UM2585

User manual

STSW-L9788 GUI software

Introduction

STSW-L9788 is a software, based on LabVIEW™ runtime, with a graphical user interface (GUI) that initialize, configure and control the EVAL-L9788 board through the Micro Second Channel (MSC) bus protocol.

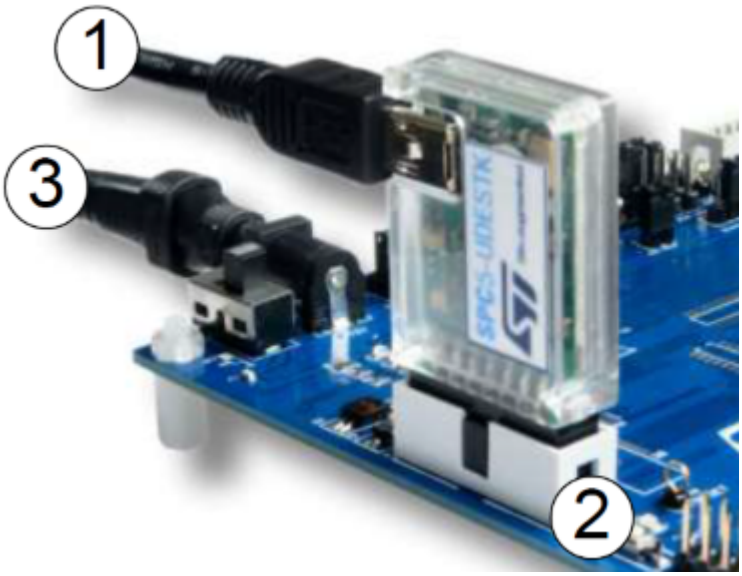
Commands and register configurations can be executed singularly or, grouped in a script, as a continuous loop. Scripts, GUI setting and communication history can be saved for later reuse. The GUI works together with an hardware node composed by a microcontroller board plugged with the EVAL-L9788 board. The whole system is designed to evaluate the L9788, a multifunction IC for automotive engine management.

1 Microcontroller board preparation

1.1 SPC5-UDESTK adapter

To program the firmware of the microcontroller board a PLS USB/JTAG Adapter for SPC5xxx is needed.

Figure 1. SPC5-UDESTK connected to JTAG connector



1. USB connection with PC/laptop
2. JTAG connector
3. Power supply

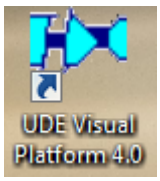
Together with the adapter, you need to download and install the standalone software environment SPC-UDESTK (UDE) starter-kit version at http://www.pls-ms.com/spc5-udestk. The software can also be used as SPC5-STUDIO plug-in.

1.2 SPC563M-DISP board programming

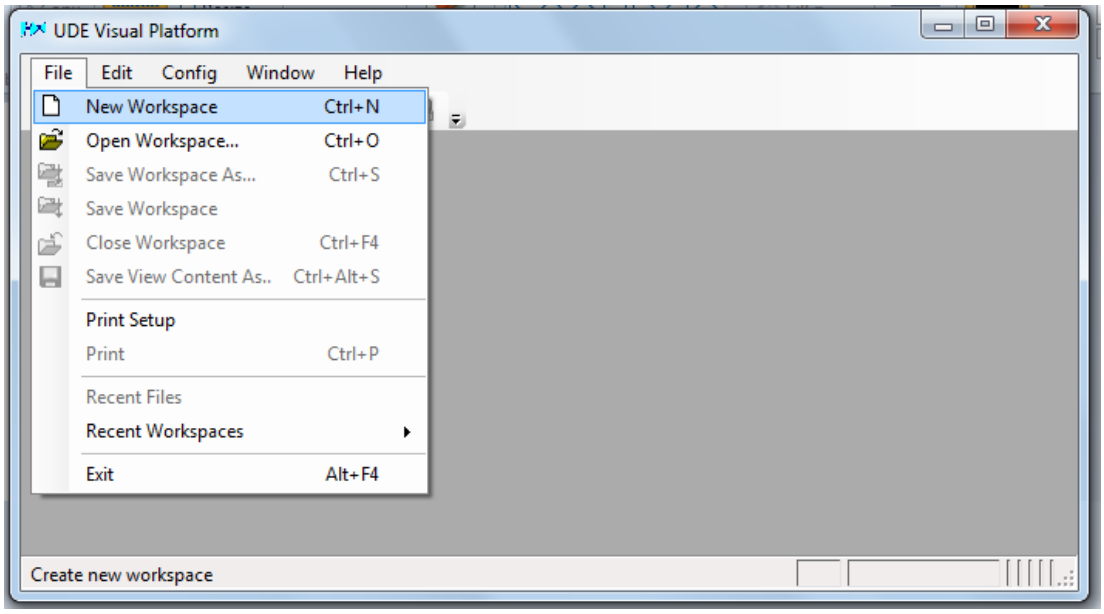
To use the STSW-L9788 GUI, the microcontroller board SPC563M-DISP must be programmed with a dedicated firmware (STSW-L9788.elf). This is the procedure to program the SPC563M-DISP using the ST tool-chain based on SPC5-UDEDEBG.

Make sure that EVAL-L9788 is not connected to the microcontroller board.

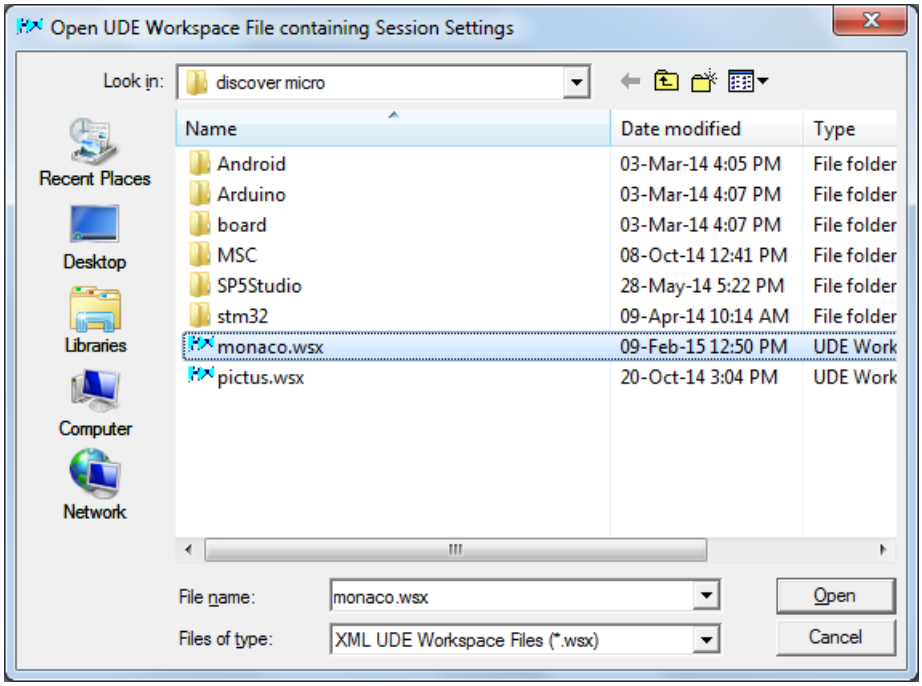
Step 1. Start UDE Visual Platform 4.0



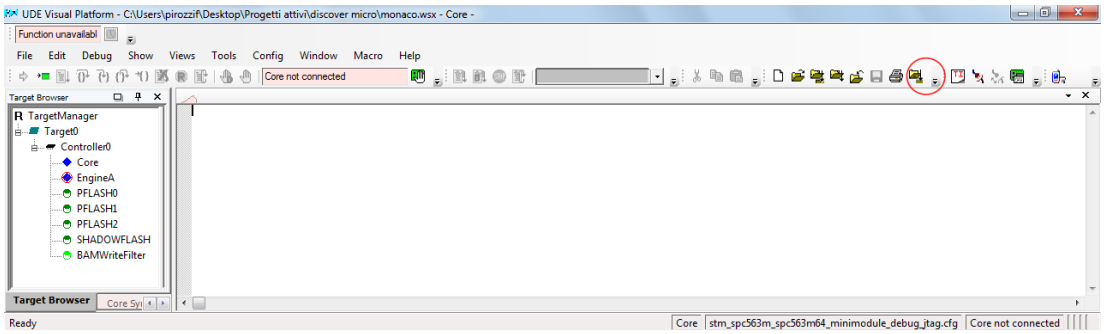
Step 2. If not yet done, create a New Workspace for SPC56M. Click [**File > New Workspace**]



Step 3. Name the new Workspace i.e. "monaco" and select [**Open**]

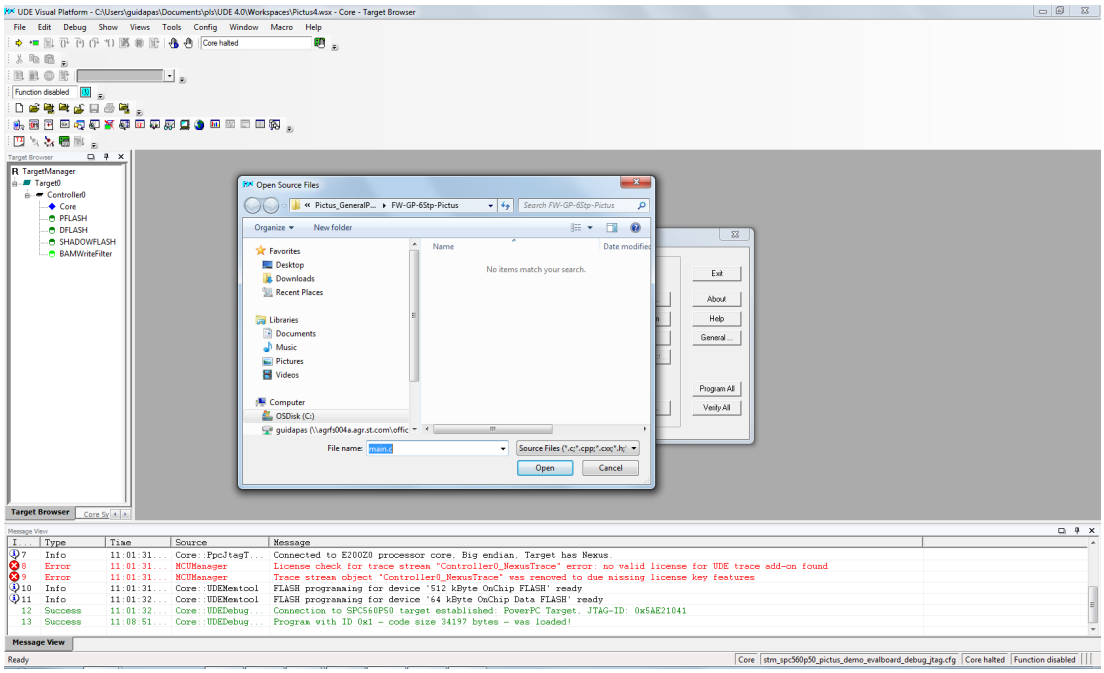


Step 4. Click "Load Program" icon or [**File > Load Program**]

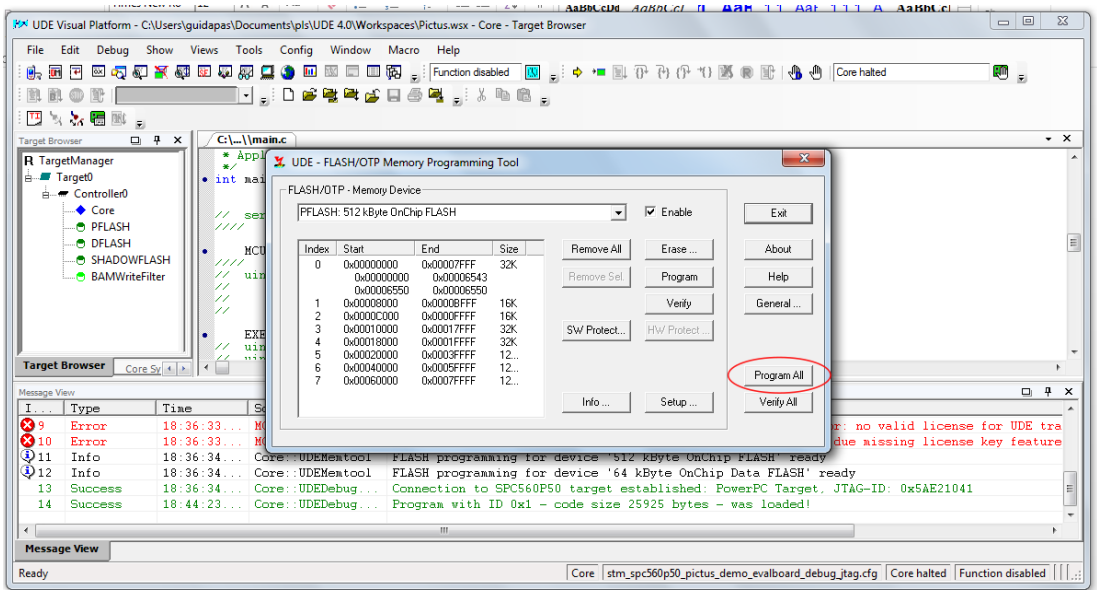


Step 5. Browse to the location of the file “STSW-L9788.elf “and click [**Open**]

