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EM100-Pro
Serial Flash Emulator
Specification

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 75MHz, 512Kb to 512Mb***
- ***The Highest Code download performances: less than 3 seconds for code update whatever the density selected***
- ***Support the new Dual and Quad IO communication***
- ***Emulate up to two Serial Flash (2*256Mb)***
- ***Display and Edit memory content evolution***
- ***Debug functions: SPI Protocol analyzer, SPI HyperTerminal, Memory status.***
- ***Work with the Serial Flash soldered on board***

Table of content:

I. GENERAL INFORMATION

A.Introduction

The EM100 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 EM100-PRO 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.

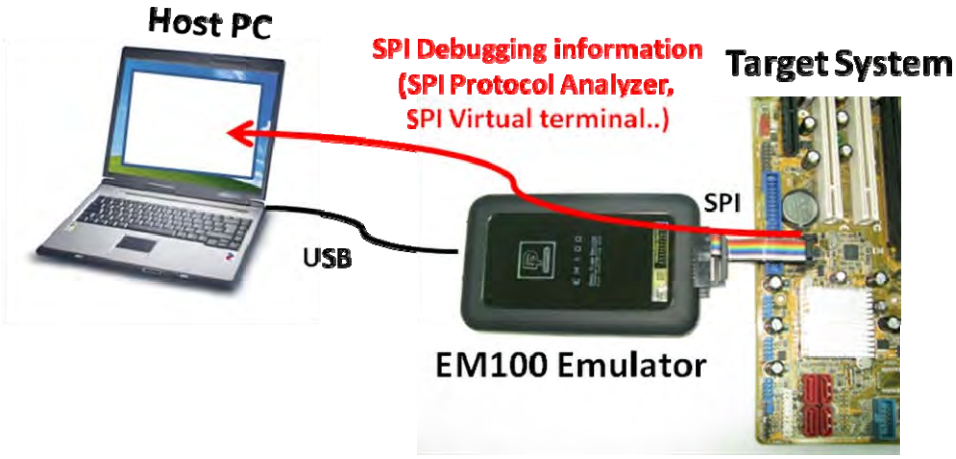
B. Accelerates embedded software development

EM100-PRO 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. EM100-PRO 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.

C.Powerful debugging features

EM100-PRO improves debugger performance:
- With the SPI Protocol Analyzer allowing monitoring all the SPI bus communication
- With the SPI Hyper Terminal interface allowing to display 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»



D.Flexible

Connects to any target hardware

EM100-PRO 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 ***"EM100-PRO Hardware connection.pdf"*** for more detailed information

E. EM100-Pro versus EM100

EM100-Pro replaces the older version EM100 and offer additional features to fit the new Serial Flash specification.

Comparison table: EM100-Pro (New) versus EM100

Features	EM100	EM100-Pro
SPI Flash Emulation: 512Kb to 128Mb	Yes	Yes
SPI Flash Emulation: 256Mb and 512Mb	No	Yes
SPI Flash Emulation of two Serial Flash (up to 2*256Mb)	No	Yes
Performance	Fast	Very Fast
Single IO	Yes	Yes
Dual IO	No	Yes
Quad IO	No	Yes
SPI Protocol analyzer	Yes	Yes
SPI Protocol storage memory	No	Yes
SPI debug messages (hyper terminal)	Yes	Yes
Universal header compatible	Yes	Yes
Availability	Now	Now

II. SPI Flash Emulator Main features

A. EM100-PRO main features

General information:

- ✓ USB powered
- ✓ Palm size
- ✓ Windows XP/ Vista / window 7 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 512Kb to 512Mb SPI Flash
- ✓ **Frequency:** from DC to 75MHz (chipset and application dependant)
- ✓ **I/O:** Unidirectional SPI input and output
- ✓ **Transparency:** Small add-in capacitance to the application SPI bus
- ✓ **Pins option:** Support Wp, Hold and Reset features (when supported by the target Serial flash)
- ✓ **Memory Power:** 3.3V, 3V, 2.5V, 1.8V
- ✓ **Vcc monitoring** for Power On Reset and I/O level auto set.
- ✓ **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.

