EM100Pro-G2
Serial Flash Emulator Specification
V1.4

Simply the best solution to develop code on SPI Flash memories

- **Emulate all the market Serial Flash**

- **Designed to support the future Serial Flash evolution:**

  - **1.8-3.6V, up to 50MHz, 512Kbits to 2Gbits**

- **The Highest Code download performances: less than 3 seconds for code update whatever the density selected**

- **Support Single IO, Dual IO and Quad IO communication**

- **Display and Edit memory content evolution**

- **Debug functions: SPI Protocol analyzer and SPI HyperTerminal**

- **Work with the Serial Flash soldered on board**

- **Suitable connect with Intel motherboard by specific adaptor**

Table of Content

Important notice:

I. General Information

1.1 Introduction

The EM100Pro-G2 is a DediProg Serial Flash Emulator based on RAM memory in order to offer the best update performances compared to the Flash technology. This advanced tool has been designed in close cooperation with the Serial Flash suppliers to emulate the behavior of all the market Serial Flash including the next generation Serial Flash.

The EM100Pro-G2 will reduce your development time thanks to its RAM base memory and powerful debugging features.

"Minutes become seconds for code update"
"SPI bus and application debugger features"

➢ Engineer can select any market SPI Flash in one Click

➢ Engineer can update code in less than 3 seconds whatever the densities selected when a standard Serial flash memory would need more than one or two minutes for erasing and programming.

➢ Engineer can monitor all the SPI bus communication thanks to our SPI Trace function (Logic analyzer).

➢ Application firmware can send debug information through the SPI to be displayed on the Host PC for easy debugging.

➢ Flash emulator is transparent and straightforward for your application controller.

1.2 Accelerates embedded software development

EM100Pro-G2 provides high speed links from host to target via USB 2.0 interface allowing code download and debug to begin just few seconds after compile is complete. The whole process can be automated and executed with a single command. EM100Pro-G2 completely eliminates the delays in Erasing and programming memories or loading code to target memory. Time saved means better quality firmware and projects finished on-time.


PC   EM100Pro-G2 Emulator   Target Board

1.3 Powerful debugging features

EM100Pro-G2 improves debugger performance:

➢ With the SPI Protocol Analyzer allowing monitoring all the SPI bus communication.

➢ With the SPI Hyper Terminal interface allowing displaying on the host PC any debug messages coming from the controller Firmware through the SPI bus.

➢ Customized software on host PC can also take the hand on the firmware execution like a debugger tool.

Debug easily your application code
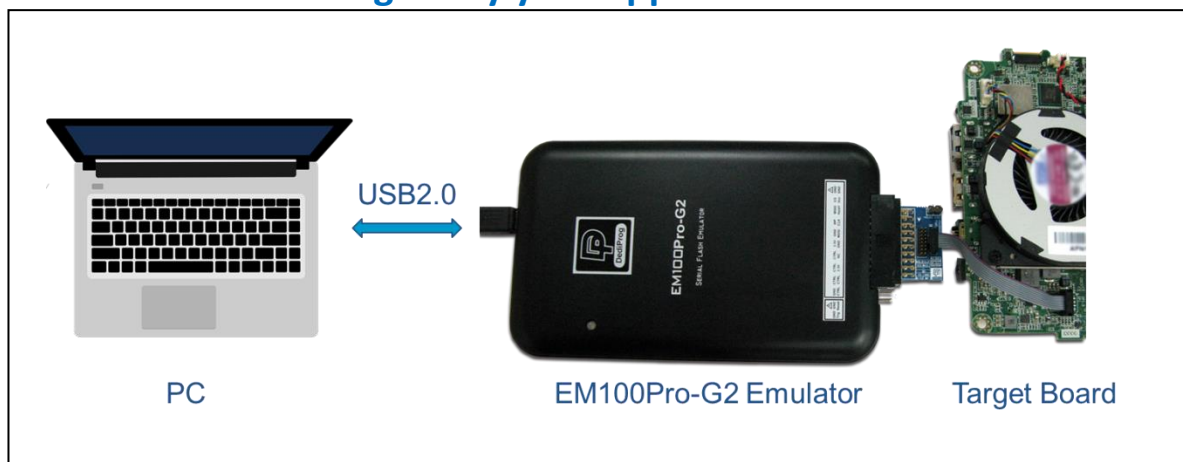
1.4 Flexible

EM100Pro-G2 provides the widest range of target SPI Flash connectivity from DIP to the SMT footprints.