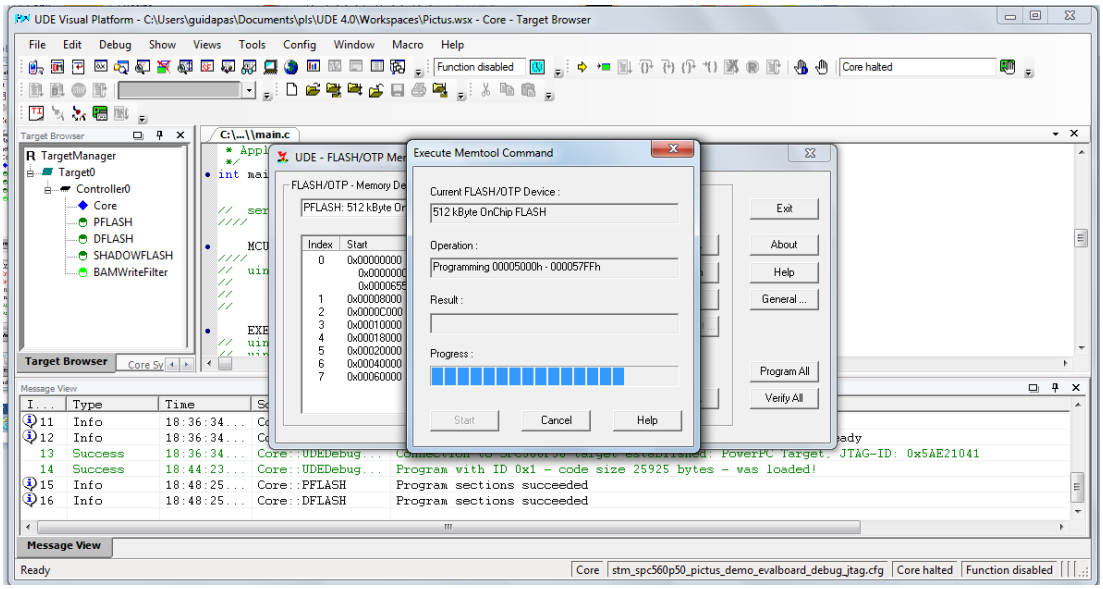
Step 6. In the next windows click [**Cancel**]



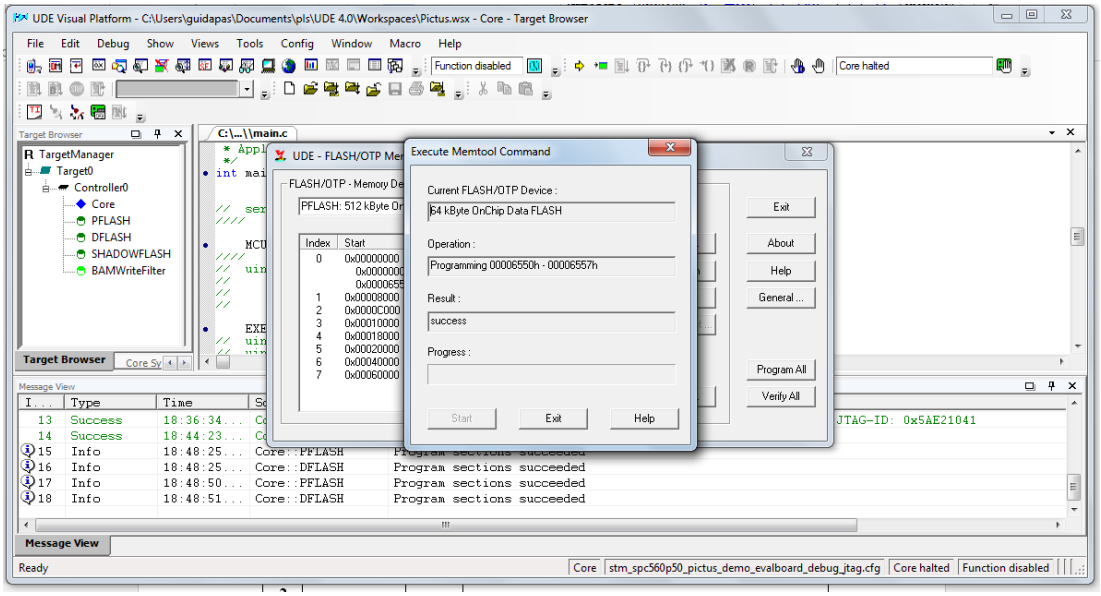
Step 7. Click [**Program All**] to start programming the firmware



The UDE Visual Platform 4.0. will start to flash the firmware



Step 8. When the procedure is terminated click **[Exit]** on all windows



Step 9. Close UDE Visual Platform 4.0.

Step 9a. Power down the microcontroller board;

Step 9b. If connected, remove the SPC5-UDESTK;

Step 9c. Connect the EVAL-L9788 to the microcontroller board using the 4x36 connector

Step 9d. Power up the microcontroller board

The SPC56M-Discovery is ready to be used with the Graphical User Interface (GUI) for EVAL-L9788

Step 10. Connect the eSCI-B port of microcontroller board to PC COM port with a RS232 cable. In case your PC doesn't have the COM port an USB to RS232 adapter is needed. For the correct installation please refer to the documentation of the adapter.

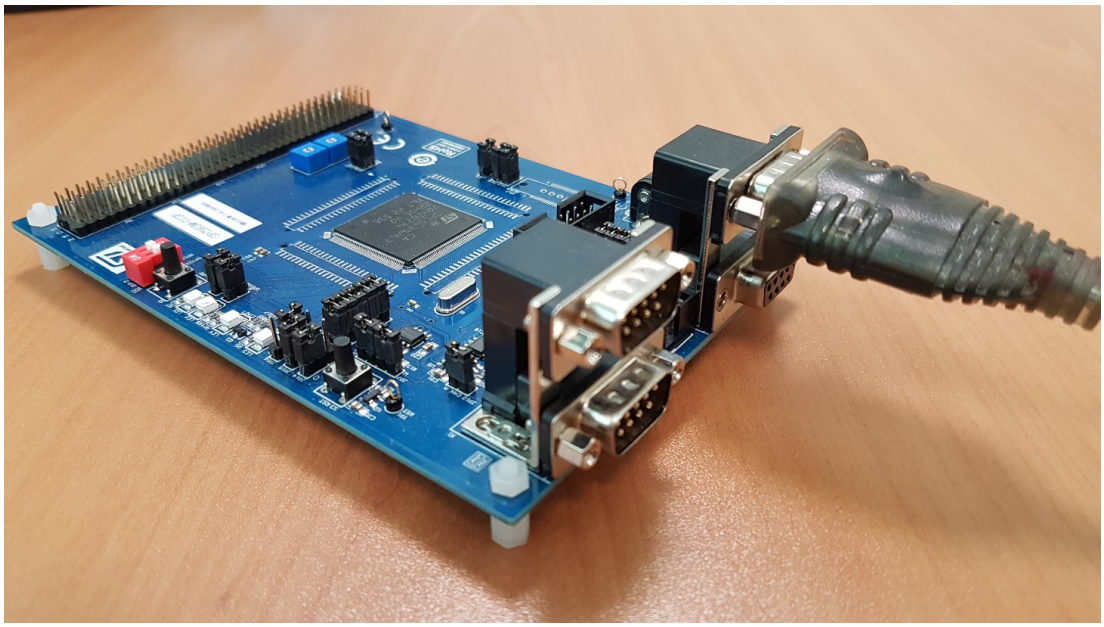
2 Hardware connection

To operate the EVAL-L9788 board it must be connected to a microcontroller board (SPC563M-DISP).

Step 1. Connect the EVAL-L9788 board (not shown in picture below) to the SPC563M-DISP microcontroller board using the 4x36 connector;

Step 2. Connect the eSCI-B (top female DB9 connector) of microcontroller board to a serial port of the PC or to USB to Serial adapter in case the PC doesn't have a serial port.

Figure 2. SPC563M-DISP eSCI-B COM port connection



3 STSW-L9788 software package

The software to evaluate EVAL-L9788 is distributed in a package that contains:

- STSW-L9788.exe: executable file of GUI.
- STSW-L9788.elf: firmware need to be flashed to SPC563M-DISP.
- STSW-L9788.ini: support file.

Download and install the National Instruments runtime engine and VISA driver:

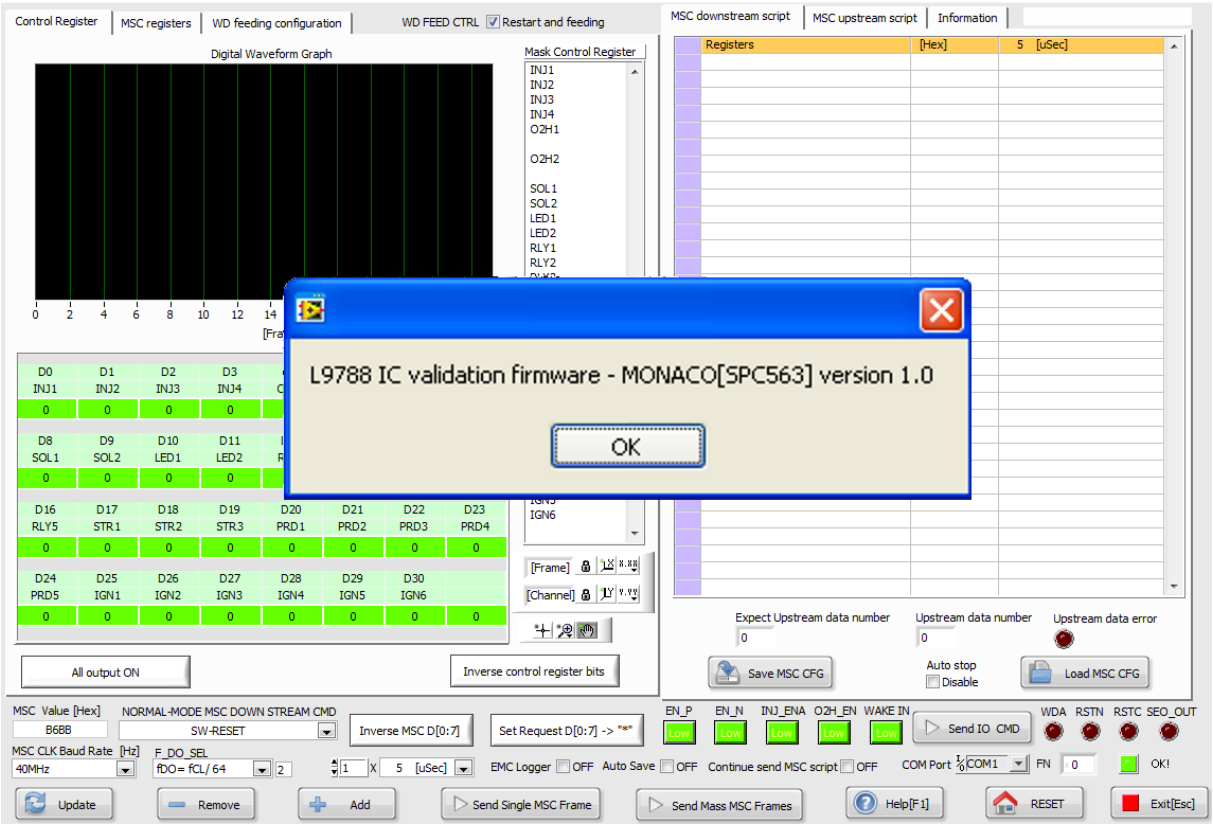
- Runtime engine LVRTE2013std.exe (see http://www.ni.com or search for "labview-run-time-engine-2013")
- VISA driver visa540_runtime.exe (see http://www.ni.com or search for "ni-visa-runtime-engine-5.4")

Run the software executing STSW-L9788.exe.

4 GUI description

After setup finished, check whether all the hardware connections are correct, and then power on microcontroller board, run GUI from start menu.

