
# Cryostation Communication Specification

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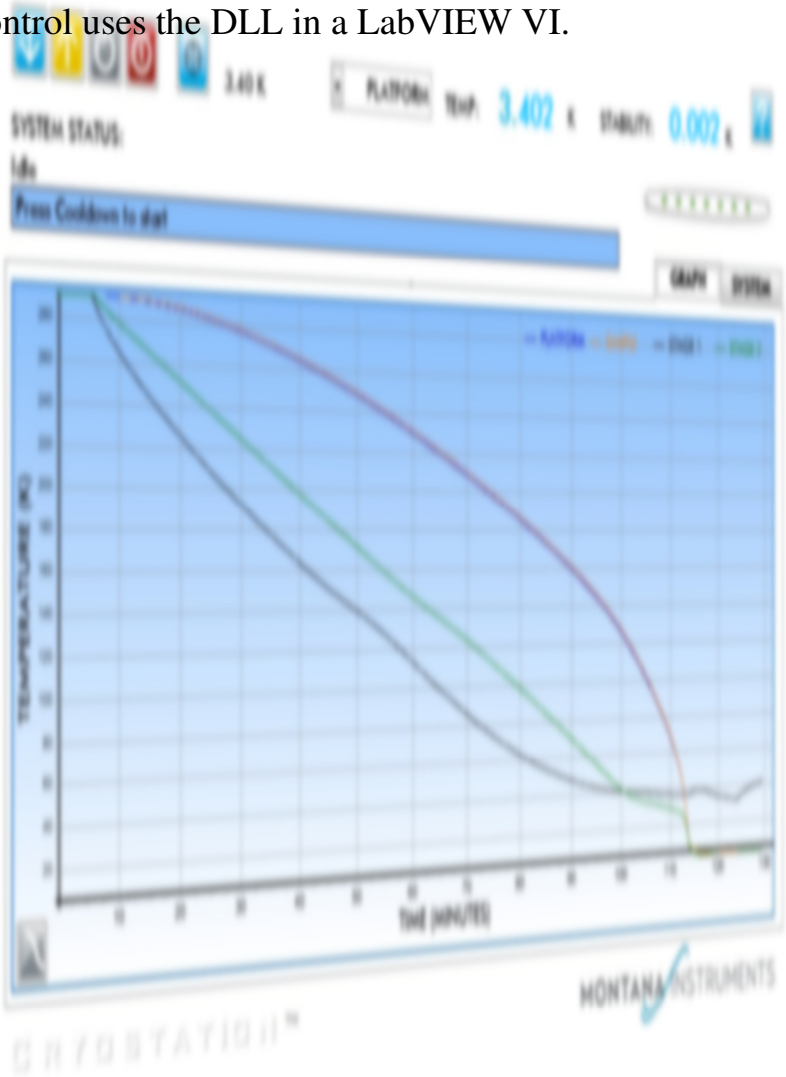
# Remote Control of the Cryostation

There are four ways to control the Cryostation or Nanoscale Workstation remotely. All rely on a TCP/IP Ethernet connection between the system PC and the device running the control software. At the lowest level, the user may issue text commands over the connection. The next level up provides software routines for communicating via a DLL with text messages. With the third method, a LabVIEW VI (virtual instrument) can be used to issue the text commands. The last method of remote control uses the DLL in a LabVIEW VI.



# Cryostation Communication Specification

This guide defines the communication protocol between an external client computer and the Cryostation server computer and the Cryostation DLL. External clients can utilize the Cryostation DLL to simplify communication with the Cryostation server, but use of the Cryostation DLL is not required. External clients can communicate directly with the Cryostation server. The Cryostation DLL is CryostationComm.dll.

The communication interface is an Ethernet port connection. The Communications protocol is TCP/IP.

The Cryostation acts as a server and implements a typical Client-Server architecture


Client PC or Device

Server PC- Cryostation

The default listen port for the Cryostation is **7773**. External clients connect to the IP address of the Cryostation on the default port.