➢ Connectors footprint compatible with DIP, SO8N, SO8W, SO16W, MLP5*6 (WSON) and MLP6*8(WSON) packages.

➢ Cable adaptors for 2.54mm pitch pin headers with SPI Flash or ISP pin outs

➢ Cable adaptors for 1.27mm pitch pin headers

➢ Engineering sockets footprint compatible with SO8 and SO16 sockets to replace the SPI Flash memories with SPI Flash Emulator and vice versa easily.

See **"EM100Pro-G2 Hardware connection.pdf"** for more detailed information

1.5 EM100Pro-G2 versus EM100Pro

EM100Pro-G2 replaces the older version EM100Pro and offer additional features to fit the new Serial Flash specification.

Comparison table: EM100Pro-G2 (New) versus EM100Pro

Model	EM100Pro-G2	EM100Pro
Internal memory	DDR DRAM	SDRAM
Buffer size For SPI Trace	512MB	Limited
Emulation Capacity	Up to 2Gbit	Up to 512Mbit
Emulating IC concurrently	One IC only	One or two ICs
Quad IO Support	Up to 50MHz	Slower than 50MHz
1.8V / 3.3V FW	Swap automatically by IC model	Need re-plug
SPI Bus activity indicator	Dual color LED indicator	No

II. SPI Flash Emulator Main features

2.1 EM100Pro-G2 main features

General information:

➢ USB powered

➢ Palm size

➢ Windows XP / 7 / 8.1 / 10 compatible

➢ Intel-Hex, Motorola S-record and binary input file format supported

Memory Emulation:

➢ Emulate **all the market Serial Flash** (suppliers, families, densities and future road map serial Flash). Memory part number to be selected by user on the software list.

➢ **Densities**: from 512Kbits to 2Gbits SPI Flash

➢ **Frequency:** from DC to 50MHz (chipset and application dependant)

➢ **I/O:** Unidirectional SPI input and output

➢ **Transparency:** Small add-in capacitance to the application SPI bus

➢ **Pins option:** Support the options for #Reset, #Hold and MISO

➢ **Memory Power:** 3.3V, 3V, 2.5V, 1.8V

➢ **Instructions:** Support standard market Serial flash instructions and features

Output signals:

➢ **Reset Output:** used to synchronize the emulator start with the application boot by resetting the application system.

2.2 SPI Trace Window

When the SPI *Trace* feature is started, the EM100Pro-G2 monitors the application SPI bus and display all the SPI bus communication in the SPI Trace window. The SPI information can then be displayed in Hexadecimal (03h, 0Bh, 02h...) or translated in SPI Flash command (Normal Read, Fast Read, Page Programming…).

SPI information will be tagged with timing information so that engineers can use it for development with boot time constraints.

In case of buffer overflow due to application high SPI throughput or slow Host PC, the user will be noticed with some Stars inserted "****************".

2.3 SPI Hyper Terminal Window

The *SPI Hyper Terminal* window displays Virtual messages coming from the application controller through the SPI bus. Application firmware can send checkpoints, ASCII debugging messages, application information such as look-up table, variable value, timing etc.. by using specific protocol through the SPI Bus even during boot from the emulated memory. The SPI Hyper Terminal offers a powerful and flexible method to debug the application in development as each engineer can customize the information sent to PC Host according to his own needs.

The target system controller must include a small portion of code for handling the process of outgoing messages on the SPI bus. Please, contact us to access the SPI Hyper Terminal specification and source code.

