

Quick Start Manual Matlab Embedded Controller v1.1

This manual only introduces the most basic application of MATLAB Solution Toolkit. For more detailed information, please refer to **I-8438/8838 User Manual**.

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[Introduction]

MATLAB Solution Toolkit is a useful tool for you to construct your controller model. With it, you can design your controller in MATLAB/Simulink, and convert it into an executable file easily and quickly.

Note:

This manual is written based on MATLAB Solution Toolkit version 1.0.0.

[System requirement]

Hardware:

Module: ICPDAS I-8438/8838. SRAM: 512KB

FLASH: 512KB

Software:

MATLAB 6.1 or 6.5 Simulink 4.1 or 5.0 Real-Time Workshop 4.1 or 5.0 Real-Time Workshop Embedded Coder 2.0 or 3.0 Stateflow and Stateflow Coder 4.1 or 5.0(opt.)

Notice:

Please make sure that MATLAB, Simulink, RTW and RTW Coder has been installed in your system before you setup this toolkit. Otherwise it will not work properly.

[Default IP setting]

IP:	192.168.0.15
Gateway:	192.168.0.1
Mask:	255.255.0.0

If the default IP has a conflict with other devices in the network, users can change the IP setting of the I-8438/8838 by the S-MMI buttons or from the GUI tool. You can refer to Appendix C. on 8438/8838 User Manual for detailed information.

[OS & Firmware Version]

OS: MiniOS7 Ver. 2.00 build 001. (8E031103.img)

Firmware: mat_load.exe Ver. 1.00

To update the OS or firmware on the I-8438/8838 embedded controller, please refer to Appendix A. or B. on 8438/8838 User Manual respectively for detailed information.



- 1.) Connect the network cable to the RJ-45 connector and a hub.
- 2.) Apply power (+Vs, GND) to I-8438/8838. The DC power can be the value from +10V to +30V.
- 3.) Check the 5 digits of the 7-segment LED. If the firmware is running, the IP address of the I-8438/8838 will be displayed.

[Chapter 2 Create a model using Simulink]

1.) First start **MATLAB** and then click the Simulink icon 👸 on the MATLAB toolbar.



2.) Click D on the Library Browser's toolbar (Windows only). Simulink opens a new model window, and then you can start to construct your own control model on the blank area of the window.

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3.) Copy a SYS_INIT, a DataToFile, an I-8024 and an I-8017H block from the System, AO and AI library to the model window respectively.



4.) Double-click on the SYS_INIT block to open the dialog box. On the dialog box that appears, 8438/8838 Quick Start Manual, Version 1.0, 02/2004 -- 4

select the correct target hardware type from the field, Target Hardware Type. In this demo, the target hardware is selected as I-8838.

Block Parameters: SYS_INIT	×
_ I8838-Simulink link (mask)	
Initialize the I-8000 control system.	
Parameters Target Hardware Type: 18838	⊸
184.38 18838 OK Cancel Help Appl	у

5.) Double-click on the I-8024 block, and then the dialog box appears. To use channel 0 of I-8024 module, enter [0] in the field "Output Channel". And select the slot as 2, Output Mode as "Voltage Out", Gain as 1 and Type of Value as "Floating".

Block Parameters: I-8024 📃 🗵
_S-Function (mask)
4-channel 14-bit analog output module.
- Parameters
Output Mode : Voltage Out
Output Channel :
[0]
Gain :
1
Slot: 2
Type of Value : Floating
OK Cancel <u>H</u> elp <u>Apply</u>

6.) Double-click on the block of I-8017H, enter [0] in the field "Channel". And select the Voltage range as "+/-1.25V", Slot as 3 and Type of Value as "Floating".

Block Parameters: I-8017H
_S-Function (mask)
14-bit 100K sampling rate, 8-channel analog input module.
- Parameters
Channel :
[0]
Voltage range : +/- 1.25V
Slot: 3
Type of Value : Floating
OK Cancel <u>H</u> elp <u>A</u> pply

 Double click on the block of DataToFile, assign the Filename as "f001.mat", and Decimation as 1.

Block Parameters: DataToFile	×
_ S-Function (mask)	
Write time and input to specified MAT file in row format. Time is in row 1.	
Parameters-	
Filename :	
(f001.mat)	
Decimation :	
OK Cancel <u>H</u> elp <u>Apply</u>	

- 8.) Copy a Sine Wave block to the model window from the Simulink\Sources library.
- 9.) Connect all the blocks as shown in the following figure.



[Chapter 3 Build the program by RTW]

In this section, we will demonstrate you how to convert the control model created in the previous section into an .exe by RTW.

1.) Open the Simulation Parameters dialog box by choosing *Simulation parameters* from the *Simulation* menu.