## Command Response Architecture

The communications protocol is defined as command-response. For each command given to the server, a response is provided to the client.

## Messaging Format

Commands and responses consist of text messages within the TCP/IP communications protocol.
The first 2 bytes of each command and response indicates the length of the remaining message.
The Cryostation DLL adds the length to each command and strips the length from each response. If the Cryostation DLL is not utilized the external client computer must include the 2 byte length on any command and must process the 2 byte length on any response.
For example, the command to request the platform temperature is GPT. Utilizing the Cryostation DLL the external client computer would send the command “GPT”. If the platform temperature is 295.155, the Cryostation DLL, would respond to the command with “295.155”.
If the Cryostation DLL is not used, the external client computer would send “03GPT” to the Cryostation server. If the platform temperature is 295.155, the Cryostation server would respond to the command with “07295.155”.

## Security

Due to the nature of the Cryostation hardware, it is assumed that the external client computer is a trusted computer or on a trusted network. No security or encryption is provided by the Cryostation server. Credentials are also not required.

# Commands

Following is the list of commands supported by the Cryostation server.

## GAS - Get Alarm State

*Returns:* Returns true or false indicating the presence or absence of a system error

*CryostationComm.dll Returns:*

T

F

*Cryostation Server Returns:*

01T

01F

## GCP - Get Chamber Pressure

*Returns:* Returns the current chamber pressure or -0.1 to indicate the chamber pressure is not available.

*Units:* mTorr

*CryostationComm.dll Returns:*

XXXXXX.X

Examples:

660848.6

859.4

-0.1

*Cryostation Server Returns:*

08XXXXXX.X

Examples:

08660848.6

05859.4

04-0.1

## GCRS - Get Compressor Run State

*Returns:* Returns the current run state of the compressor.

*CryostationComm.dll Returns:*

On

Off

*Cryostation Server Returns:*

02On

03Off

## GCS - Get Compressor Speed

*Returns:* Returns the current compressor speed or -0.1 to indicate the compressor speed is not available.

*Units:* Hz

*CryostationComm.dll Returns:*

XX

Examples:

22

14

-0.1

*Cryostation Server Returns:*

02XX

Examples:

0222

0214

04-0.1

## GCVS - Get Case Valve State

*Returns:* Returns the current case valve state.

*CryostationComm.dll Returns:*

Open

Closed

*Cryostation Server Returns:*

04Open

06Closed

## GHS - Get cold Head Speed

*Returns:* Returns the current cold head speed or -0.1 to indicate the cold head speed is not available.

*Units:* Hz

*CryostationComm.dll Returns:*

XX

Examples:

50

70

-0.1

*Cryostation Server Returns:*

02XX

Examples:

0250

0270

04-0.1

## GMS - Get Magnet State

*Returns:* Returns the current magnet state

*CryostationComm.dll Returns:*

MAGNET ENABLED

MAGNET DISABLED

System not able to execute command at this time. Activate the magnet module first.

*Cryostation Server Returns:*

14MAGNET ENABLED

15MAGNET DISABLED

83System not able to execute command at this time. Activate the magnet module first.

## GMTF - Get Magnet Target Field

*Returns:* Returns the current set point for magnetic field or -9.999999 if the magnet is not enabled or the magnet module is not activated.

*Units:* Tesla

*CryostationComm.dll Returns:*

X.XXXXXX

Examples:

0.670000

-0.200000

-9.999999

*Cryostation Server Returns:*

08X.XXXXXX

Examples:

080.670000

09-0.200000

09-9.999999

## GPHP - Get Platform Heater Power

*Returns:* Returns the current platform heater power reading or -0.100 to indicate the platform heater power is not available.

*Units:* Watts

*CryostationComm.dll Returns:*

XX.XXX

Examples:

4.904

1.000

-0.100

*Cryostation Server Returns:*

06XX.XXX

Examples:

054.904

051.000

06-0.100

## GPS - Get Platform Stability

*Returns:* Returns the current platform stability or -0.10000 to indicate the platform stability is not available.