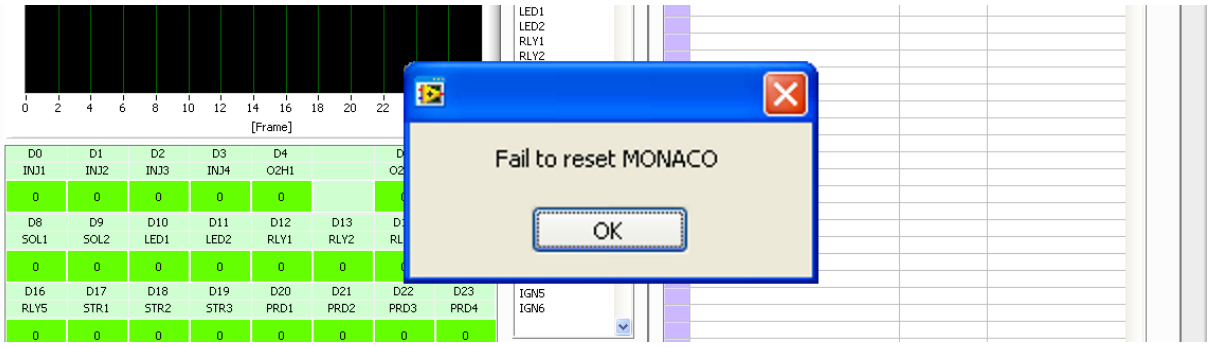
Figure 3. GUI at startup



And then the firmware version dialog will appear.

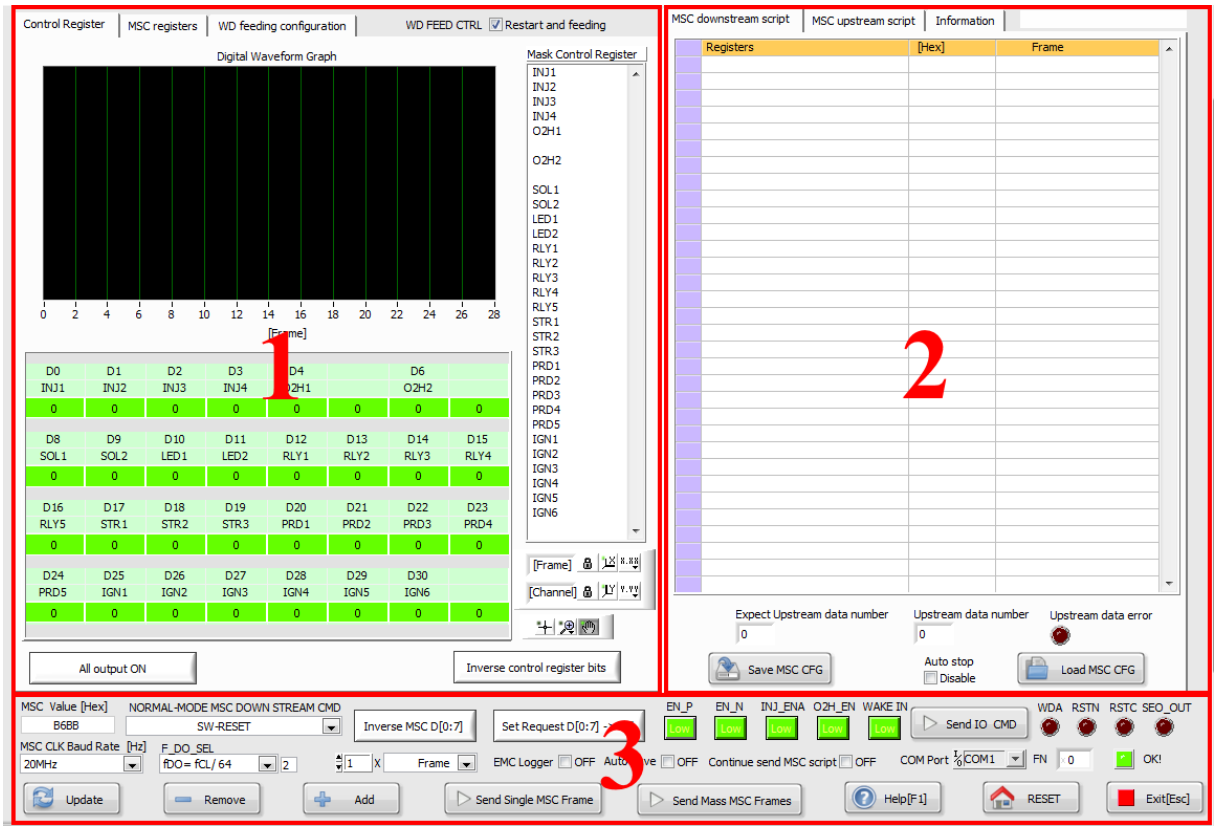
If “FAIL” information appears, please check the UART connection and COM PORT configuration.

Figure 4. Failing communication with microcontroller



There are 3 areas in the GUI:

Figure 5. STSW-L9788 GUI main window



1. MSC control register, MSC registers configuration and variable WD timing / error WD frame injection / absent WD feeding configuration;
2. Script editor, upstream information and command recorder;
3. Global configuration and I/O control.

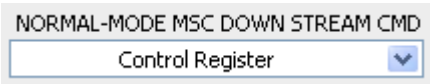
4.1 MSC control/function registers configuration and WD timing/error/no feeding

There are 3 tabs/pages in this area which support:

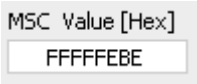
- MSC control registers (data frame) and digital waveform graph
- Function registers, EMC test with request bits and target bits
- Variable WD timing / error WD frame injection / absent WD feeding

4.1.1 MSC control registers and digital waveform graph

Register can be selected from the [**NORMAL-MODE MSC DOWN STREAM CMD**] drop-down list

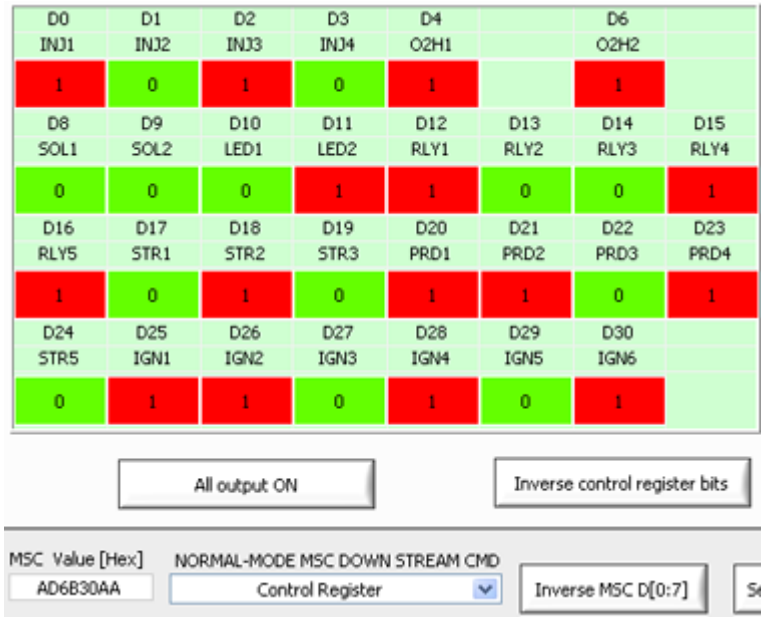


or by directly changing the value of control bits [D30:0] (except the D5, D7).

The MSC value 

shows the MSC data frame of the control register.

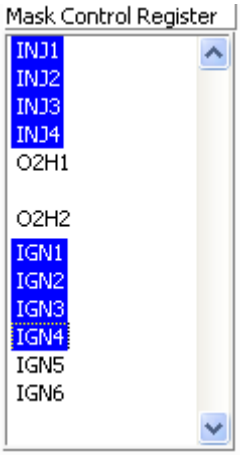
Figure 6. Control register bits status



User can edit (add, remove, update) mass control registers in script, and send to L9788 with different output control timing.

For example: edit 4-cylinder EMS injector / ignition signals, please see below for the detailed procedure:

1. Change the unit to 50 [uSec] instead of Frame
2. input the multiple value = 20 20 X 50 [uSec] that means the dwell time is 20 * 50 µs = 1000 µs
3. clicks the INJ1, INJ2, INJ3, INJ4, IGN1, IGN2, IGN3, IGN4 with the “Ctrl” key pressed in keyboard to select the signals to be displayed on digital graph.



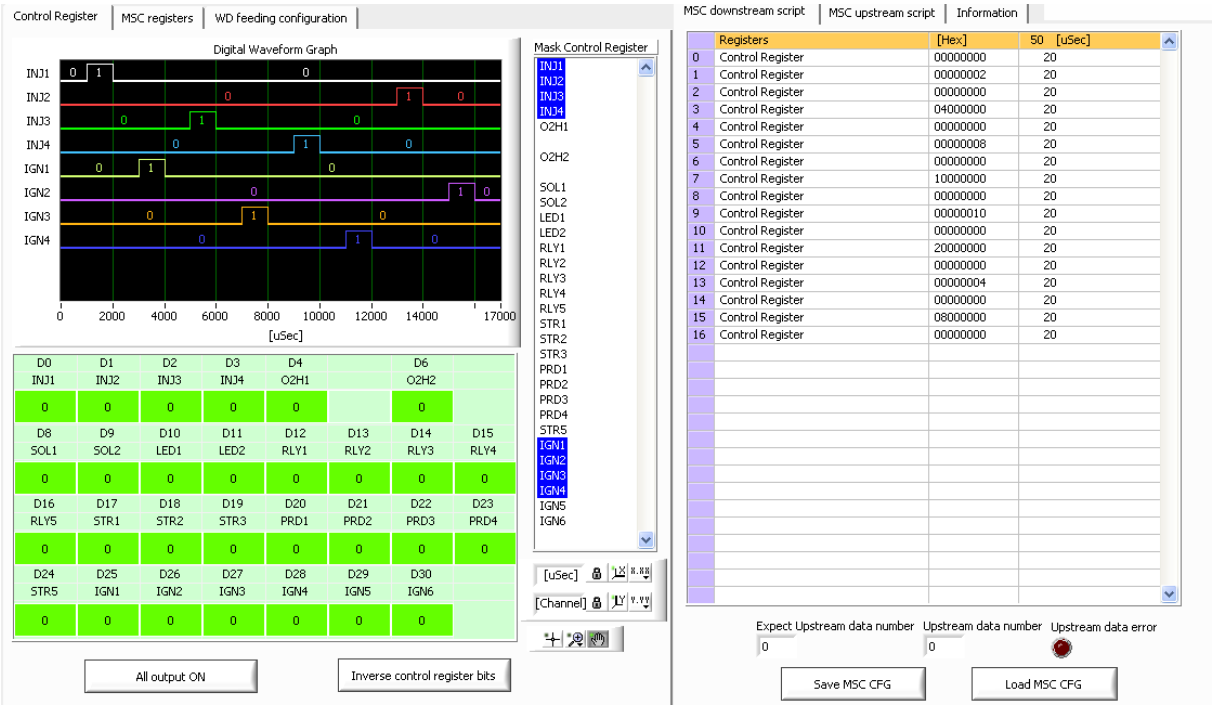
4. Turn [**ON**] the INJ1 and add to the script.

5. Turn [**OFF**] the INJ1 and add to the script.
6. Turn [**ON**] the IGN1 and add to the script.
7. Turn [**OFF**] the IGN1 and add to the script.

8. Turn [**ON**] the INJ3 and add to the script.
9. Turn [**OFF**] the INJ3 and add to the script.
10. Turn [**ON**] the IGN3 and add to the script.
11. Turn [**OFF**] the IGN3 and add to the script.
12. Turn [**ON**] the INJ4 and add to the script.
13. Turn [**OFF**] the INJ4 and add to the script.
14. Turn [**ON**] the IGN4 and add to the script.
15. Turn [**OFF**] the IGN4 and add to the script.
16. Turn [**ON**] the INJ2 and add to the script.
17. Turn [**OFF**] the INJ2 and add to the script.
18. Turn [**ON**] the IGN2 and add to the script.
19. Turn [**OFF**] the IGN2 and add to the script.

The following digital chart and script is generated:

Figure 7. Script listing



And then the 4 stroke engine injection and ignition control signals generated @ 6250 RPM while the dwell time is 1mSec for example. User can change the multiply factor (max. 255) and unit (max.100us) for different timing or insert the MSC diagnostic command anywhere in the script.

