.

PLC Commander Wiring:

Connect a wire from the (+) terminal(12V) of any Input from the PLC Commander to the supply voltage input of the sensor. Then connect a wire from the output(4-20mA) of the sensor to the (+) terminal of the Analog Input. Connect GND of the sensor to the (–) terminal of the Analog Input.

Very important, connect a 470 ohm resistor in parallel with the output signal of the sensor and GND as illustsrated above. This resistor together with the internal voltage divider resistors ensures that the voltage across the Analog Input is between 0 – 10V as required.

To be more specific, the minimum voltage would be 1.8V when the output signal is 4mA, and the maximum voltage would be 9V when the output signal is 20mA.

Further Clever Ideas (The MacGyver Move):

The possibility exists, that the Temperature Interface module could be used to make an extra 2x Analog Inputs available. The slight drawback would be that you would have to make use of the temperature monitoring features in the software to control these inputs.

Thus a 4mA output signal of the sensor would be equivalent 19°C and a 20mA output signal would be equivalent to 94°C. Convert this temperature reading in the Setup Software in order to send a "value" instead of a temperature reading.

Eg: If temperature at probe A stays below 36C, then send "Alarm: 200-Lit in reservoir" via serial port.

It may not be pretty, but it works!

17. TROUBLESHOOTING

17.1. PLC Commander setup software reports "Hardware not detected"

This error can have several causes:

*Cause 1: PLC Commander not powered properly*

Cause 2: PLC Commander not connected via USB

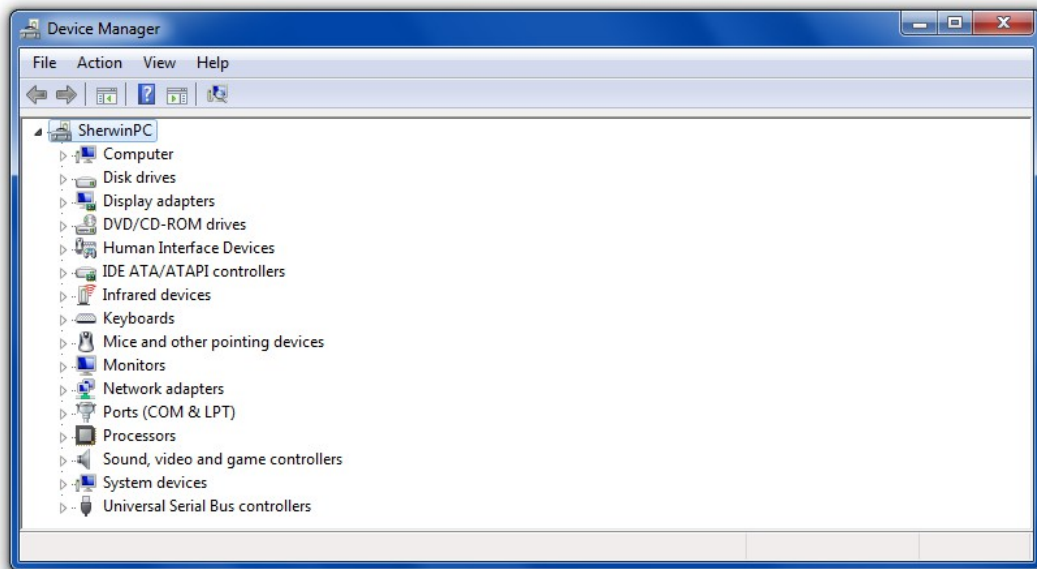*Cause 3: PLC Commander USB drivers not installed.*

It is a good idea to disconnect all cables from the PLC Commander, and then reconnecting everything (power and USB cable). If the problem persists, please follow this procedure to verify that the drivers are correctly installed:

Step 1: Connect USB Cable to PLC Commander (ONLY USB, and not the Power)
Press "Windows key" and "Pause" simultaneously on your computer keyboard. This will bring up the "System properties" window as below:
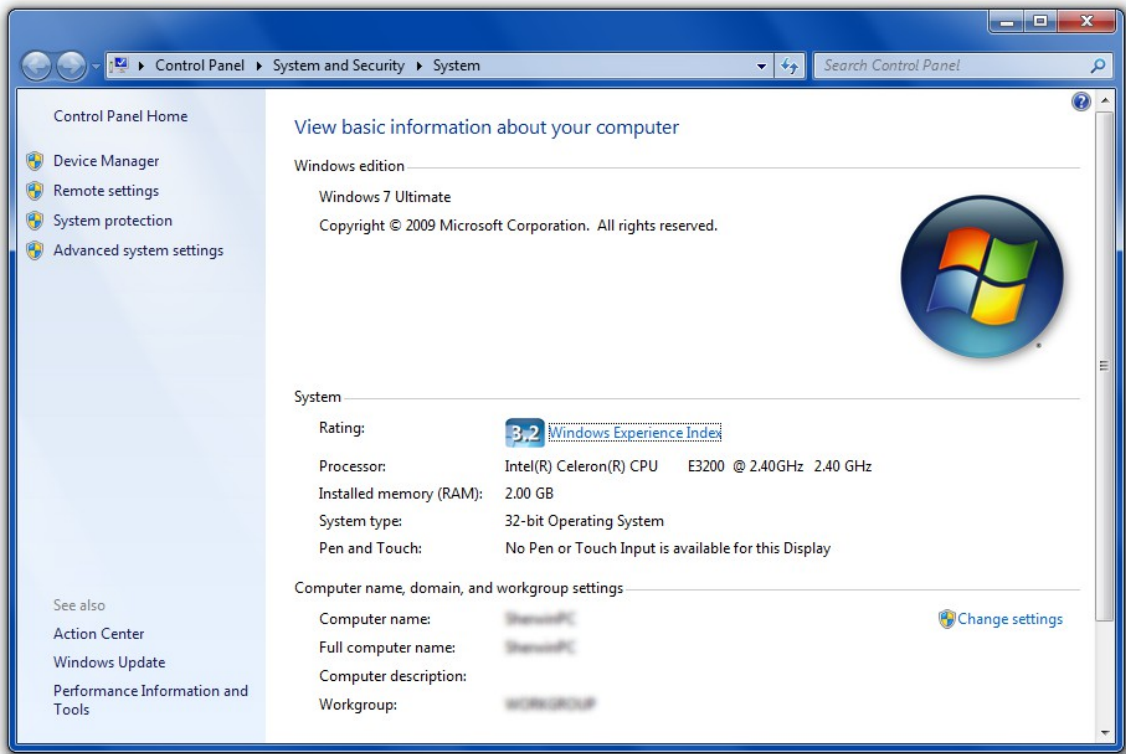
Step 2: Select "Device Manager". This will open the device manager window as below:

Double Click on "Universal Serial Bus(USB) controllers"
In the list of USB controllers, you should see an item called "PLC Commander".

If this item is not present, the drivers are not installed correctly. To install your drivers, go to Start>All Programs>PLC Commander V6>Reinstall drivers. This will install your drivers.

17.2. PLC Commander setup software reports "Could not initialize the internal module"(Also shown by the green Status LED flickering at a vary fast rate)

This is a problem state, and may be caused by a supply voltage that is too low. (The supply must be in the range 10..24V). If this problem persists, the PLC Commander is faulty.

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18. GUARANTEE

The PLC Commander is guaranteed for a period of 24 months against defects in materials or workmanship. Should your product become defective during the guarantee period it will be repaired or replaced at the sole discretion of **Polygon Technologies** under the following conditions:

A: The unit must not have been opened or otherwise tampered with. If the enclosure of any unit has been opened at all, the guarantee will be null and void.
B: The guarantee does not cover damage resulting from excessive input voltages, lightning, power surges or water ingress.

A decision about issues A and B will be at the sole discretion of **Polygon Technologies**. This guarantee does not provide for shipping costs. This will be for the account of the user under all circumstances.

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