*Units:* Kelvin

*CryostationComm.dll Returns:*

X.XXXXX

Examples:

0.00900

10.20239

-0.10000

*Cryostation Server Returns:*

07X.XXXXX

Examples:

070.00900

0810.20239

08-0.10000

## GPT - Get Platform Temperature

*Returns:* Returns the current platform temperature or -0.100 to indicate the platform temperature is not available.

*Units:* Kelvin

*CryostationComm.dll Returns:*

XXX.XXX

Examples:

289.904

3.498

-0.100

*Cryostation Server Returns:*

07XXX.XXX

Examples:

07289.904

053.498

06-0.100

## GS1HP - Get Stage 1 Heater Power

*Returns:* Returns the current stage 1 heater power reading or -0.100 to indicate the stage 1 heater power is not available.

*Units:* Watts

*CryostationComm.dll Returns:*

XX.XXX

Examples:

4.904

1.000

-0.100

*Cryostation Server Returns:*

06XX.XXX

Examples:

054.904

051.000

06-0.100

## GS1T - Get Stage 1 Temperature

*Returns:* Returns the current stage 1 temperature or -0.10 to indicate the stage 1 temperature is not available.

*Units:* Kelvin

*CryostationComm.dll Returns:*

XXX.XX

Examples:

274.92

33.02

-0.10

*Cryostation Server Returns:*

06XXX.XX

Examples:
06274.92
0533.02
05-0.10

## GS2T - Get Stage 2 Temperature

*Returns:* Returns the current stage 2 temperature or -0.10 to indicate the stage 2 temperature is not available.

*Units:* Kelvin
*CryostationComm.dll Returns:*
XXX.XX
Examples:
275.84
6.85
-0.10
*Cryostation Server Returns:*
06XXX.XX
Examples:
06275.84
046.85
05-0.10

## GSS - Get Sample Stability

*Returns:* Returns the current sample stability or -0.10000 to indicate the sample stability is not available.

*Units:* Kelvin
*CryostationComm.dll Returns:*
X.XXXXX
Examples:
0.00900
10.20239
-0.10000
*Cryostation Server Returns:*
07X.XXXXX
Examples:
070.00900
0810.20239
08-0.10000

## GST - Get Sample Temperature

*Returns:* Returns the current sample temperature or -0.100 to indicate the sample temperature is not available.

*Units:* Kelvin

*CryostationComm.dll Returns:*

XXX.XXX

Examples:

289.904

3.498

-0.100

*Cryostation Server Returns:*

07XXX.XXX

Examples:

07289.904

053.498

06-0.100

## GTSP - Get Temperature Set Point

*Returns:* Returns the current temperature set point

*Units:* Kelvin

*CryostationComm.dll Returns:*

XXX.XX

Examples:

295.00

4.20

*Cryostation Server Returns:*

06XXX.XX

Examples:

06295.00

044.20

## GUS - Get User Stability

*Returns:* Returns the current user stability or -0.10000 to indicate the user stability is not available.

*Units:* Kelvin

*CryostationComm.dll Returns:*

X.XXXXX

Examples:

0.00900

10.20239

-0.10000

*Cryostation Server Returns:*

07X.XXXXX

Examples:

070.00900

0810.20239

08-0.10000

## GUT - Get User Temperature

*Returns:* Returns the current user temperature or -0.100 to indicate the user temperature is not available.

*Units:* Kelvin

*CryostationComm.dll Returns:*

XXX.XXX

Examples:

289.904

3.498

-0.100

*Cryostation Server Returns:*

07XXX.XXX

Examples:

07289.904

053.498

06-0.100

## GUTSP - Get User Temperature Set Point

*Returns:* Returns the current User module temperature set point

*Units:* Kelvin

*CryostationComm.dll Returns:*

XXX.XX

Example:

395.00

System not able to execute command at this time. Activate the User module first.

*Cryostation Server Returns:*

06XXX.XX

Example:

06395.00

81System not able to execute command at this time. Activate the User module first.

## GVPS - Get Vacuum Pump State

*Returns:* Returns the current vacuum pump state.