ə f0	01							
File	<u>E</u> dit	<u>V</u> iew	Simulation	F <u>o</u> rmat	<u>T</u> ools	<u>H</u> elp		
	🖻	8	<u>S</u> tart Stop			Ctrl+T	ormal	•
			Simulatio	on para <u>m</u> e	ters	Ctrl+E		
			Mechani	cal enviro	nment		6	
			✓ <u>N</u> ormal		Introller			
			<u>A</u> ccelerat	tor			Т	
			<u>E</u> xternal					
			s	ine Wave			•	•0

2.) On the dialog box that displays, select Type as **Fixed-step**, Mode as **Single Tasking** and Fixed step time as **0.002** in the field "Solver options".

📣 Simulation Parameters: f001 📃 🗔 🗙
Solver Workspace I/O Diagnostics Advanced Real-Time Workshop
Simulation time Start time: 0.0 Stop time: 5
Solver options Type: Fixed-step discrete (no continuous states)
Fixed step stee: 0.002 Mode: SingleTasking
Output options Refine output Refine factor: 1
OK Cancel Help Apply

3.) Then click the "Real-Time Workshop" tab and the panel changes. On the panel that shows up, select **Target configuration** from the Category field. Then click the Browse button to open the "System Target File Browser" window.

📣 Simulation Paramete	rs: f001	
Solver Workspace	/0 Diagnostics Advanced	Real-Time Workshop
Categore Target con	figuration	Build
- Configuration		
System target file:	grt.tlc	Browse
Template makefile:	grt_default_tmf	
Make command:	make_rtw	
🔲 Generate code d	only	Stateflow options
	OK Cancel	Help Apply

4.) On the System Target File Browser dialog, select the correct system target file from the list and then click the OK button to close the dialog box. Here, we choose I_8xx8.tlc.

🥠 System Target File Browser:	f001
System target file	Description
asap2.tlc	ASAM-ASAP2 Data Definition Target
drt.tlc	DOS(4GW) Real-Time Target
ert.tlc	RTW Embedded Coder
ert.tlc	Visual C/C++ Project Makefile only for the RTW Em
grt.tlc	Generic Real-Time Target
grt.tlc	Visual C/C++ Project Makefile only for the "grt"
grt_malloc.tlc	Generic Real-Time Target with dynamic memory allo
grt_malloc.tlc	Visual C/C++ Project Makefile only for the "grt_m
I_8xx8.tlc	I8xx8 Embedded Target

5.) And select the "ERT code generation options" (for MATLAB 6.1) or "ERT code generation options (1)" (for MATLAB 6.5) in the Category field. Then check the **Terminate function required** and **Single output/update function** options on the pane.

Simulation Parameters: f001					
Solver Workspace I/O Diagnostics Advanced Real-Time Workshop					
Category: ERT code generation options (1)					
Options MAT-file logging					
Integer code only					
Initialize internal data					
☐ Initialize external I/O data					
Terminate function required					
✓ Single output/update function					
Insert block descriptions in code					
OK Cancel Help Apply					

6.) For MATLAB 6.5, you have to select "ERT code generation options (3)" from the Category field. Then cancel the option **Generate an example main program**.

Simulation Parameters: f001
Solver Workspace I/O Diagnostics Advanced Real-Time Workshop
Category: ERT code generation options (3)
Options Generate an example main program
Target operating system: BareBoardExample
🔲 Generate reusable code
Reusable code error diagnostic: Error
Suppress error status in real-time model data structure
Target floating point math environment: ANSI_C
OK Cancel Help Apply

7.) When the above steps are done, save the model and click the Build button to start the build process.

Note:

The name of the model cannot be over 4 characters. (This is due to the limitation of Turbo C/C++ Compiler.)

[Chapter 4 Program downloading & uploading]

Now we can download the .exe generated for testing. Please follow the steps:

1.) Enter **gui8000** at the MATLAB prompt to start the GUI. Then specify the correct IP and Port of the I-8438/8838 and press Connect. **Note: The default listening port is 10000.**

-> I8000 Series User Interface	
RS232 TCP/IP Connect to :	Connect
IP 192 168 0 15	Stop
Port 10000 Set NET	Download
	Upload
Message	
TCP/IP Mode	Exit GUI
STATUS Not Connected	

2.) After the connection is established, press Download to select the file and transfer it to the I-8838 control system.

BOOO Sector User Interface RS232 TCP/IP Connect to :	15	Disconnect Start		
Port 10000 Set NET	l Select File to Do 按尊位置①:	Download wraided	- + E	3× 0'⊡•
STATUS Connection	Untitled Winnov D001.E D002.E D003.E	o10 Blockset_edge_imnoise XE XE XE	D004.EXE D005.EXE D006.EXE FOOLEXE PAPI.EXE PID.EXE	
	4案名額(N): 格案頻型(D):	[F001 EXE [*.exe		▶ 開啓(○) 取清

3.) As soon as the download process is completed successfully, you can click Start to execute the program.

