1. Appendix K – External Control

1.1 *Overview*

The External Control Interface enables external applications to communication with the Medoc Main Station software. The interface enables the user to automate the process of program selection and test initiation, timing of trial onset, emulate patient response and more. In combination with analog output option, the interface can be used to implement complex decision-making protocols.

Communication between Medoc Main Station and the external application can be established using either parallel communication or TCP socket communication. The interface can be used with any experiment control program or research application that supports any of the above communication protocols.

1.2 *Use Examples -Open Control Mode*

the external application communicates with the Medoc Main Station computer and sends commands to select and start specific programs, start or stop the test, or emulate the subject's response by sending 'Yes' or 'No' commands.

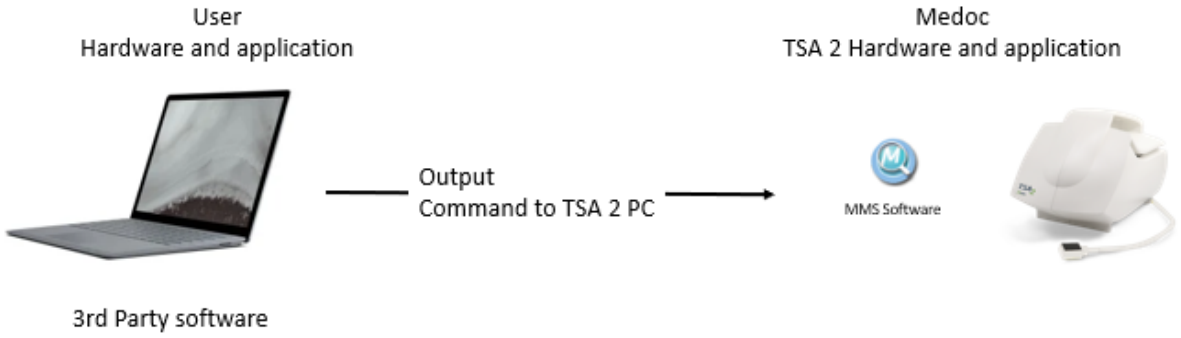

Figure 1: External Control Interface Open Control Loop Example

1.2.1 Typical Workflow

The diagram below illustrates a typical workflow, using the Closed Control mode. Medoc Main Station receives commands (TCP socket communication) which determine which test program to use. The external application decides which test program to send based on input it receives from the TSA II (analog output) or other sources such as EEG or MRI systems.

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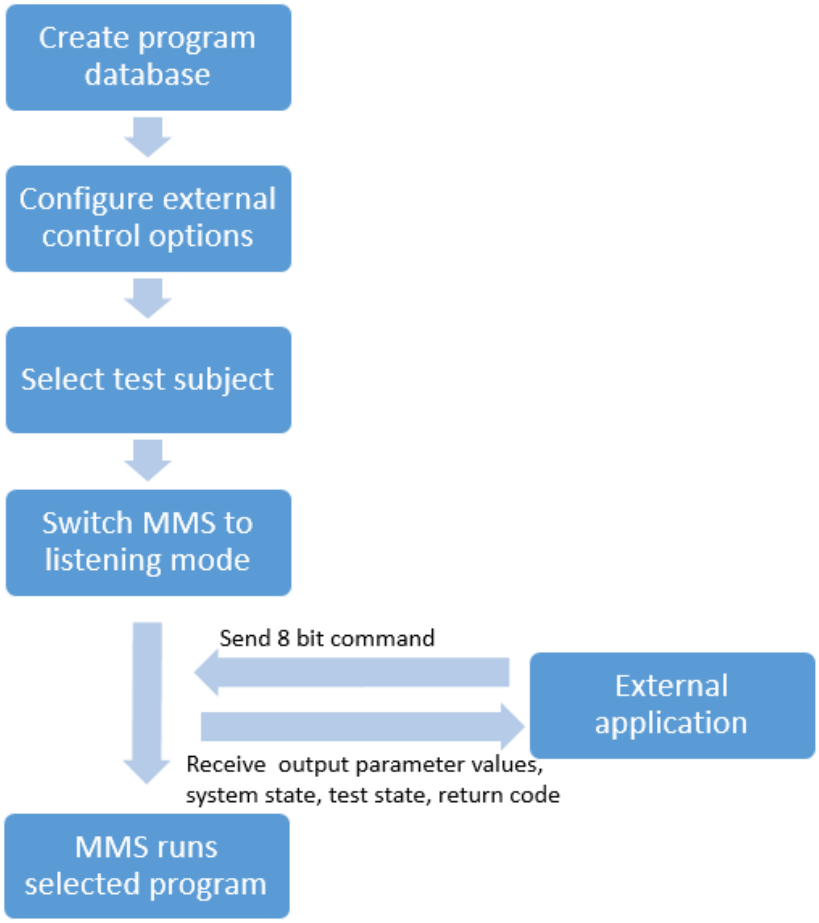