*CryostationComm.dll Returns:*

On
Off

*Cryostation Server Returns:*

02On
03Off

## GVVS - Get Vent Valve State

*Returns:* Returns the current vent valve state.

*CryostationComm.dll Returns:*

Open
Closed

*Cryostation Server Returns:*

04Open
06Closed

## SCD – Start Cool Down

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK
System not able to cool down at this time

*Cryostation Server Returns:*

02OK
41System not able to cool down at this time

## SCS – Set Compressor Speed

Sets the compressor and cold head speed and turns the compressor on or off.
*Takes:* Integer number corresponding to the combination of compressor and cold head speeds from the COMPRESSOR drop down selection on the MANUAL CONTROL tab page of the SYSTEM tab page. Send 0 to turn the compressor off.
For example, to turn the compressor on and set the compressor and cold head speed to the first selection send

SCS1

To turn the compressor on and set the compressor and cold head speed to the third selection send

SCS3

To turn the compressor off send

SCS0

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK, Compressor off

OK, Compressor = xxxxxxxx

Example:

OK, Compressor = Startup_14_70

System not able to start compressor or set compressor speed at this time

Error: Invalid compressor speed

*Cryostation Server Returns:*

18OK, Compressor off

xxOK, Compressor = xxxxxxxx

Example:

30OK, Compressor = Startup_14_70

72System not able to start compressor or set compressor speed at this time

31Error: Invalid compressor speed

## SMD - Set Magnet Disabled

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK, MAGNET DISABLED

System not able to execute command at this time. Activate the magnet module first.

System not able to execute command at this time. The magnet is already disabled.

*Cryostation Server Returns:*

19OK, MAGNET DISABLED

83System not able to execute command at this time. Activate the magnet module first.

81System not able to execute command at this time. The magnet is already disabled.

## SME - Set Magnet Enabled

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK, MAGNET ENABLED

System not able to execute command at this time. Activate the magnet module first.

System not able to execute command at this time. The magnet is already enabled.

*Cryostation Server Returns:*

18OK, MAGNET ENABLED

83System not able to execute command at this time. Activate the magnet module first.
80System not able to execute command at this time. The magnet is already enabled.

## SMTF - Set Magnet Target Field

*Takes:* Takes a decimal value in the range -2.000000 to 2.000000
*Units:* Tesla
*Returns:* Status of the set command and the current value of the target magnetic field if the set command is successful.
*CryostationComm.dll Returns:*
OK, Magnet Target Field = X.XXXXXX
Example:
OK, Magnet Target Field = 0.123123
System not able to execute command at this time. Activate the magnet module first.
System not able to execute command at this time. Enable the magnet first.
System not able to set magnetic field at this time.
Error: Invalid target magnetic field: abc. Input string was not in a correct format.
*Cryostation Server Returns:*
34OK, Magnet Target Field = X.XXXXXX
Example:
34OK, Magnet Target Field = 0.123123
83System not able to execute command at this time. Activate the magnet module first.
74System not able to execute command at this time. Enable the magnet first.
51System not able to set magnetic field at this time.
85Error: Invalid target magnetic field: abc. Input string was not in a correct format.

## SMTZ – Start Magnet True Zero

*Returns:* Status of the command.
*CryostationComm.dll Returns:*
OK
System not able to execute command at this time. Activate the magnet module first.
System not able to execute command at this time. Enable the magnet first.
System not able to erase remnant field at this time.
*Cryostation Server Returns:*
02OK
83System not able to execute command at this time. Activate the magnet module first.

74System not able to execute command at this time. Enable the magnet first.
52System not able to erase remnant field at this time.

## SSB – Start StandBy

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK
System not able to standby at this time

*Cryostation Server Returns:*

02OK
39System not able to standby at this time

## STP – SToP

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK
System not able to stop at this time

*Cryostation Server Returns:*

02OK
36System not able to stop at this time

## STSP - Set Temperature Set Point

*Takes:* Takes a decimal value in the range 2.00 to 350.00

*Units:* Kelvin

*Returns:* Status of the set command and the current temperature set point if the set command is successful.