SPI Trace Window

When the SPI *Trace* feature is started, the EM100-PRO 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 “**********”.

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

A. EM100-PRO pins assignment

The EM100-PRO has two 2.54mm pitch males connectors of:
- 2*2 for the Reset and Trig signals
- 2*10 for the Emulation signals

Tab 1: EM100-PRO pins assignments

3	*1*
GND	*GND*
Trig	*Reset*
4	*2*

19	*17*	*15*	*13*	*11*	*9*	*7*	*5*	*3*	*1*
GND	*CTRL*	*CTRL*	*CTRL*	*3.3V*	*GND*	*WP1*	*MISO*	*CS1*	*Hold2*
CTRL	*CTRL*	*3.3V*	*NC*	*Wp2*	*MOSI*	*CLK*	*Hold1*	*Vcc*	*CS2*
20	*18*	*16*	*14*	*12*	*10*	*8*	*6*	*4*	*2*

- *The signals 3 to 10 (blue) are use for the SPI Flash 1 and are pin out compatible with the standard SPI pin out.*
- *The signals 1, 2 and 12 are used for the SPI Flash 2. Quad IO is only supported if Serial Flash 2 is sharing the SPI bus with Serial Flash 1.*
- *The others signals are planned for future options.*

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

The signals WP1, WP2, CS1, CS2, CLK, MISO, MOSI Hold1 and Hold2 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.

Vcc signal has to be connected to the application Serial flash power as EM100-PRO is monitoring the power level in order to enable or disable the SPI outputs.
- *If Vcc>POR then SPI output are enabled*
- *If Vcc<POR then SPI outputs are switched in High impedance to not damage the application controller.*

B.Performances

This section summarizes the operating and measurement conditions, and the DC and AC characteristics of the EM100-PRO. 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 EM100-PRO	4.8	5.2	V
I_USB	Current supplied by USB	500		mA
Vcc	Application Vcc to memory	2.7	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 EM100-PRO, cable and application capacitance.

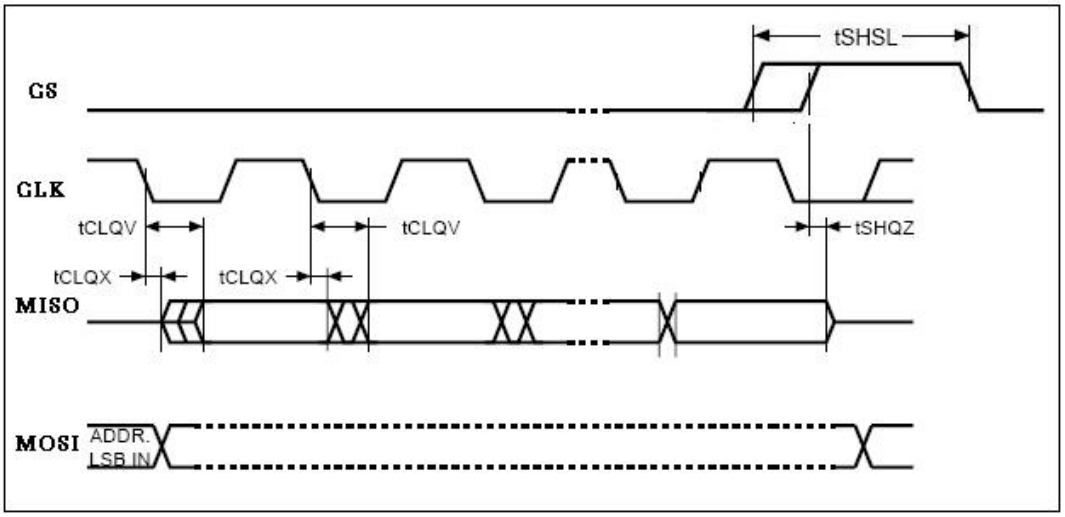
Tab 6: DC Characteristics

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	75	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:

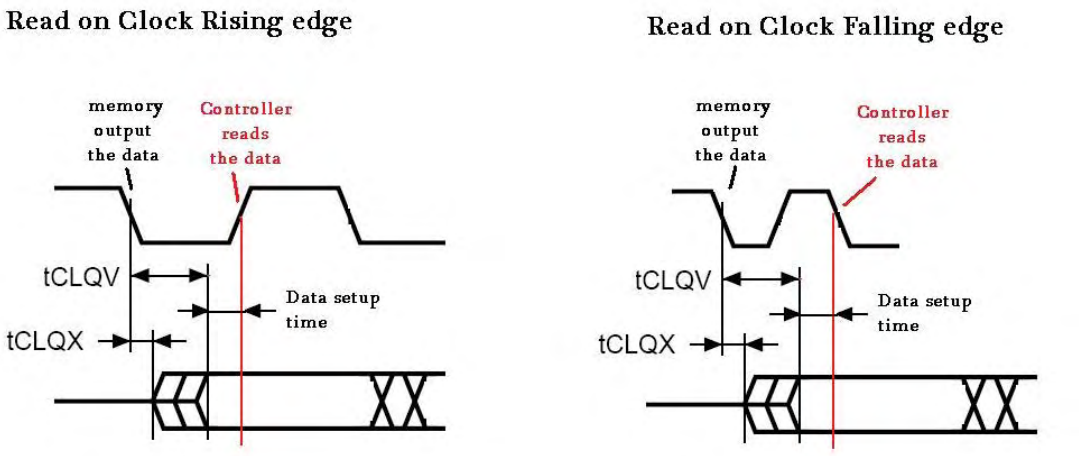
1) **The total SPI bus Capacitance:**
   - Application capacitance (Controller IO, SPI layout..)
   - EM100-PRO capacitance
   - Cable capacitance (length dependant)

   From this total SPI bus capacitance will depend the Data out valid time (Tclqv).

2) **The controller Data In latch time:**
To stay compatible with the market SPI flash, the EM100-PRO 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 EM100-PRO 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 EM100-PRO 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 you're your chipset capability and provide an efficient service to your customers. **support@dediprog.com**

A.Delivery content

Tab 8: Content description

Item	Product	Numb	Description
1	EM100-PRO	1	SPI Flash Emulator main unit
2	USB Cable	1	Connect EM100-PRO to the Host PC
3	2.54mm 2x10 to 2.54mm 2x5 cable	1	Connect the EM100-PRO 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 EM100-PRO to the target application 1.27mm SMT connector (from Item 6 to item 9)
5	1.27mm 2x8 to 1.27mm 2x8 cable	1	Connect the EM100-PRO to the target application 1.27mm SMT connector (from Item 6 to item 10)
6	2.54mm 2x10 to 1.27mm 2x4 connection adaptor	1	Connection adaptor from 2.54mm to 1.27mm pitch (From EM100-PRO to Item 4 or 5 in application)
7	EM100-PRO Split Cable	1	Connect the EM100-PRO to the target application with 2.54mm pin header but no standard pin out
8	EM100-PRO DIP Cable	1	Connect the EM100-PRO to the target application using DIP engineering socket
9	1.27mm 2x4 SMT male header	2	Soldered in place of the application SPI Flash (Footprint compatible with SO8N & SO8W)
10	1.27mm 2x8 SMT male Header	2	Soldered in place of the application SPI Flash (Footprint compatible with SO16)
11	15cm single wire with Dupond header	1	Can be used with Gabber Clip (item 14) to force the Hold pin low of the on board Serial Flash
12	EM100-PRO Reference Flash Adaptor (SO8W)	1	Can be used to test the boot from a real Serial Flash
13	EM100-PRO Reference Flash Adaptor (SO16W)	1	Can be used to test the boot from a real Serial Flash
14	Grabber Clip	1	Can be used with item 11
15	CD ROM	1	EM100-PRO software and relative documentation

Fig 4. EM100-PRO description

F. 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 EM100-PRO 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.*

H. Application Power monitoring

EM100-PRO continuously checks for the presence of the voltage supplied by the target board to the device under emulation (Vcc pin), and indicates on the user interface (in the status bar) when no voltage is detected. In this case, an error message is issued in the user interface, emulation is stopped and SPI output switched in High impedance to protect the target application.

J. Warning

User has to notice that the EM100-PRO 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.

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