*Note: user can select the [**Update**], [**Remove**] and [**Add**] button to modify the script for different output timing:*

Button [**All output ON**] set all the control register to "1"

Figure 8. Control register status after [All output ON]

D0	D1	D2	D3	D4		D6	
INJ1	INJ2	INJ3	INJ4	O2H1		O2H2	
1	1	1	1	1		1	
D8	D9	D10	D11	D12	D13	D14	D15
SOL1	SOL2	LED1	LED2	RLY1	RLY2	RLY3	RLY4
1	1	1	1	1	1	1	1
D16	D17	D18	D19	D20	D21	D22	D23
RLY5	STR1	STR2	STR3	PRD1	PRD2	PRD3	PRD4
1	1	1	1	1	1	1	1
D24	D25	D26	D27	D28	D29	D30	
STR5	IGN1	IGN2	IGN3	IGN4	IGN5	IGN6	
1	1	1	1	1	1	1	

Use [**Inverse control register bits**]

to invert the bits of control register. is used

For example, original control bits in control register:

Figure 9. Starting bits register

D0	D1	D2	D3	D4		D6	
INJ1	INJ2	INJ3	INJ4	O2H1		O2H2	
1	0	1	0	1		1	
D8	D9	D10	D11	D12	D13	D14	D15
SOL1	SOL2	LED1	LED2	RLY1	RLY2	RLY3	RLY4
0	0	0	1	1	0	0	1
D16	D17	D18	D19	D20	D21	D22	D23
RLY5	STR1	STR2	STR3	PRD1	PRD2	PRD3	PRD4
1	0	1	0	1	1	0	1
D24	D25	D26	D27	D28	D29	D30	
STR5	IGN1	IGN2	IGN3	IGN4	IGN5	IGN6	
0	1	1	0	1	0	1	

The inverted control bits:

Figure 10. Inverted bits register

D0	D1	D2	D3	D4		D6	
INJ1	INJ2	INJ3	INJ4	O2H1		O2H2	
0	1	0	1	0		0	
D8	D9	D10	D11	D12	D13	D14	D15
SOL1	SOL2	LED1	LED2	RLY1	RLY2	RLY3	RLY4
1	1	1	0	0	1	1	0
D16	D17	D18	D19	D20	D21	D22	D23
RLY5	STR1	STR2	STR3	PRD1	PRD2	PRD3	PRD4
0	1	0	1	0	0	1	0
D24	D25	D26	D27	D28	D29	D30	
STR5	IGN1	IGN2	IGN3	IGN4	IGN5	IGN6	
1	0	0	1	0	1	0	

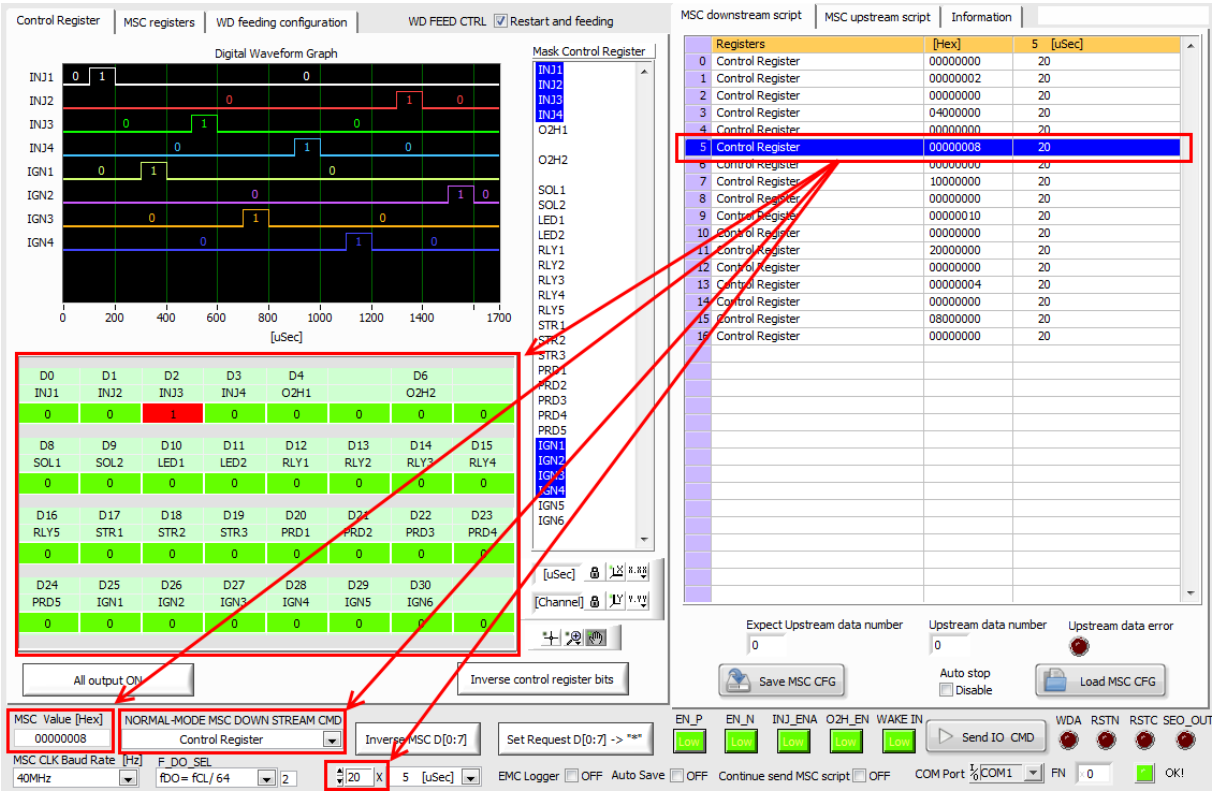
Note: the bit 5 and bit 7 in control register are ignored, for detailed information see datasheet.

Figure 11. Control register

D0	D1	D2	D3	D4	D5	D6	D7
LSD-INJ1	LSD-INJ2	LSD-INJ3	LSD-INJ4	LSD-O2H1		LSD-O2H2	
D8	D9	D10	D11	D12	D13	D14	D15
LSD-SOL1	LSD-SOL2	LSD-LED1	LSD-LED2	LSD-RLY1	LSD-RLY2	LSD-RLY3	LSD-RLY4
D16	D17	D18	D19	D20	D21	D22	D23
LSD-RLY5	LSD-HSD-STR1	LSD-HSD-STR2	LSD-HSD-STR3	FET-PRD1	FET-PRD2	FET-PRD3	FET-PRD4
D24	D25	D26	D27	D28	D29	D30	
FET-PRD5	IGN1	IGN2	IGN3	IGN4	IGN5	IGN6	

Select the control register in script, the corresponding information will be displayed in the page:

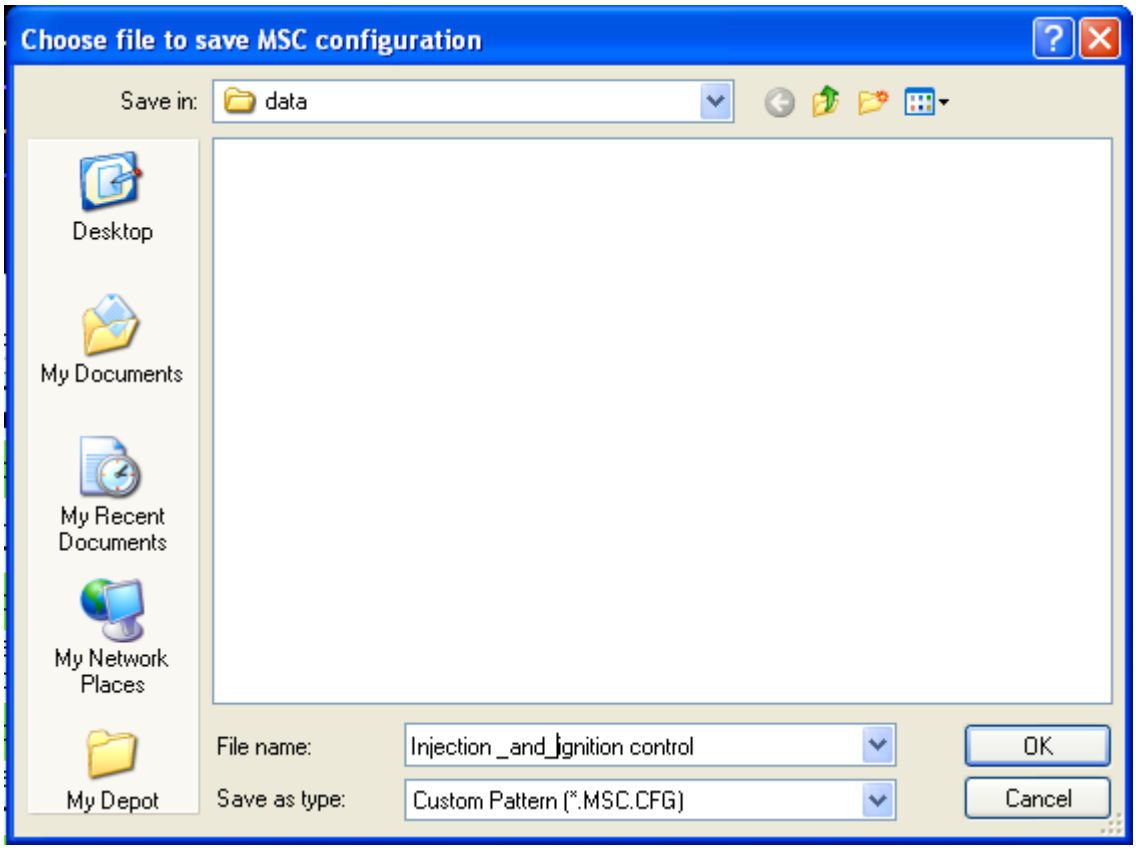
Figure 12. Selected register information



The corresponding control bits, MSC value, register name, multiple factor will be updated.

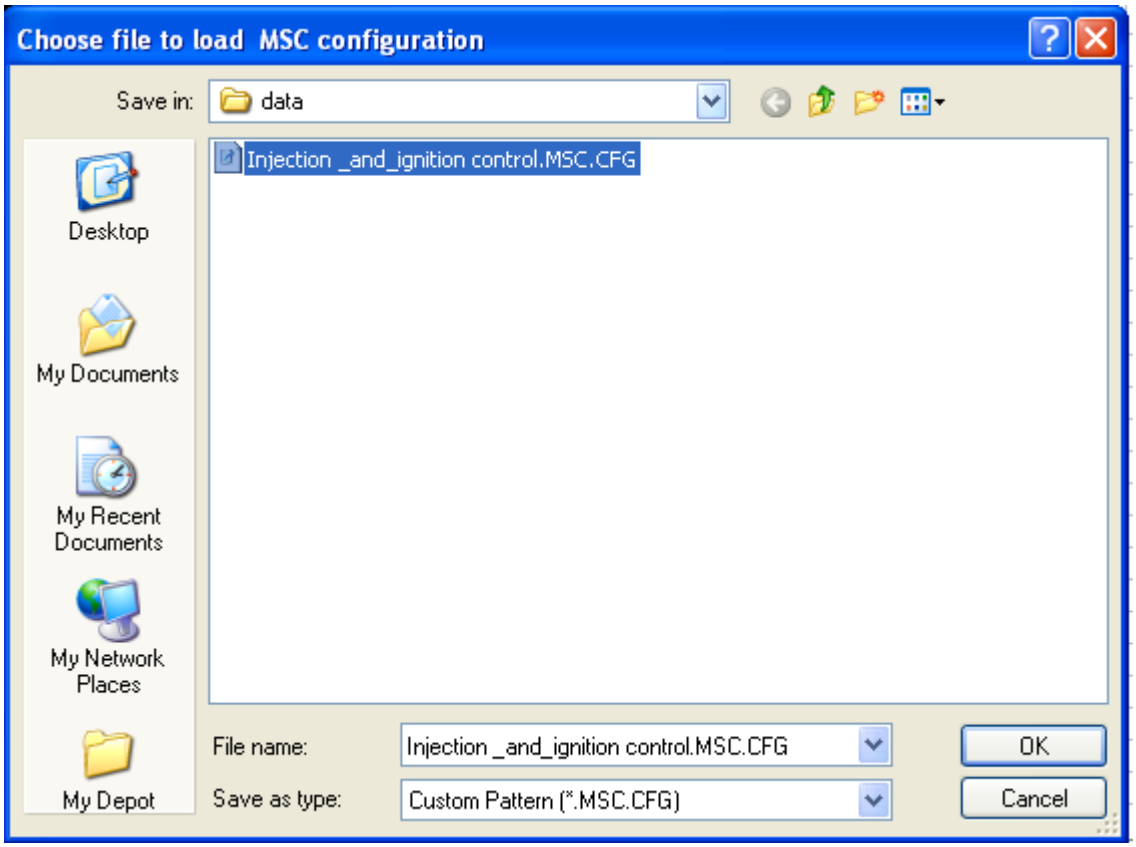
User can save the configuration to file with