Figure 2: External Control Workflow Example

1.3 *Network Communication (TCP Sockets)*

Network communication is based on inter-application communication using TCP socket connection. The external application can be running from the same computer as Medoc Main Station or it can be installed on a second computer.

1.3.1 System Requirements

1. Computers must have an IP address (even when using one computer for Medoc Main Station and external controlling application).
2. A local network must exist between both computers.
3. Communication port must be open to data transmitting and receiving on both sides (check firewall settings).
4. Medoc Main Station license must include the External Control Interface. For additional information please contact your local distributor.

1.3.2 TCP Socket Interface Overview

Communication between MMS and the Controlling application is achieved using a TCP Socket. MMS acts as the server-side program and establishes a socket connection on specific port on the computer it is running on (host). The controlling application acts as the client-side program and

establishes a connection to the server program (MMS) on the particular host and port number. The host address and port number can be configured in Medoc Main Station.

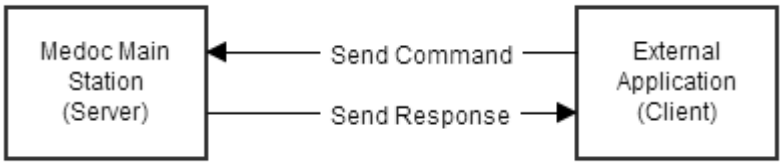


Figure 3: Server Client Relationship

All communications are initiated by client application and consist of two stages:

1. Client application sends command
2. Server application (MMS) sends response after performing the required action

In order to control command order, the commands contain the current time stamp and corresponding response will contain the same time stamp.

For a detailed description of the command and response structure please refer to the documentation provided with the External Control License.

1.4 *External Control Configuration*

To access the External Control configuration menu: from the top menu bar, select **Settings** and then **External Control**.

1.4.1 Setting Communication Method

The IP address of the Medoc Main Station computer will be displayed as well as the default Port number. The port number can be changed.

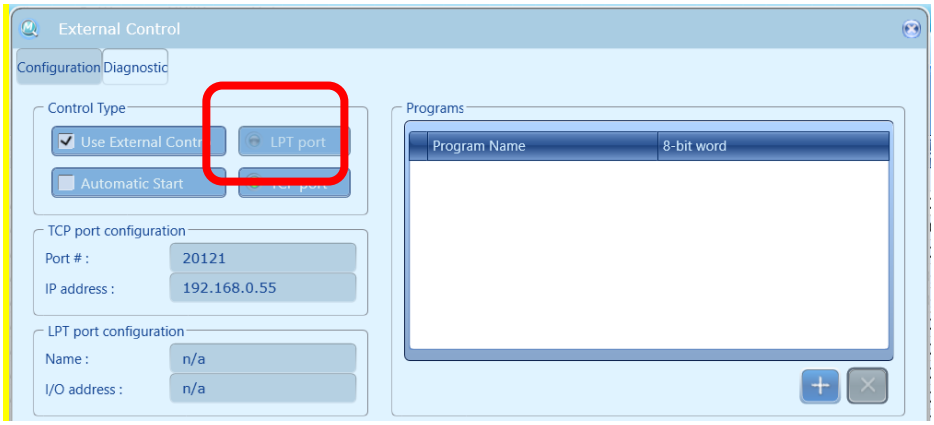


Figure 4: External Control – Select Communication Method

1.4.2 Program Setup

In order to use the external control to select a program, the program must be added to the remote program list and assigned an 8-bit word.
To add programs to the program list:

1. Click on the add program button  to add a new row
2. Click the new row on the Program Name column to show the list of available programs and select a program from the list
3. Enter an 8-bit word
4. Click Apply to save and apply the changes

To remove a program, select the row in the table and click the remove button 
The program setup can also be exported and saved as backup.

1.4.3 Activating the External Control

To Activate the External Control, enable the '**Use External Control**' option. When External Control is enabled it will be the default operating mode. To return to normal operating mode, disable the '**Use External Control**' option.

Automatic Start

When the '**Automatic Start**' option is enabled, the test will start automatically after the program is selected. When it is disabled, the program will be selected and the test screen will be displayed. In order to start the test, the 'Start' command must be sent.

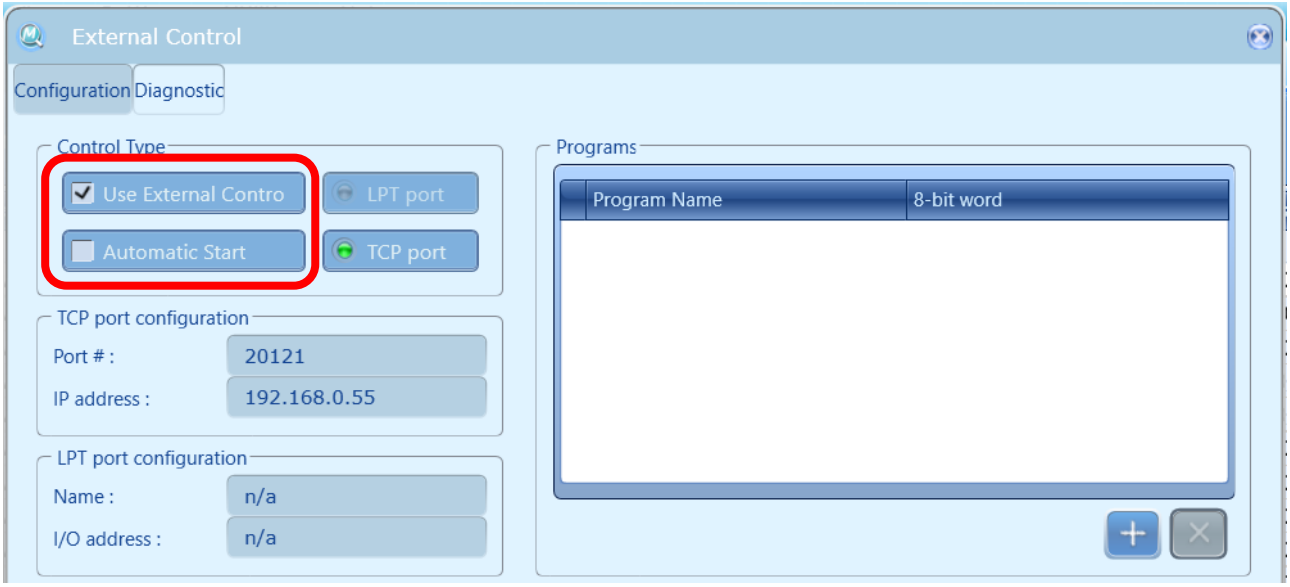


Figure 5: Activating External Control

1.4.4 Common Test Operations

The following common test operations can be performed during a test by sending the equivalent command (ActionCode). Note that the 8-bit words used for these actions are reserved and cannot be assigned to programs.