III. Hardware

3.1 EM100Pro-G2 pins assignment

The EM100Pro-G2 has two 2.54mm pitch males connectors of:

- 2x2 for the Reset and Trig signals

- 2x10 for the Emulation signals

Tab 1: EM100Pro-G2 pins assignments

3	1		19	17	15	13	11	9	7	5	3	1
GND	GND		GND	CTRL	CTRL	CTRL	3.3V	GND	WP	MISO	CS1	NC
Trig	Reset		NC	CTRL	3.3V	NC	NC	MOSI	CLK	Hold	Vcc	CS2
4	2		20	18	16	14	12	10	8	6	4	2

- The signals 3 to 10 (blue) are use for the SPI Flash and the pin out is compatible with the standard SPI pin out.

- The signals 2 is used for another CS pin, user can select CS1 or CS2 as the CS pin.

- The others signals are planned for future options.

※ **Signal 11 and 16 are used for VCC to output 3.3V only. Therefore, no matter what is the emulated IC voltage (1.8, 2.5 or 3.3V), it will only output 3.3V.**

In Quad IO: DQ0 (MOSI), DQ1 (MISO), DQ2 (Wp), DQ3 (Hold)

The signals WP, CS1, CS2, CLK, MISO, MOSI, Hold are configured in High Impedance when the emulation is stopped to stay transparent for the application.

The Hold signals can also been driven low to disable the SPI Flash soldered on the board in single IO or dual IO mode.

3.2 Performances

This section summarizes the operating and measurement conditions, and the DC and AC characteristics of the EM100Pro-G2. The parameters in the DC and AC Characteristic tables that follow are derived from tests performed on samples only.

Tab 2: Operating conditions

Symbol	Parameters	Min	Max	Unit
USB_Vcc	Vcc supplied to EM100Pro-G2	4.8	5.2	V
I_USB	Current supplied by USB	500		mA
Vcc	Application Vcc to memory	1.7	3.6	V
Ta	Ambient temperature	+5	45	C

Tab 3: Endurance

Symbol	Parameters	Min	Max
Cycles	Memory Code update		Unlimited

Tab 4: AC measurement conditions

Symbol	Parameters	Min	Max	Unit
Cl	Load capacitance on SPI bus		15	pF
	Input timing reference voltages	0.3Vcc to 0.7Vcc		V
	Output timing reference voltages	Vcc/2		V

Tab 5: Capacitance

Symbol	Parameters	Min	Max	Unit
Cout	Output Capacitance without cable		8	pF
Cin	Input capacitance without cable		8	pF

Cable capacitance must be added to calculate the total capacitance.

In application, the total SPI bus capacitance will be the sum of the EM100Pro-G2, cable and application capacitance.

Tab 6: DC Characteristics

Symbol	Parameters	Min	Max	Unit
Icc	Operating current on memory Vcc		5	mA
Vil	Input low voltage	-0.5	0.3Vcc	V
Vih	Input high voltage	0.7Vcc	Vcc+0.4	V
Vol	Output low voltage (Iol=2mA)		0.4	V
Voh	Output High Voltage (Ioh=2mA)	Vcc-0.4		V

Tab 7: AC Characteristics

Symbol	Parameters	Min	Max	Unit
Fc1*	All operations except Read => Chipset latch data on Clock falling edge	DC	50	MHz
Fc2*	All operations except Read => Chipset latch data on Clock rising edge	DC	40	MHz
Fr1*	Normal Read => Chipset latch data on Clock falling or rising edge	DC	40	MHz
Tclch	Clock rise time (peak to peak)	0.1		V/ns
Tchcl	Clock fall time (peak to peak)	0.1		V/ns
Tshsl	Deselect time	200		ns
Tshqz	Output disable time	10		ns
Tclqx	Output hold time (Cl=15pF)	4ns		
Tclqv	Clock low to output valid (Cl=15pF)		10	ns
Tpp	Page Programming time		600	us
Tse	Sector Erasing time		3	ms
Tce	Chip Erasing time		90	ms/Mb