Figure 13. **Save MSC configuration**



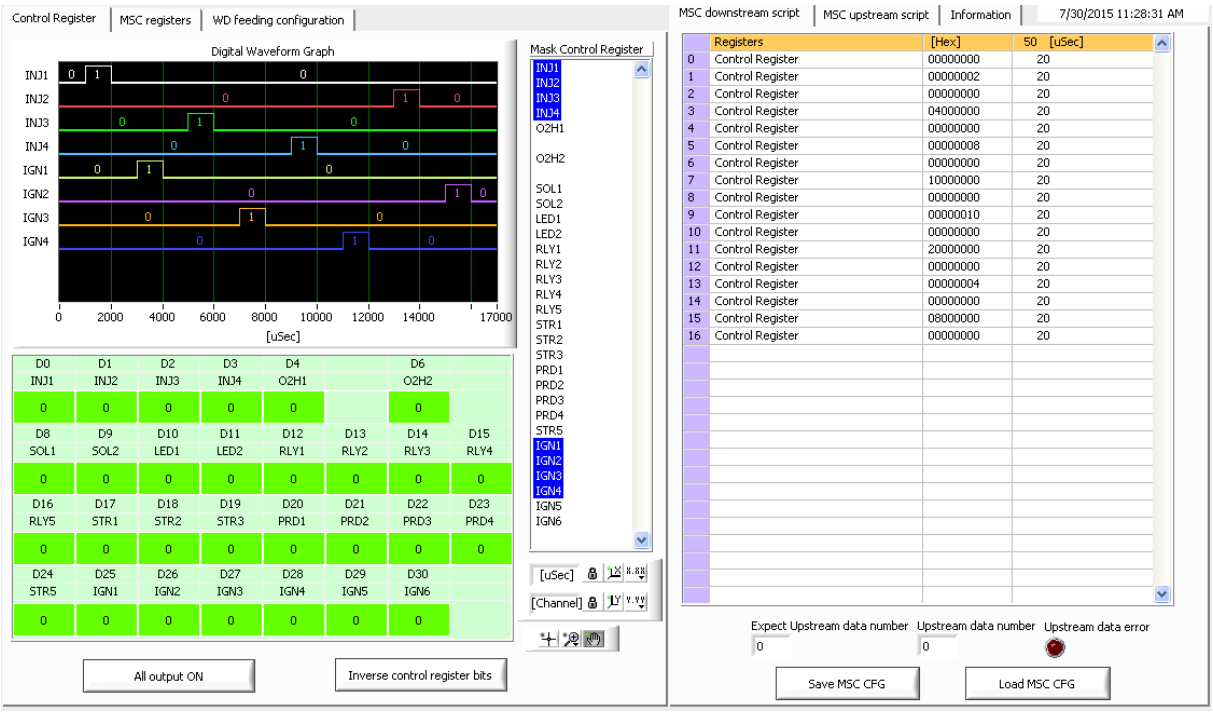
User can load the MSC configuration file with

Figure 14. Load MSC configuration



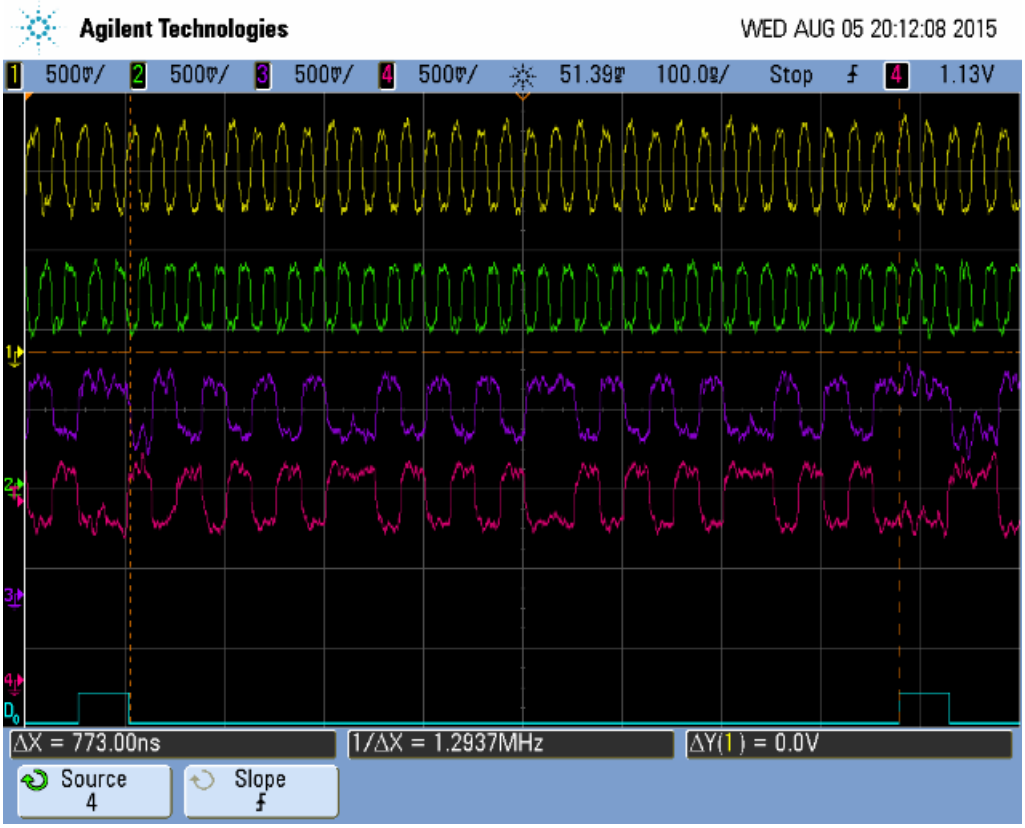
Below are data frames, digital waveform and Mask channels after MSC configuration file loaded:

Figure 15. Status of GUI after configuration load



Then the corresponding configuration information will be updated in the page.
The minimum transfer time of data frame / control registers:

Figure 16. Minimum data frame transfer time

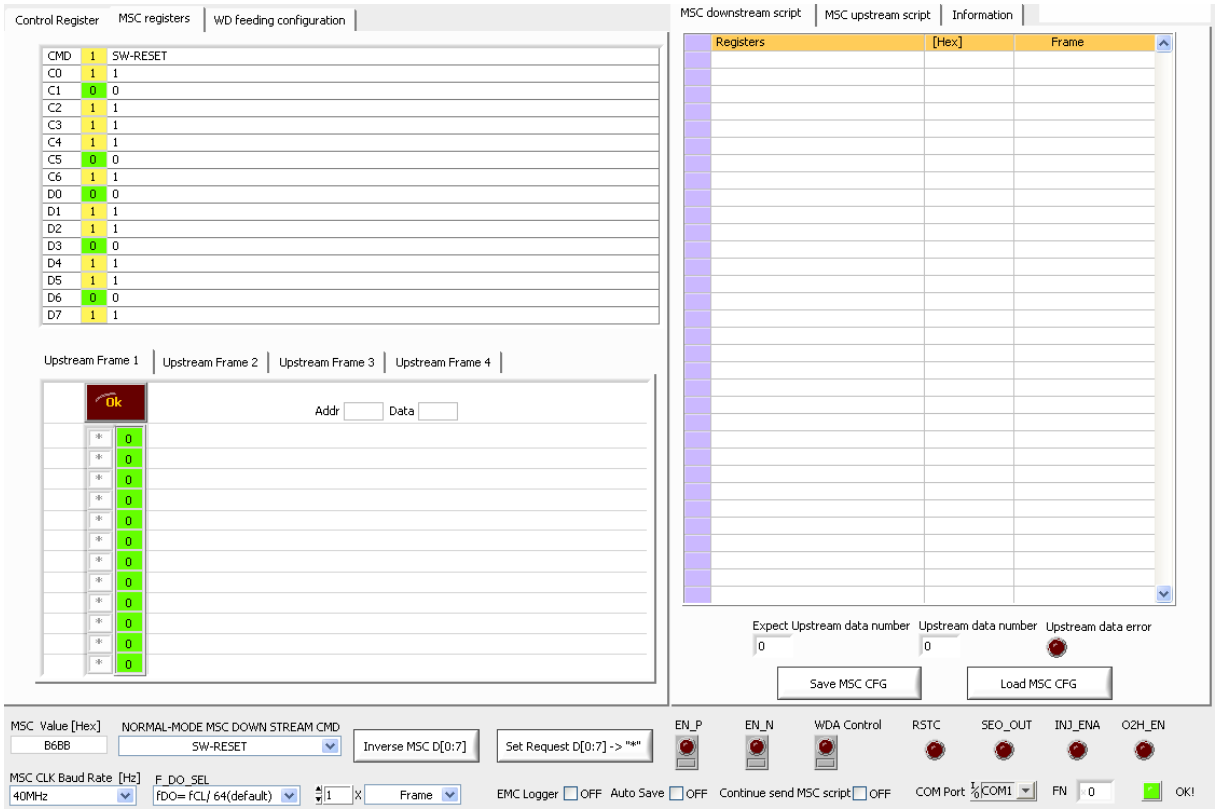


D0 --> MSC EN, the minimum transfer time of data frame is 773 µs @ 40 MHz MSC clock.

4.1.2 MSC function registers, EMC test configuration with request bits and target bits

The page includes MSC command/upstream registers, expected upstream data configuration.

Figure 17. MSC register page

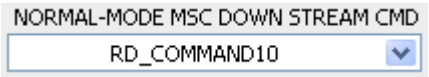


Content of a command frame (transmitted LSB first):

Table 1. MSC interface command frame

Bit	Description
0	= '1': command selection bit
1 - 7	Command. LSB first
8 - 15	Data for the command. LSB first

The MSC command frame including Read data 1~16, configuration registers and general commands, user can select the register from [**NORMAL-MODE MSC DOWN STREAM CMD**] drop-down list



When RD_COMMANDx is selected, the meaning of the corresponding downstream and upstream bits are displayed.

For example RD_COMMAND10 with the MSC value:

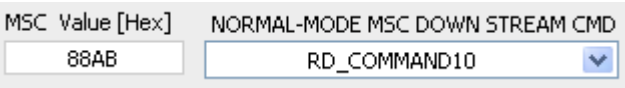


Figure 18. Bit map read command 10

CMD	1	RD_COMMAND10
C0	1	1
C1	0	0
C2	1	1
C3	0	0
C4	1	1
C5	0	0
C6	1	1
D0	0	0
D1	0	0
D2	0	0
D3	1	1
D4	0	0
D5	0	0
D6	0	0
D7	1	1

The upstream data are 4 bytes according to datasheet:

Figure 19. MSC interface upstream bit map fast read10

	ADDRESS				DATA							
	A0	A1	A2	A3	D0	D1	D2	D3	D4	D5	D6	D7
FRAME1	0	0	0	0	WDA REQULO							
					REQU[0:3]				ERR_CNT[0:2]			WDA_INT
FRAME2	0	0	1	0	WDA REQUHI							
					RESP_TOO_EARLY	NO_RESP	W_RESP	CHRT	RESP_Z0	RESP_ERR	RESP_CNT[0 :1]	
FRAME3	0	0	0	1	WDA PWR_RST_CNT							
					RST_CNT[0 :2]			PWR_CNT[0:2]				WDA_RST
FRAME4	0	0	1	1	WDA RESPTIME							
					RESPTIME[0:5]						WDA_WIN_SEL	WDA_INIT

See below the RD_DATA10 corresponding upstream bits:

Figure 20. Upstream frame 1

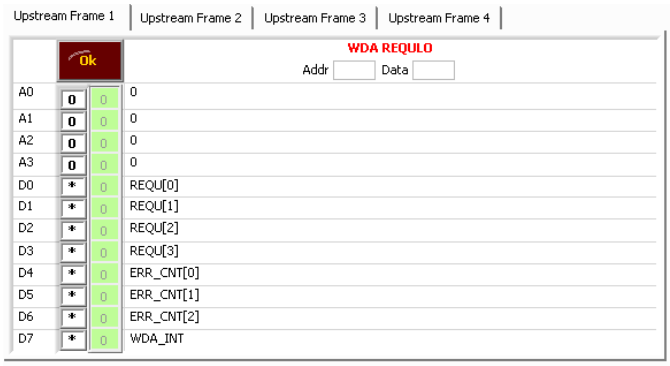


Figure 21. Upstream frame 2

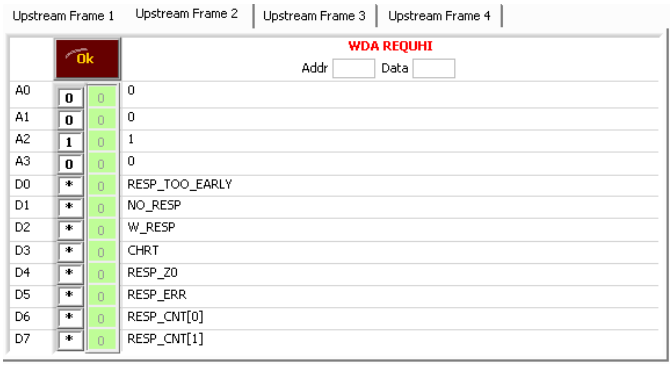


Figure 22. Upstream frame 3

Upstream Frame 1 | Upstream Frame 2 | Upstream Frame 3 | Upstream Frame 4

Ok — WDA PWR_RST_CNT — Addr Data

A0	0	0	0
A1	0	0	0
A2	0	0	0
A3	1	0	1
D0	*	0	RST_CNT[0]
D1	*	0	RST_CNT[1]
D2	*	0	RST_CNT[2]
D3	*	0	PWR_CNT[0]
D4	*	0	PWR_CNT[1]
D5	*	0	PWR_CNT[2]
D6	*	0	
D7	*	0	WDA_RST

Figure 23. Upstream frame 4

Upstream Frame 1 | Upstream Frame 2 | Upstream Frame 3 | Upstream Frame 4

Ok — WDA RESPTIME — Addr Data

A0	0	0	0
A1	0	0	0
A2	1	0	1
A3	1	0	1
D0	*	0	RESPTIME[0]
D1	*	0	RESPTIME[1]
D2	*	0	RESPTIME[2]
D3	*	0	RESPTIME[3]
D4	*	0	RESPTIME[4]
D5	*	0	RESPTIME[5]
D6	*	0	WDA_WIN_SEL
D7	*	0	WDA_INIT

The upstream data (address, data and bits) will be updated when the command send to L9788.