*CryostationComm.dll Returns:*

OK, Temperature Set Point = XXX.XX

Example:

OK, Temperature Set Point = 4.20

Error: Invalid set point

*Cryostation Server Returns:*

34OK, Temperature Set Point = XXX.XX

Example:

32OK, Temperature Set Point = 4.20

24Error: Invalid set point

## SUTSP - Set User Temperature Set Point

*Takes:* Takes a decimal value in the User module temperature range

*Units:* Kelvin

*Returns:* Status of the set command and the current User module temperature set point if the set command is successful.

*CryostationComm.dll Returns:*

OK, User Temperature Set Point = XXX.XX

Example:

OK, User Temperature Set Point = 395.00

Error: Invalid set point

System not able to execute command at this time. Activate the User module first.

*Cryostation Server Returns:*

39OK, User Temperature Set Point = XXX.XX

Example:

39OK, User Temperature Set Point = 395.00

24Error: Invalid set point

81System not able to execute command at this time. Activate the User module first.

## SWU – Start Warm Up

*Returns:* Status of the command.

*CryostationComm.dll Returns:*

OK

System not able to warmup at this time

*Cryostation Server Returns:*

02OK

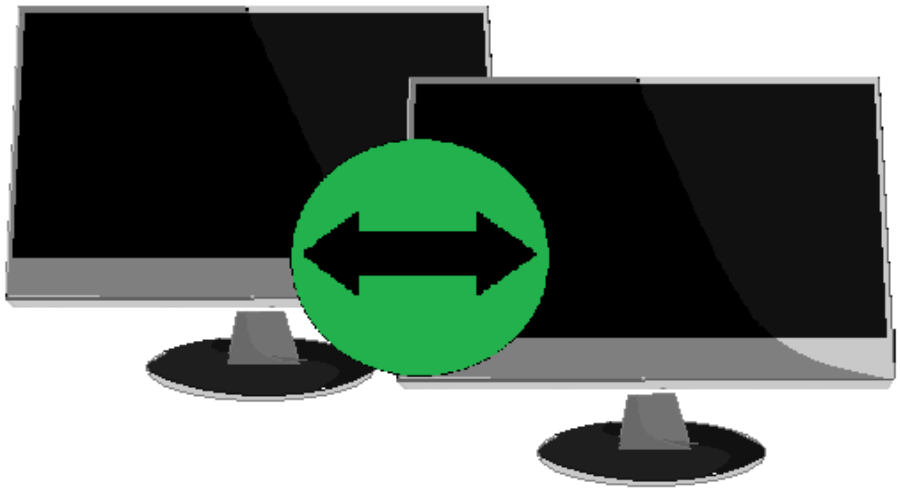
# How to Use the "CryostationComm" DLL

This document describes how to implement the Cryostation communications DLL into another project.