Fig 1: SPI Waveform
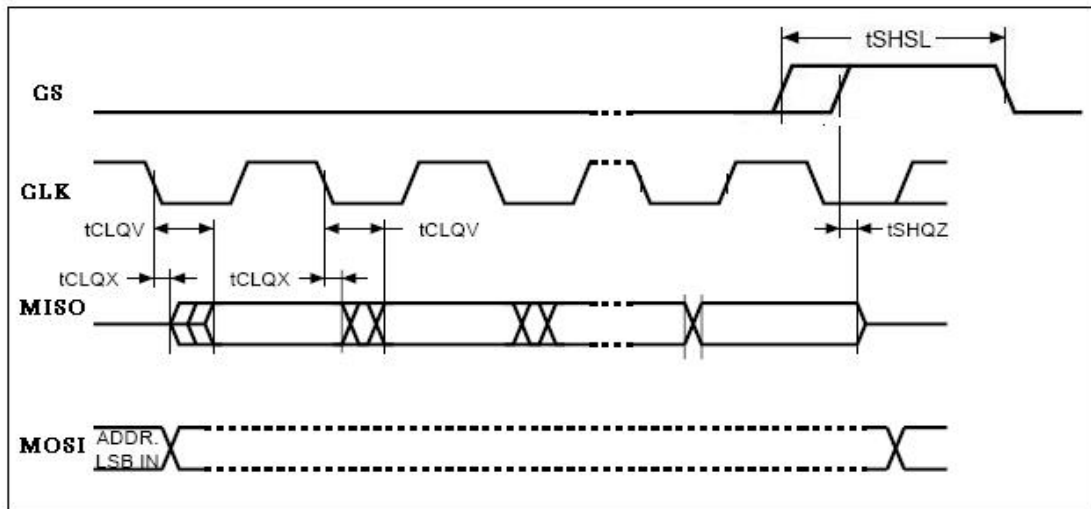
The real maximum frequency in the application could be different from the one measured during our samples test. Actually, the maximum frequency will depend of two majors' parameters which are application dependant:

1) **The total SPI bus Capacitance:**
   - Application capacitance (Controller IO, SPI layout..)
   - EM100Pro-G2 capacitance
   - Cable capacitance (length dependant)
   From this total SPI bus capacitance will depend on the Data out valid time (Tclqv).

2) **The controller Data In latch time:**
   To stay compatible with the market SPI flash, the EM100Pro-G2 switches the data out in the SPI bus after the clock falling edge.
   - If the **controller reads the Data on the next rising edge** of the clock, the data needs to be valid before half a period of the clock (T/2) with a controller data setup time.
   So maximum Frequency = 1 / ((Tclqv + controller data setup time) * 2)

   - If the **controller reads the Data on the next falling edge** of the clock, the data needs to be valid before a period of the clock (T) with a controller data setup time.
   So maximum Frequency = 1 / (Tclqv + controller data setup time)

Fig 2: Frequency versus Controller Data Latch time
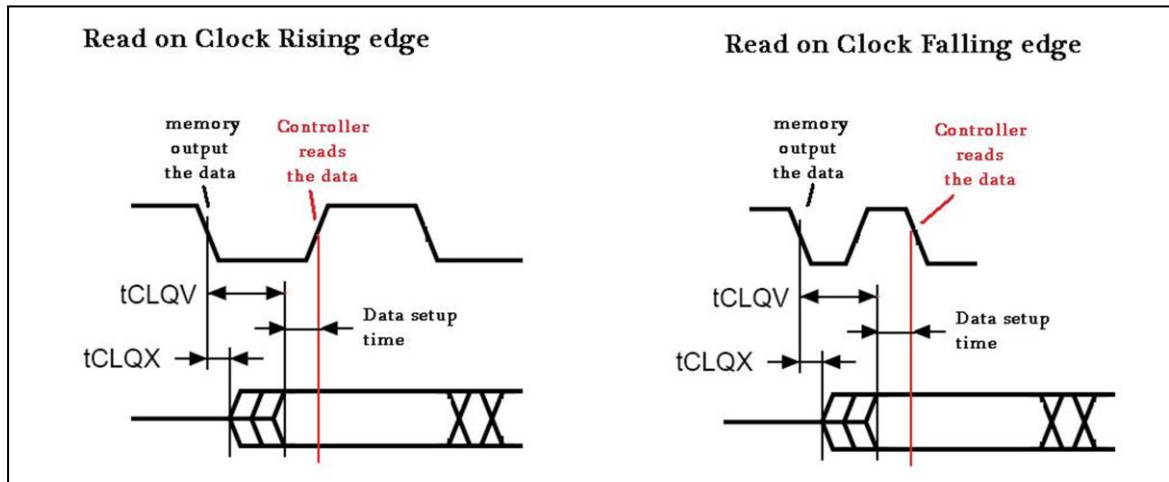
With the same EM100Pro-G2 Data out Valid time (Tclqv), application can use higher frequencies when chipset latch the data on the next falling edge of the clock.