📣 I8000 Series User Interface	
RS232 TCP/IP Connect to : IP 192 168 0 15 IP 192 168 0 15 Port 10000 Set NET	Disconnect Start Download Upload
Message	
Connection is established	Exit GUI
STATUS Connection is established	

4.) Then the pane changes like the following figure.

📣 I8000 Series User Interface	
RS232 TCP/IP	Disconnect
Connect to : IP 192 168 0 15	Stop
Port 10000 Set NET	Download Upload
Message	
program is running	Exit GUI
STATUS Connection is established	

5.) After the time that you specified is up, press Upload button to collect the data for further analysis. After the upload process is completed successfully, data will be saved as f001.mat, which is the name you assigned in the DataToFile block.

MATLAR	🥠 19000 Serger U er Infridace		X
Elle Edit Yiew We	BS232 TCP/IP		Disconnect
C:\MATLAB6p5\work			Stop
All Files		Upload 54%	(ovmand)
D006.EXE			Upload
d006.sat		nessage	
1006.md 1	progra	ro is running	Exit GUI
dt.mat			
[H] edge.jpg	STATUS	Connection is established	
eeprom.mat	MAT-file	06-十一月-20 05:15 下午	11
eeprom0.mat	MAT-file	06-十一月-20 01:44 下午	
FOO1.EXE	EXE File	05-十二月-20 02:06 下午	
🖬 f001.mat	MAT-file	05-十二月-20 04:31 下午	

6.) Double-click on f001.mat and then enter **plot(tcpdata(1, :), tcpdata(2, :))** at the MATLAB prompt. The result would look like below:



Note: To run this demo, what you need is that an I-8024 AO module and an I-8017H AI module have been installed on slot 2 and 3 of the I-8838 respectively.

Addition Function for New Driver Version

[New Function for Matlab Driver v1.1]

There are two new buttons -- "Auto" and "eAuto" provided in the GUI screen for <u>RS-232</u> and <u>Ethernet</u> interface separately. After users complete connection and download file to the matlab controller, users can click "Auto" or "eAuto" button to execute the following continuous steps automatically :

- (1) "Run Program"
- (2) "Upload when stop time is up"
- (3) "<u>Close GUI</u>"

That will be more convenient for users to test the control algorithm during the development stage. These two Auto button are showed as the following figure.

🥑 18000 S	eries User I	aterface		
RS232	TCP/IP			
Seri	al Port		Auto	Disconnect
COM6	•	Baudrate	Stop •	Start
		Parity	Data	Download
				Upload
		Message		
	Conne	ection is established		Exit GUI
STATUS		Connect	ion is established	

RS-232 Interface

🜗 18000 Series User Interface	
RS232 TCP/IP eAuto Connect to :	Disconnect
IP 192 168 0 15 Port 10000 Set NET	Download
Message Connection is established	Exit GUI
STATUS Connection is established	

Ethernet Interface 8438/8838 Quick Start Manual, Version 1.0, 02/2004 -- 13 The whole process for **Auto** button function is described as following (Ethernet Interface Example) :

After users complete the connection and download file to the matlab controller, users can click Auto button in the GUI screen to execute the following steps :

(1) "<u>Run Program</u>" :

🜗 18000 Series User Interface	
RS232 TCP/IP	
Connect to :	Disconnect
	Stop
IP 192 168 0 15	Download
Port 10000 Set NET	Unload
Message	
Program is running	Exit GUI
STATUS Connection is established	

(2) "Upload when stop time is up" :

🜗 18000 Series User Interface	
RS232 TCP/IP	
eAuto	Disconnect
Connect to :	
	Stop
IP 192 168 U 15	
Port 10000 Set NET	Download
	Upload
Message	
2, TimeUp	Exit GUI
STATUS Connection is established	
STATUS Connection is established	

🜗 18000 Series User Interface	
RS232 TCP/IP	
Connect to :	Disconnect
IP 192 168 0 15	Stop
Port 10000 Set NET	Download
	Upload
Message 3. Data is uploading	Exit GUI
STATUS	
Uplo	ad 78%

(3) "<u>Close GUI</u>" :

J 18000 Series User Interface	
RS232 TCP/IP	
eAuto	Disconnect
Connect to :	
	Start
IP 192 168 0 15	
	Download
Port 10000 Set NET	
	Upload
Message	
4. GUI Will Close	Exit GUI
STATUS Connection is established	