Install the CryostationComm.dll to the following directory

C:\Montana Instruments\Cryostation Script Controller

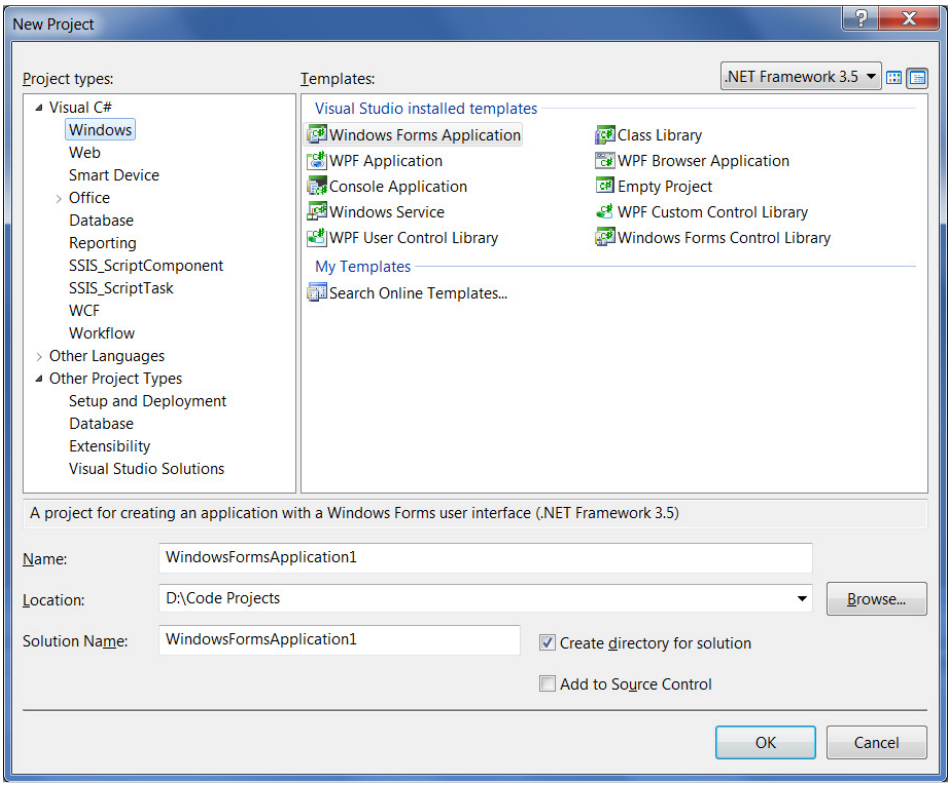
This guide assumes the use of Visual Studio 2008 or later, using the .NET framework 3.5. This example demonstrates adding the .dll to a c# project.



*NOTE: Both PCs that will be communicating must be able to ping one another. This may require adding the programs to the windows firewall exception list and/or adjusting firewall settings. Contact your System Administrator for assistance if needed.*

# Creating a new project

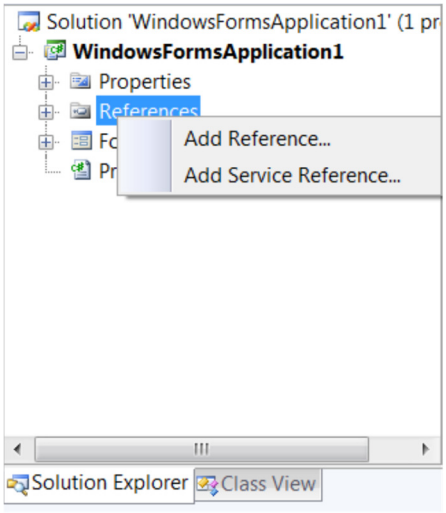
- Open VS2008
- Select File->New->Project
- Select Visual C#->Windows->Windows Form Application



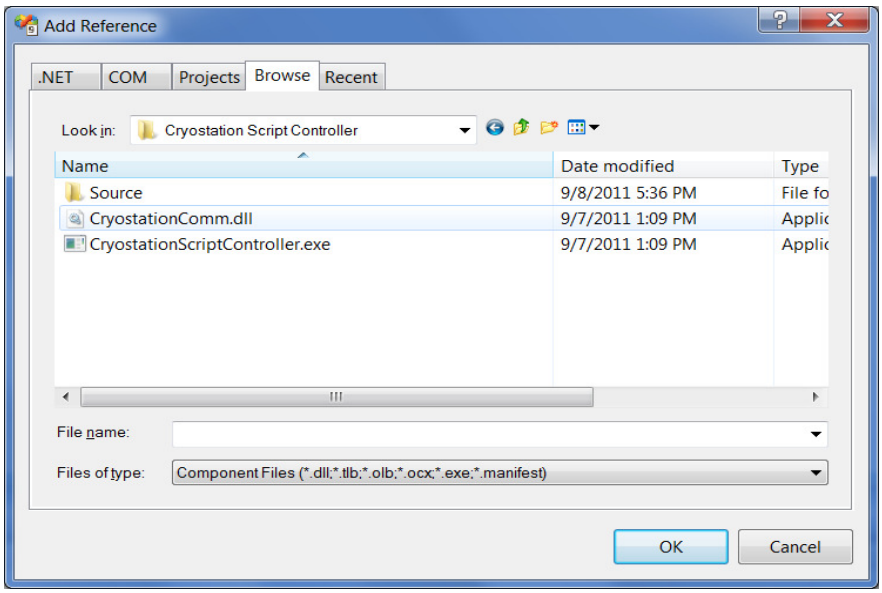

- For this example, the default name WindowsFormsApplication1 will be used
- Select the location to place the project and click the OK button.