Lot of chipset latches the data between the clock rising edge and falling edge.

The EM100Pro-G2 specification maximum frequencies are given for a chipset latching the data on the clock falling edge and for a SPI bus capacitance equal to our measurement conditions (15pF max).

Due to the total capacitance added, some application will have to reduce the SPI clock frequency or increase their chipset output buffer current capability in order to fit the SPI timing.

Please contact us for more information on your chipset capability.

If you are chipset supplier, we invite you to contact DediProg to check your chipset capability and provide an efficient service to your customers. **support@dediprog.com**

3.3 Delivery content

Tab 8: Content description

Item	Product	Num	Description
1	EM100Pro-G2	1	SPI Flash Emulator main unit
2	USB 2.0 Cable	1	Connect EM100Pro-G2 to the Host PC
3	2.54mm 2x10 to 2.54mm 2x5 cable	1	Connect the EM100Pro-G2 to the target application with 2.54mm pin header SPI Flash pin out compatible
4	1.27mm 2x4 to 1.27mm 2x4 cable	1	Connect the EM100Pro-G2 to the target application 1.27mm SMT connector (from Item 7, 10, 11)
5	1.27mm 2x4 to 1.27mm 2x4 Cable 2.5cm	1	Connect the EM100Pro-G2 to the target application 1.27mm SMT connector (from Item 7, 10, 11)
6	1.27mm 2x8 to 1.27mm 2x8 cable	1	Connect the EM100Pro-G2 to the target application 1.27mm SMT connector (Item 8 and 12)
7	2.54mm 2x10 to 1.27mm 2x4 SO connection adaptor	1	Connection adaptor from 2.54mm to 1.27mm pitch (From EM100Pro-G2 to Item 4 or 5 or 6 in application)
8	2.54mm 2x10 to 1.27mm 2x8 SO connection adaptor	1	Connect the EM100Pro-G2 to the target application with 2.54mm pin header but no standard pin out
9	EM100Pro-G2 Split Cable with grabber clip	1	Connect the EM100Pro-G2 to the target application using DIP engineering socket
10	1.27mm 2x4 SMT male Header(6mm)	4	Soldered in place of the application SPI Flash (Footprint compatible with SO8N & SO8W)
11	1.27mm 2x4 SMT male Header(10.3mm)	4	Soldered in place of the application SPI Flash (Footprint compatible with SO8N & SO8W)
12	1.27mm 2x8 SMT male Header(10.3mm)	4	Soldered in place of the application SPI Flash (Footprint compatible with SO16W)
13	15cm single wire with Dupond header	5	Can be used with Gabber Clip (item16) to force the Hold pin low of the on board Serial Flash
14	EM100Pro-G2 Reference Flash Adaptor (SO8W)	1	Can be used to test the boot from a real Serial Flash
15	EM100Pro-G2 Reference Flash Adaptor (SO16W)	1	Can be used to test the boot from a real Serial Flash
16	Grabber Clip	2	Can be used with item 13
17	CD ROM	1	EM100Pro-G2 software and relative documentation
18	AC switching power adaptor	1	Use the power adaptor as the power source when USB power is not sufficient.