To configure registers, select the register from the [**NORMAL-MODE MSC DOWN STREAM CMD**] drop down list.

CONFIG-REG 1 configuration example:

MSC Value [Hex]	NORMAL-MODE MSC DOWN STREAM CMD
00F9	CONFIG-REG 1

User can configure any bits (address C0 - C6 and data D0 – D7) in the register:

CMD	1	CONFIG-REG 1
C0	0	0
C1	0	0
C2	1	1
C3	1	1
C4	1	1
C5	1	1
C6	1	1
D0	0	PHOLD_EN
D1	0	PHOLD_TIME[0]
D2	0	PHOLD_TIME[1]
D3	0	LED1_PD_EN
D4	0	LED2_PD_EN
D5	1	BOOST_EN
D6	0	WAKE_UP_TIMER_START_STOP[0]
D7	0	WAKE_UP_TIMER_START_STOP[1]

[5] BOOST_EN
Boost enable.
1: enabled (default)
0: disabled

Change upstream baud rate.

It is possible to change the baud-rate divider of the upstream frame selecting the appropriate value in the [**F_DO_SEL**] drop-down list F_DO_SEL fDO= fCL/ 64(default) and when the value changes, the expected upstream frame baud-rate will be changed, and the information will be added to MCU to re-configure the baud rate of eSCIA of MCU; since the MCU RXD have been reconfigured for the required upstream RX baud rate, the L9788 should be re-configured by script or by sending one frame with CONFIG-REG 2 to set the correct divider of DO.

Figure 24. Upstream baud-rate selection bits

CMD	1	CONFIG-REG 2
C0	0	0
C1	1	1
C2	1	1
C3	1	1
C4	1	1
C5	0	0
C6	1	1
D0	0	MSC_ACT_EN
D1	0	F_DO_SEL[0]
D2	0	F_DO_SEL[1]
D3	0	VRS_MODE_SEL
D4	0	IGN_CURRENT_CFG
D5	0	IGN_DIAG
D6	0	IPUPD_EN
D7	0	IPUPD_MODE

Figure 25. Config-reg 2 register bit map

CONFIG-REG 2	0	1	1	1	1	0	1	MSC_ACT_EN	F_DO_SEL[0:1]		VRS_MODE_SEL	IGN_CURRENT_CFG	IGN_DIAG	IPUPD_EN	IPUPD_MODE
RW	DEFAULT							1	1	0	0	0	0	0	1

Figure 26. Config-reg 2 default value

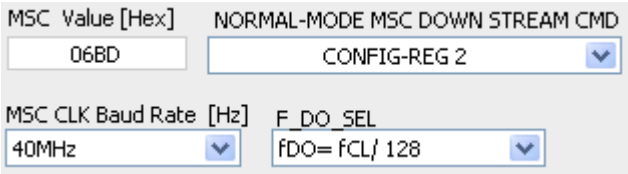
[2:1] F_DO_SEL [1:0] Upstream clock ratio selection.
00: fDO= fCL/ 16
01: fDO= fCL/ 32(default)
10: fDO= fCL/ 64
11: fDO= fCL/ 128

For example, baud rate is 625000 Hz @ MSC CLK = 40 MHz, the F_DO_SEL should set to 0x11b

Figure 27. Baud-rate selection

CMD	1	CONFIG-REG 2
C0	0	0
C1	1	1
C2	1	1
C3	1	1
C4	1	1
C5	0	0
C6	1	1
D0	0	MSC_ACT_EN
D1	1	F_DO_SEL[0]
D2	1	F_DO_SEL[1]
D3	0	VRS_MODE_SEL
D4	0	IGN_CURRENT_CFG
D5	0	IGN_DIAG
D6	0	IPUPD_EN
D7	0	IPUPD_MODE

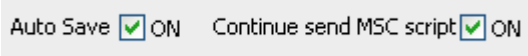
After configured, the MSC value is:



4.1.3 Upstream history data logger

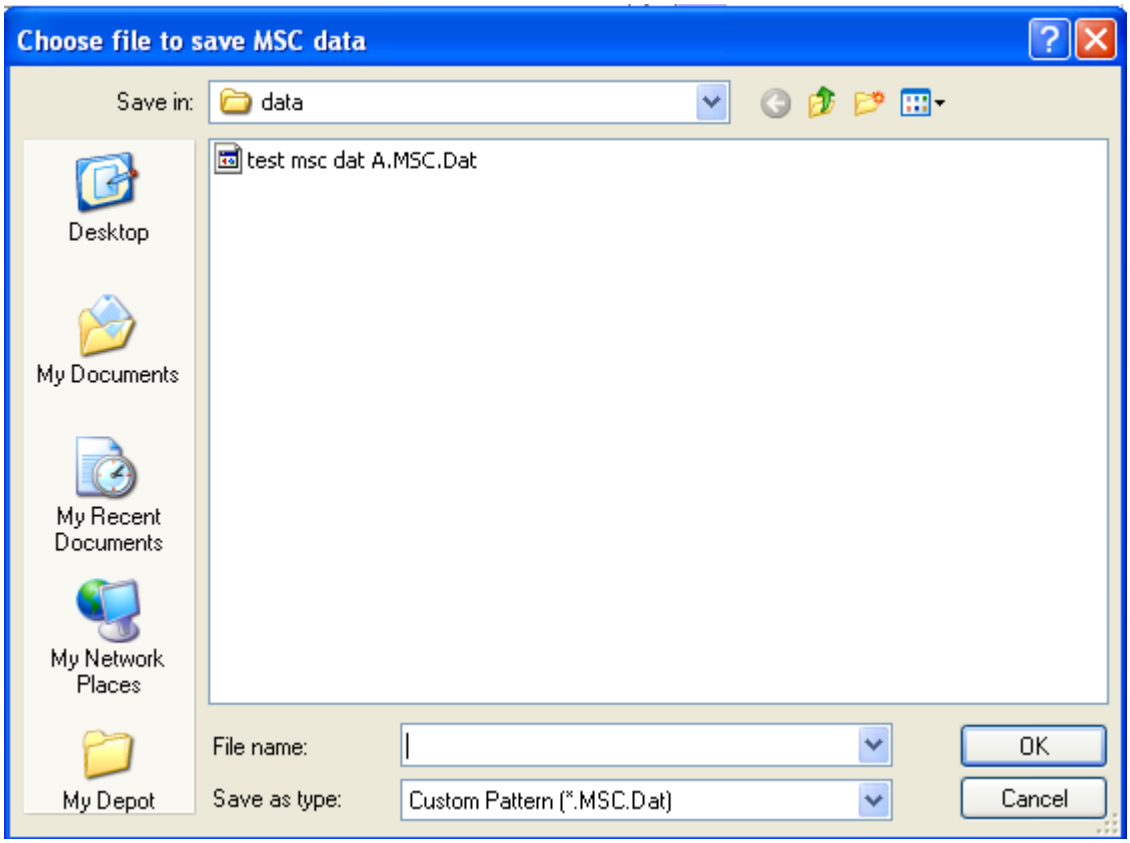
The upstream data can be saved to a file with auto save function, and can be reloaded to the upstream data indicator.

To save the upstream history data, enable [**auto save**] and [**continue send MSC script**]:



And then select the file name or type new one:

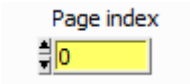
Figure 28. Save to file dialog

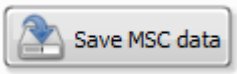


The upstream data will be saved automatically.

To reload the upstream history data use the [**Load MSC data**] button

When reloaded, the upstream data can be parsed by page selecting the page number in the [**Page Index**] control



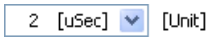
To extract only the current viewed page, use the [**Save MSC data**] button 

and select a new file name in the Choose file to save MSC data dialog.

4.2 Script, upstream information, command log area

4.2.1 Create a script with interframe delay

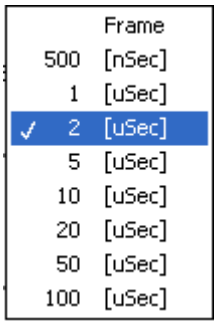
Add the frame to script by delta time interval.

Select the delta time unit: 

between 2 frames.

The delta time unit can be selected from 500 ns to 100 µs.

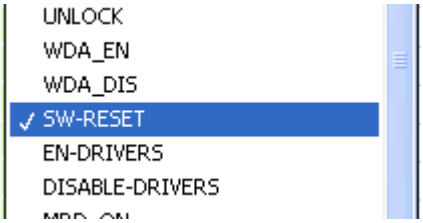
Figure 29. Delta time unit list



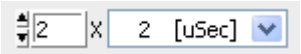
Step 1. Select [**SW_RESET**]

Registers can be selected from [**NORMAL-MODE MSC DOWN STREAM CMD**] dropdown list

Figure 30. Select MSC register



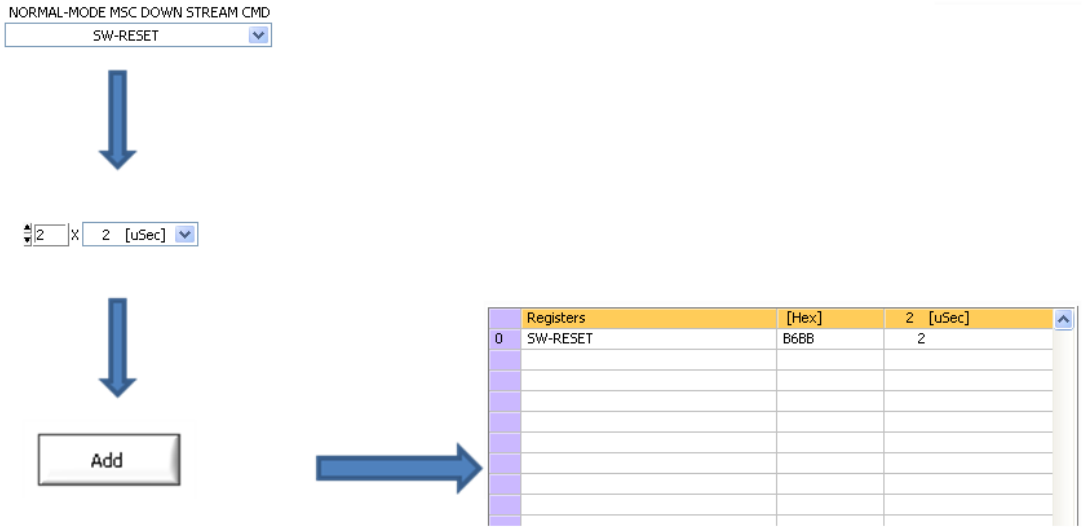
Step 2. Input delta-time multiple value:



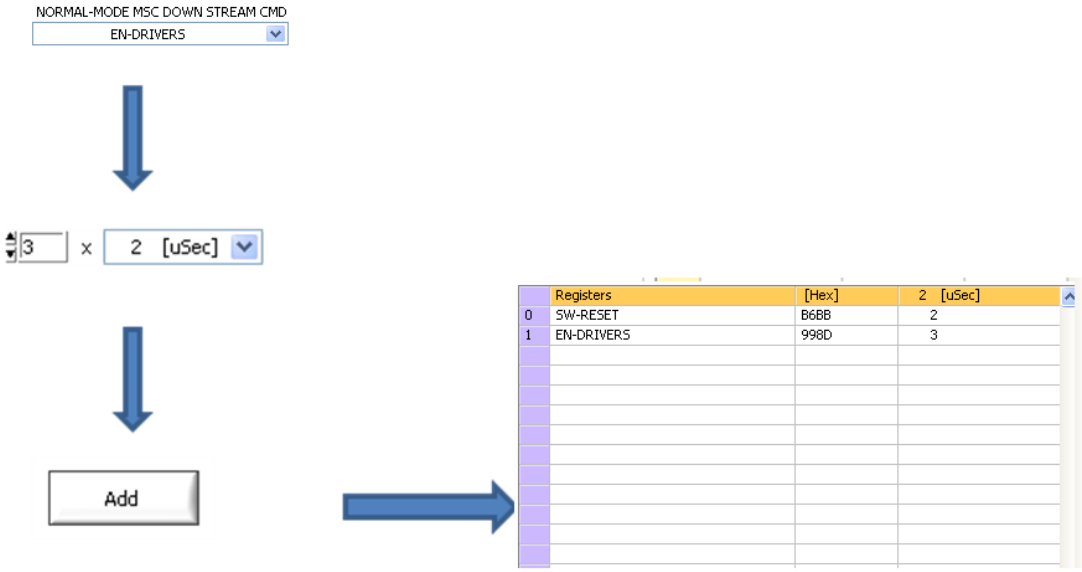
Multiple value = 2. There will be 2*2 µs delay after SW_RESET command send to L9788, then the next frame will start.