# Add the DLL to the project

- On the right side of Visual Studio in the Solution Explorer tab, right-click on the References node and select Add Reference




- Select the browse tab then browse to the C:\Montana Instruments\Cryostation Script Controller directory (or the installation directory) and select the CryostationComm.dll file




- Click on the OK button to add the dll to the project.

# Use the DLL

- Add the using statement

```
using CryostationComm;
```

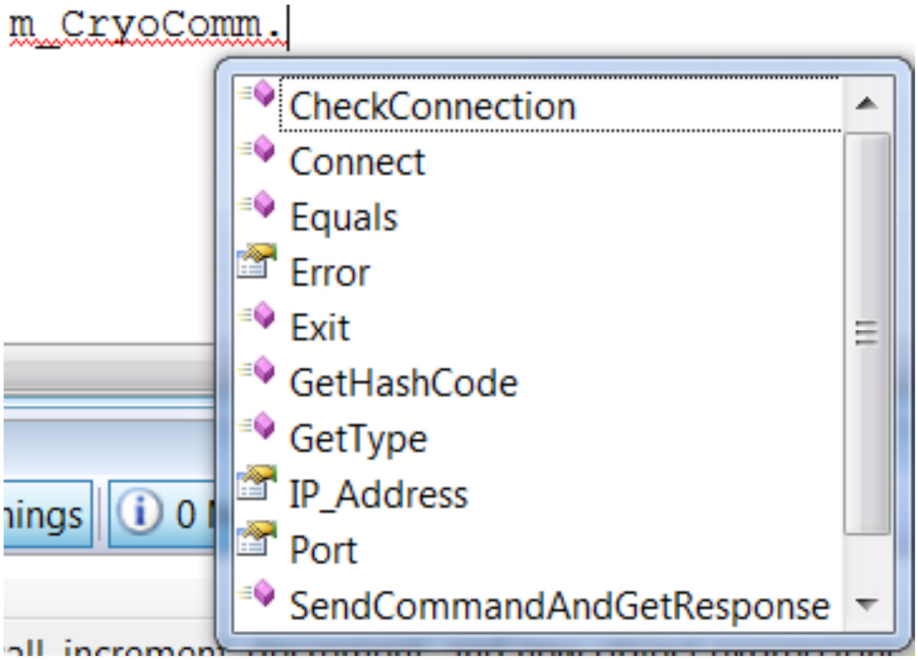
- Add a Private member called m_CryoCom

```
private CryoComm m_CryoComm;
```

- Create a new instance of the class using the default constructor

```
m_CryoComm = new CryoComm();
```

- Access the public functions of the DLL



# Example program

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;

using CryostationComm;

namespace WindowsFormsApplication1
{
    public partial class Form1 : Form
    {
        private CryoComm m_CryoComm;

        public Form1()
        {
            string szCmd = string.Empty;
            string szResponse = string.Empty;

            InitializeComponent();

            m_CryoComm = new CryoComm();

            m_CryoComm.IP_Address = "192.168.28.24";
            m_CryoComm.Port = 7773;

            if (m_CryoComm.Connect() == true)
            {
                szCmd = "STSP4.2";
                if( m_CryoComm.SendCommandAndGetResponse( szCmd, ref
szResponse) == true )
                {
                    //Got valid value, show it
                    MessageBox.Show(szResponse);
                }
                else
                {
                    //Show error
                    MessageBox.Show(m_CryoComm.Error);
                }
            }
            else
            {
                //Show error
                MessageBox.Show( m_CryoComm.Error );
            }