Fig 3. EM100Pro-G2 description

USB Connector

Power Connector

Status LED

Reset and Trig Signal

Memories Signals
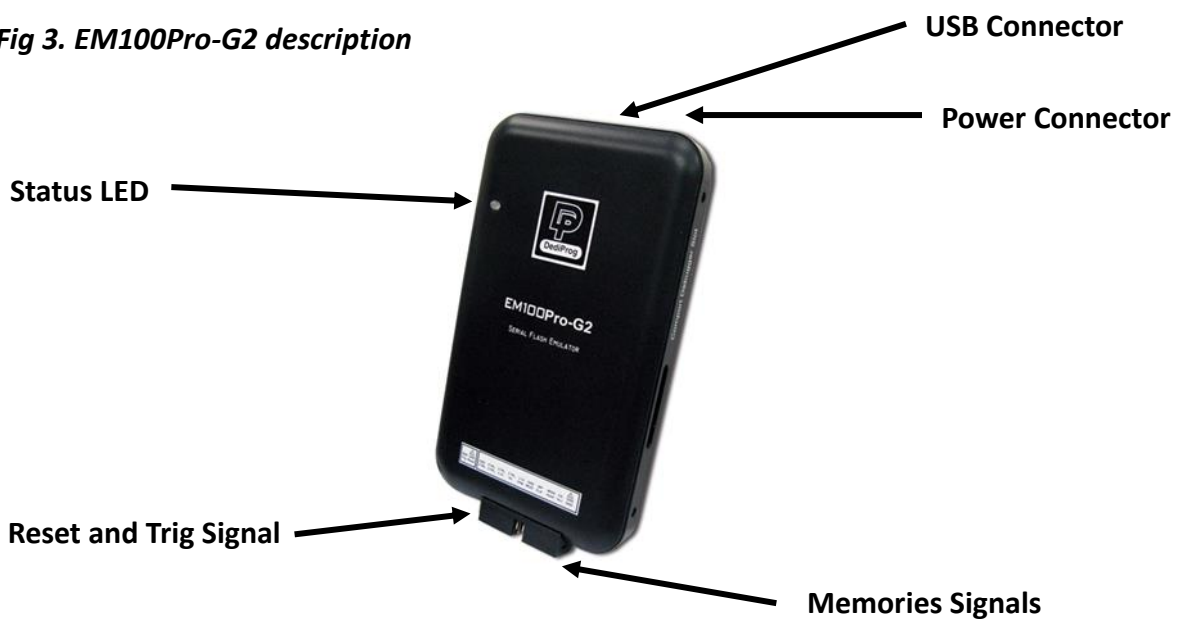
3.4 Reset signal

The Reset signal can be connected to the application system reset to synchronize the application with the emulator.

➢ When emulation is stopped, the reset signal is driven low to reset the system.
➢ When emulation is started, the reset signal is switched in high impedance (pull-up resistor is needed in the application reset circuit) or driven high according to the reset output setting.

User can then download new code release in the EM100Pro-G2 and start automatically the application for new trials.

Warning: Reset signals must only be connected to Reset circuit with open drain and not with push pull to avoid any conflict.

3.5 Warning

User has to notice that the EM100Pro-G2 emulates the Serial Flash protocol and functions and not the Serial Flash timings (frequency, Tclqv..) and analogical inputs and outputs characteristics (Vol, Voh, rising and falling edge..).

Actually, such parameters are chip design and process dependant with lot of potential variation from part to part and are impossible to emulate with accuracy.

So The Serial Flash Emulator will be very convenient to reduce your development time but cannot be completely substituted to the Serial Flash final trials.

IV. Revision History

Date	Version	Changes
2019/06/24	V1.0	Initial release.
2020/02/21	V1.1	EM100Pro-G2 Package Photo Changed.
2020/03/16	V1.2	Modified Tab 8: Content description.
2020/05/12	V1.3	Update VCC value in Tab.2.
2020/11/12	V1.4	Remove VCC voltage monitor description.

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