Step 3. Click add

the item to script.



Step 4. Add the [**EN-DRIVERS**] command to script:



Step 5. Add the data frame1 to script:

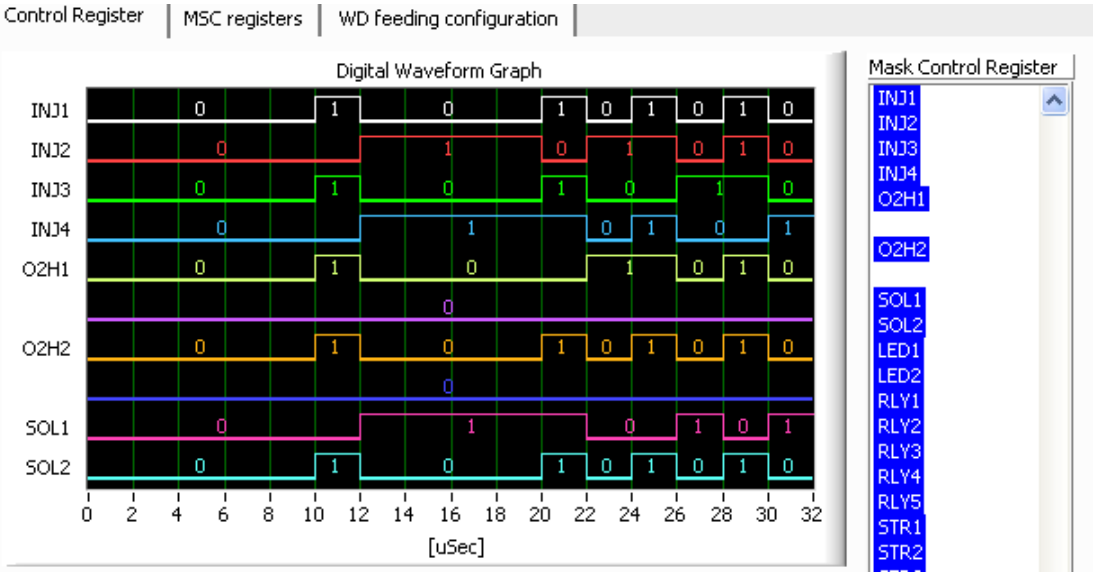
Step 6. Add the data frame 2...8 to script:

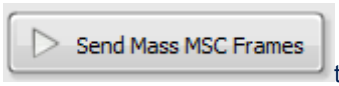
Figure 31. Script step list

	Registers	[Hex]	2 [uSec]
0	SW-RESET	B6BB	2
1	EN-DRIVERS	998D	3
2	Control Register	B75D54AA	1
3	Control Register	48A2AA14	4
4	Control Register	DEFCA69A	1
5	Control Register	21035824	1
6	Control Register	2D775CB6	1
7	Control Register	D288A208	1
8	Control Register	F73354AE	1
9	Control Register	08CCAA10	1

Output timing (control registers) can be seen on Digital Waveform Graph.

Figure 32. **Waveform graph display**

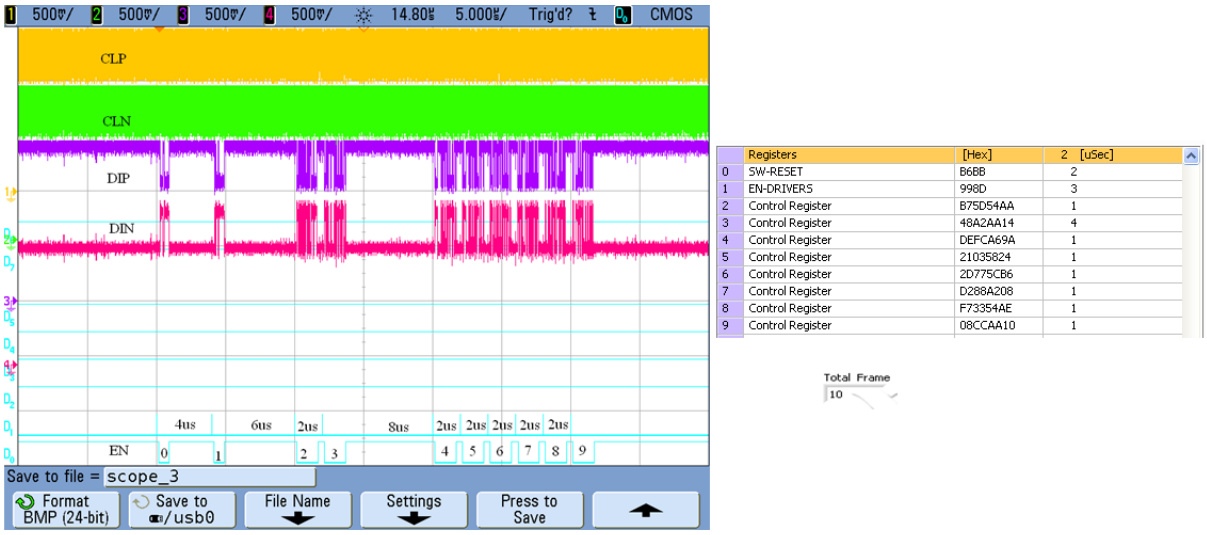


Step 7. Click 

to send the script to L9788.
To save the script for later execution see Section 4.2.3

The following wave form show the result:

Figure 33. **Delta time delay waveform**

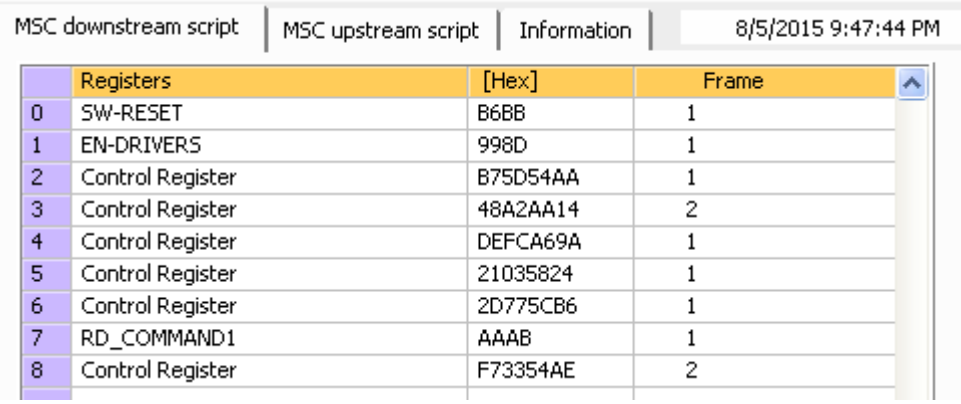


4.2.2 Create a script without frame delay

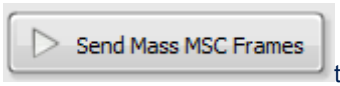
Step 1. Select Frame to send script frame by frame

Step 2. Add command/data frame to script one by one:

Figure 34. **Script steps**



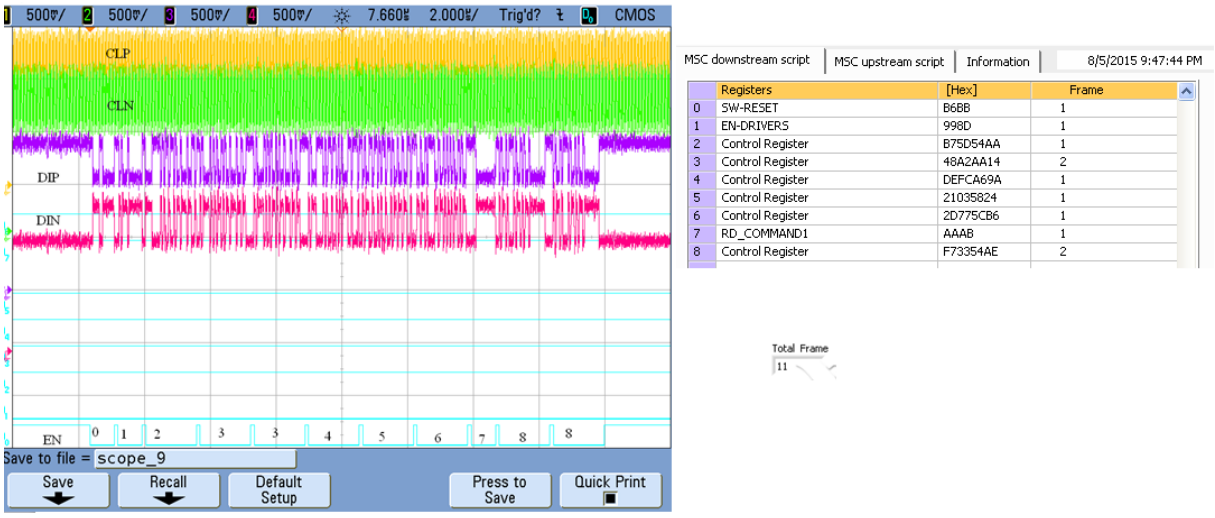
	Registers	[Hex]	Frame
0	SW-RESET	B6BB	1
1	EN-DRIVERS	998D	1
2	Control Register	B75D54AA	1
3	Control Register	48A2AA14	2
4	Control Register	DEFCA69A	1
5	Control Register	21035824	1
6	Control Register	2D775CB6	1
7	RD_COMMAND1	AAAB	1
8	Control Register	F73354AE	2

Step 3. Click 

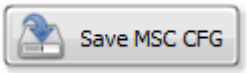
to send the script to L9788.

The following wave form show the result:

Figure 35. **Frame by frame waveform**

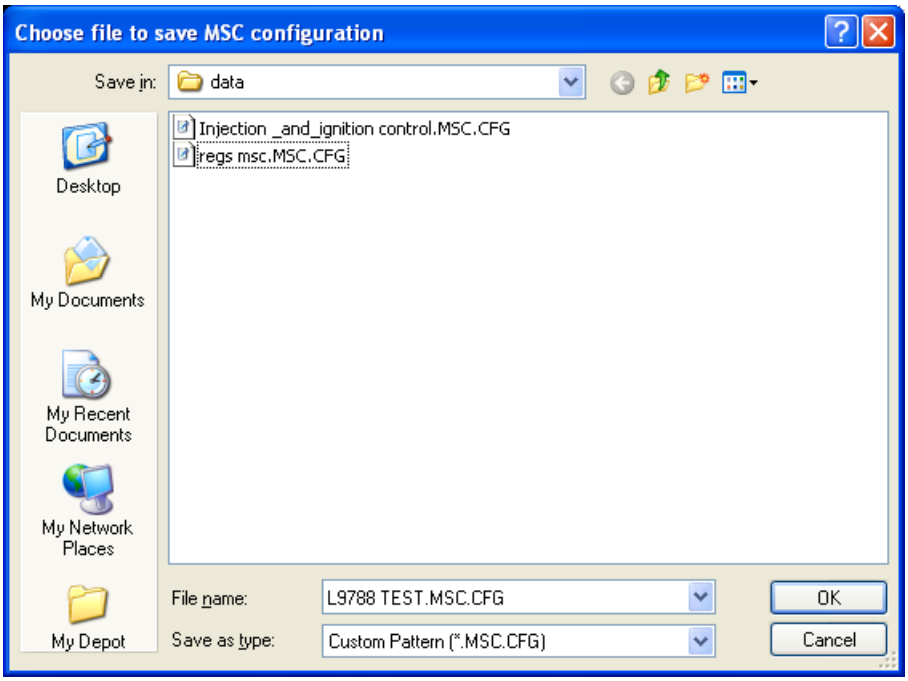


4.2.3 Save and load script file

Click 

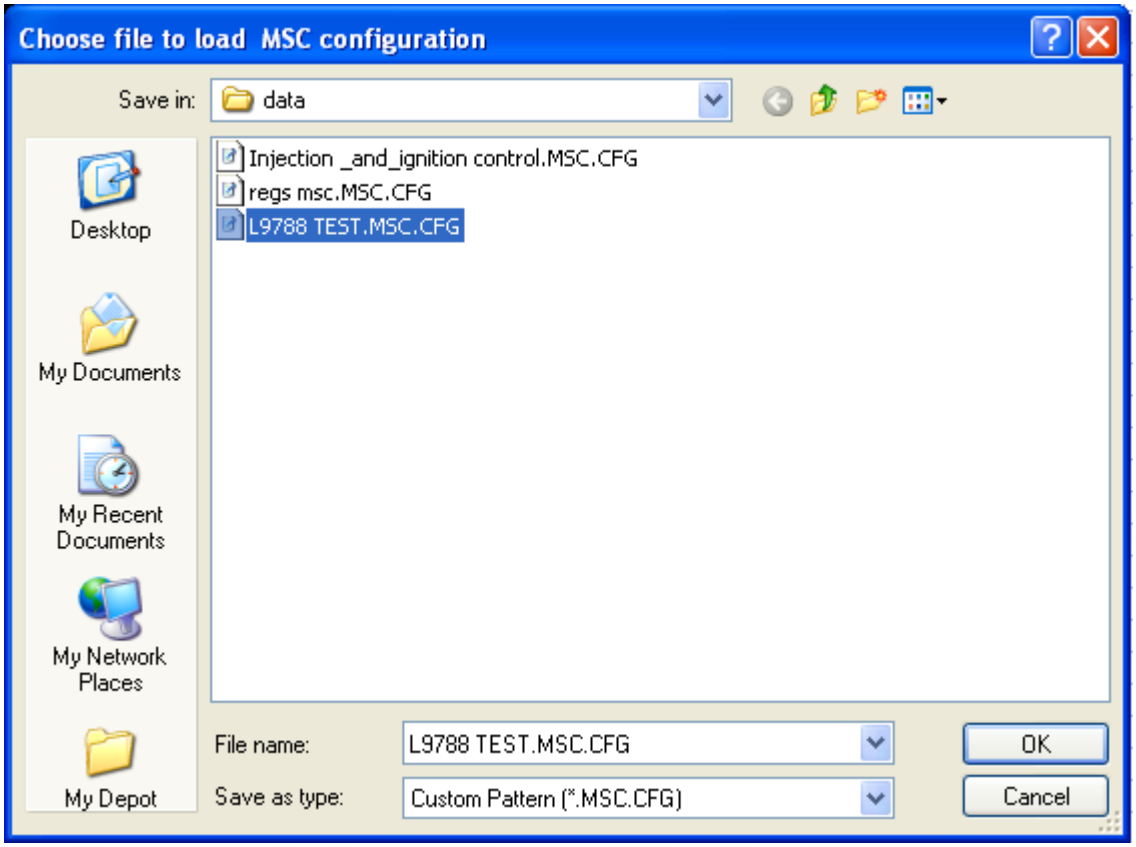
to save the MSC script file.

Figure 36. **Save script file dialog**



Load the MSC script from file:

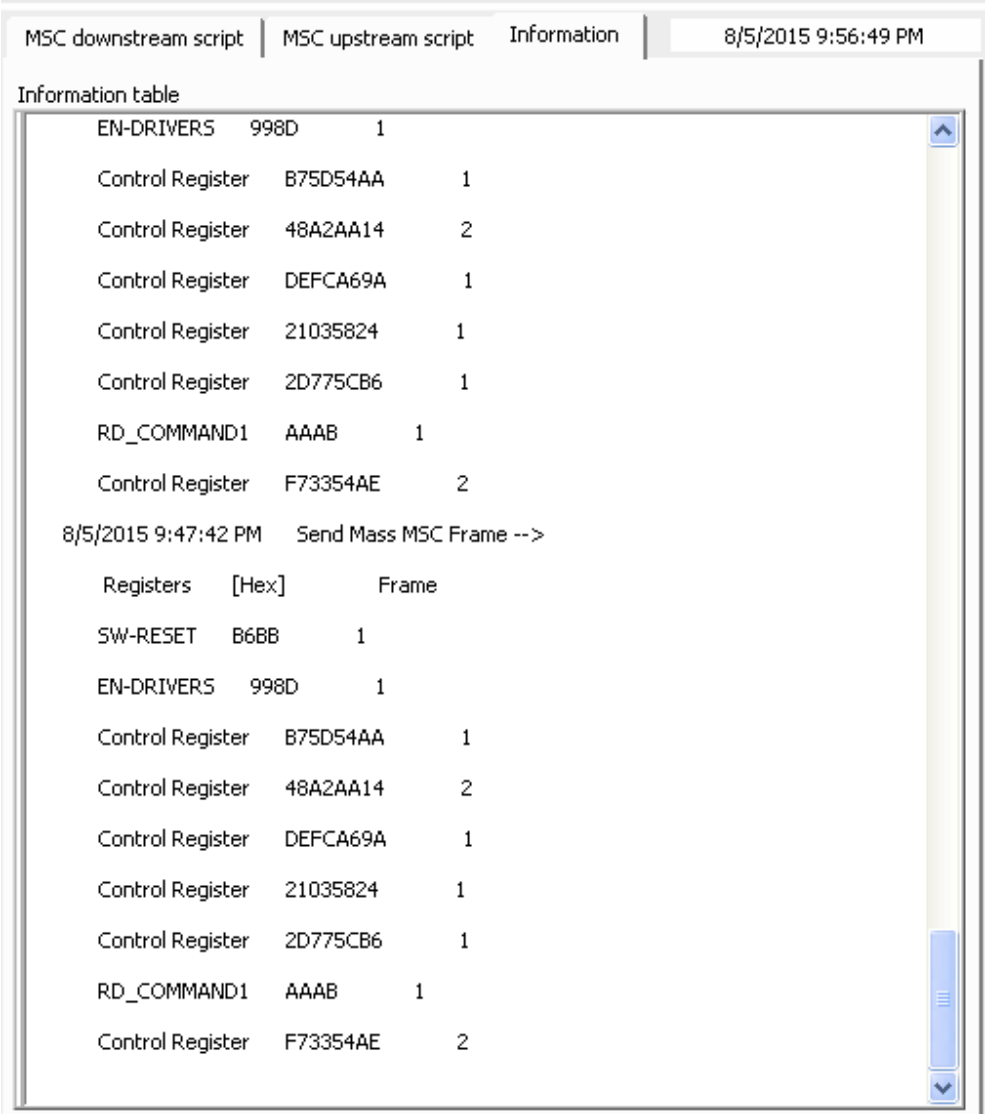
Figure 37. **Load script file dialog**



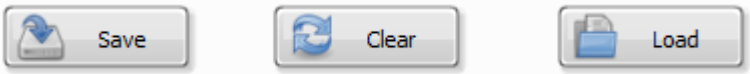
4.2.4 Command history logger

The command history is displayed in the [**Information**] page:

Figure 38. Information page



Commend history can be saved or loaded from a file. The button [**Clear**] erase the history log.



4.3 Control area

MSC control area:

Figure 39. GUI control area

Inverse MSC command bits:

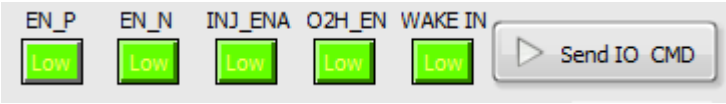
can inverse data bits of the current selected MSC command.

To set the request bits of upstream data, see Section 4.1.2 .

4.3.1 IO control in normal mode

There are 5 pins that can be controlled by GUI. They can be switched high or low by selecting the green box below the pin name. After selection, press [**Send IO CMD**] to execute the action on the EVAL-L9788.

Figure 40. L9788 IO pins



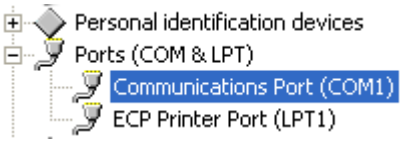
There are 4 pins indicator to monitor the output from L9788:

Figure 41. L9788 output indicators

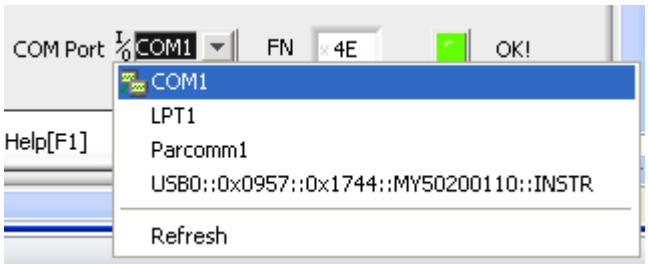
4.3.2 COM port setting

The baud rate of UART is 115200 BPS.

COM port in MS-Windows:



COM port GUI configuration:



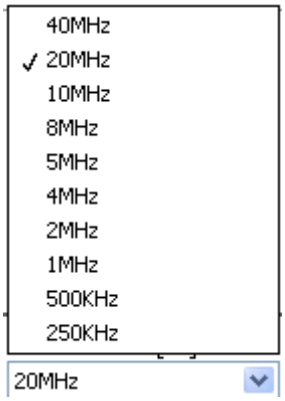
The FN 0 show the frame number from SPC563M-DISP indicates the status of communication between PC and SPC563M-DISP. The FN will be automatically increased in SPC563M-DISP and send to PC when the current communication complete successfully.

The 16-bit CRC checksum is used for COM port communication.

4.3.3 MSC clock selection

There are 10 options for clock configuration from 250 kHz to 40 MHz.

Figure 42. **Clock selection list**



The default MSC clock is 20 MHz

4.3.4 Auto load/save GUI configurations

A file with all registers and configurations is saved on [**Exit**] with default.ini filename in the ./data/ folder.

It includes MSC registers, MSC baud rate, unit, COM port…

To reset the configuration delete the data/dafault.ini file and restart the GUI

4.3.5 Reset

When RESET button clicked, the following actions will be executed:

- Soft reset SPC563M-DISP

4.3.6 Delta time setting between 2 frames

Setting delta time between 2 MSC frames, detail see the Section 4.2

1 x 10 [uSec] [Unit]

4.3.7 Add MSC frame to script

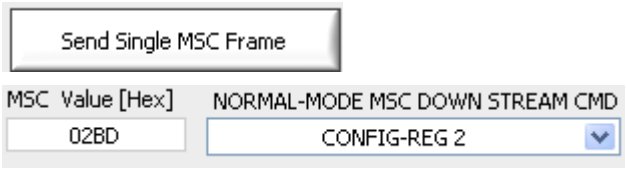
After configuration the command / data frame, user can add the value to script, with the Add button.

Note:

In the GUI, user can configure the MSC registers, no communication happen between PC an SPC563M-DISP (and nothing from SPC563M-DISP to L9788).

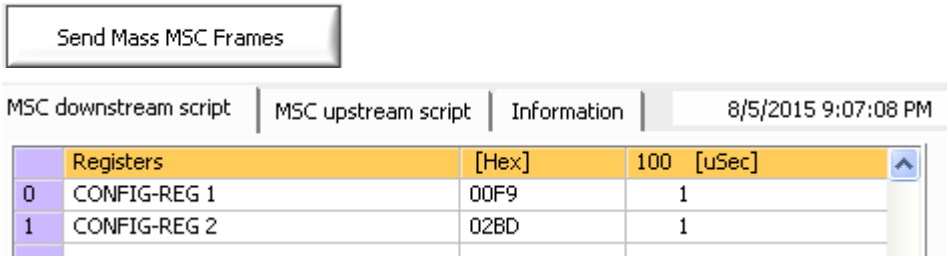
For MSC interface, the below button can send the commands to L9788:

Step 1. Send one frame,



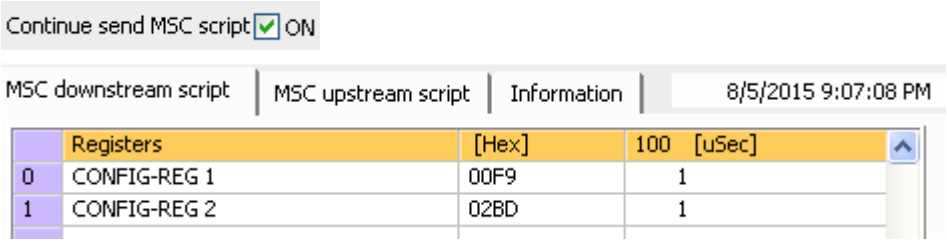
The current MSC command/ data frame send to L9788.

Step 2. Send mass MSC commands



The above MSC script sends to L9788 once.

Step 3. continue send script



The above MSC script sends to L9788 continuously.

4.4 Exit

User can exit the GUI using the

button, GUI release the COM port and exit.

Revision history

Table 2. **Document revision history**

Date	Version	Changes
27-May-2019	1	Initial release.

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