            //When done make sure exit is called to clean up
            m_CryoComm.Exit();
        }
    }
}
```

## Commands with a parameter

To call a command with a parameter, simply append the parameter to the end of a command.

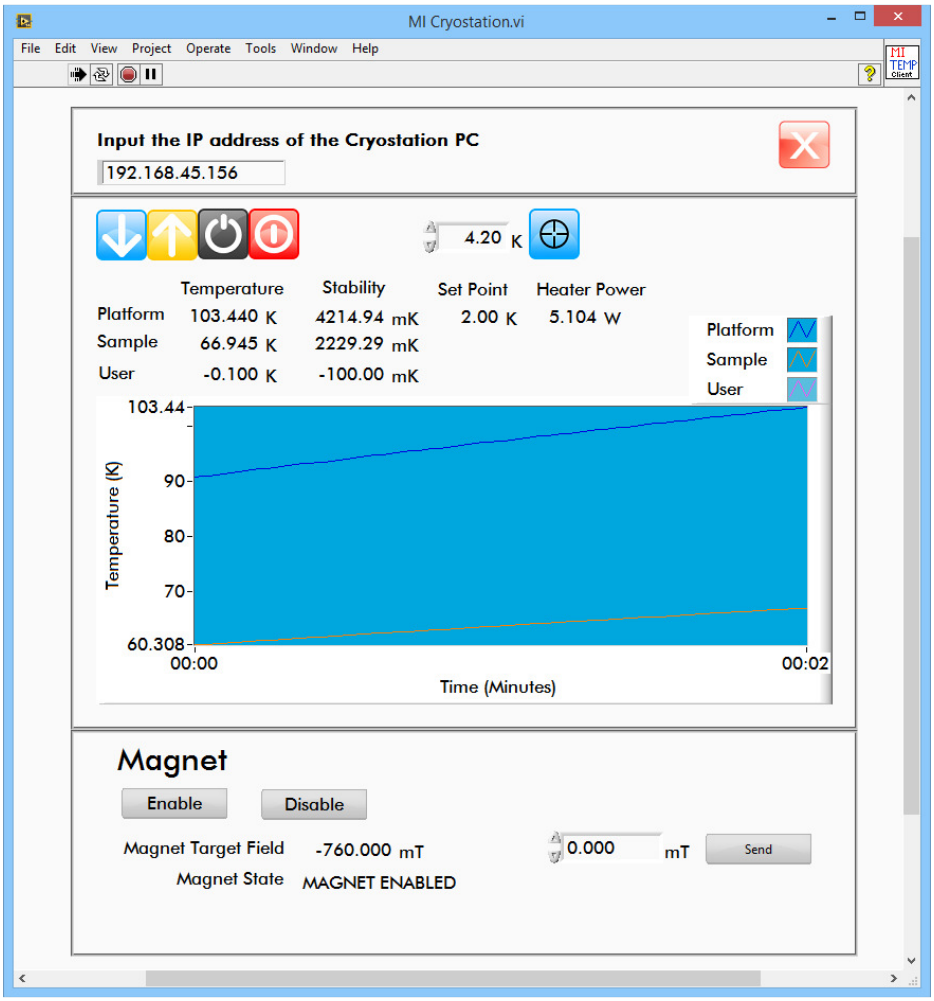
Example:

```
szCmd = "STSP4.2";
```

# Using the Cryostation with LabVIEW

There are two ways to communicate with the Cryostation from LabVIEW:

1. Communicate directly to the Cryostation via TCP/IP
2. Import the dll and use the functions similarly as a .net program as outlined above




Example LabVIEW VI

*NOTE: After enabling the remote control button on the Cryostation, the Cryostation acts as a server and waits for clients to connect to it. It is the client's responsibility to connect, maintain a connection, and correctly handle communication errors as well as being disconnected. If a client loses connection, it must re-connect to the Cryostation (the Cryostation will auto reset as necessary and will be available immediately after a client disconnect.*