Table 1: Input - 8bit ActionCodes

Action	Description	8-bit Word	Command Id
Start	Equivalent to the following action button in Test screen: Start Pre-test / Test	00000010	2

Action	Description	8-bit Word	Command Id
Pause	Equivalent to the **Pause** button in **Test** screen	00000011	3
Trigger	Equivalent to the Manual Trigger button.	00000100	4
Stop	Equivalent to the **Stop** button **Test** screen	00000101	5
Abort	The Abort action is used to stop a test without finalizing time, and switch back to Listening Mode.	00000110	6
YES	Equivalent to Response Unit's Yes button.	00000111	7
NO	Equivalent to Response Unit's NO button.	00001000	8
CoVAS	Equivalent to CoVAS (computerized VAS)	00001001	9
VAS	Enter a numerical pain rating	00001010	10
Next Sequence	Specify which sequence to execute next	00001011	11
Increase Temperature	Increase temperature of next trial (works only with VAS Search program)	00001100	12
Decrease Temperature	Decrease temperature of next trial (works only with VAS search program)	00001101	13

Table 2: Output parameter format

Type	Name	Length (bytes)
uint	Timestamp	4
byte	Command	1
byte	SystemState	1
byte	TestState	1
ushort	ReturnCode	2
uint	TestTime	4
short	Temperature	2
byte	CoVAS	1
byte	Yes	1
byte	No	1
byte	TTL	1
text	Message	ResponseLength - 19

Table 3: Output SystemState code values

SystemState	
0	IDLE
1	READY
2	TEST

Table 4: Output TestState code values

TestState	
0	IDLE
1	RUNNING
2	PAUSED
3	READY

Table 5: Output ReturnCode values

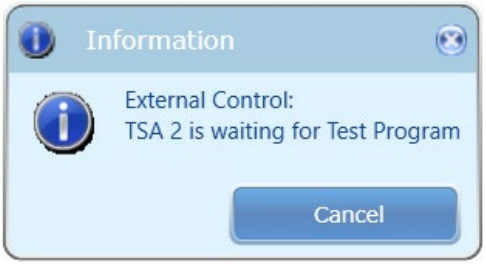
ReturnCode	
0x0000	OK
0x0001	ILLEGAL_ARG
0x0002	ILEGAL_STATE
0x0003	ILEGAL_TEST_STATE
0x1000	DEVICE_COMM_ERROR
0x3000	WAITING_MANUAL_OPERATION
0x2000	SAFETY_WARNING
0x4000	SAFETY_ERROR

1.4.5 The External Control Workflow

When the External Control is enabled, the procedure for starting a test will be as following:

1. Select a Patient from the Patient List (required) and a Body site (Optional)

2. Click the Go to Test Button. Medoc Main Station will now be in 'Listening Mode' and wait for the 8-bit word or command to select a program (see



3. Figure 139).
4. Send the 8-bit word or command from the external application
5. Medoc Main Station will select the program according to the command received and go into Test Mode.
6. If the 'Automatic Start' is enabled, the test will start automatically. Otherwise Medoc Main Station will wait for 'Start' command to be received.
7. During the test Medoc Main Station will remain in 'Listening Mode' and respond to commands such as: 'Yes', 'No' and 'Pause'.
8. At the end of the test, the results will be saved automatically and Medoc Main Station will return to the Program selection screen and wait for the next program command.

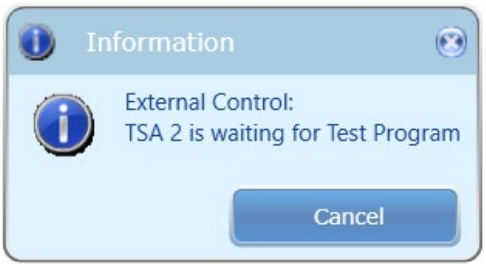


Figure 6: Listening Mode

1.4.6 Safe Mode

Medoc Main Station will not receive commands from the external application (except for 'Get Status' command in TCP communication) if for any reason TSA system is in Safe Mode. If TSA system is in safe mode, the Operator must use Medoc Main Station software directly to resolve the problem and run a system Self-Test before External Control can be resumed.