

Мастер-модуль M903E	M903E Master Module
Устройство программного управления	Program Control Unit

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1 Purpose and general description

M903E master module determines computing and network resources of a controller and is intended for use as the controller's central computing unit, for collecting data from input channels, programmable logic processing of the data received and sending control actions to output channels, as well as for organizing and supporting various communication protocols when used within complex PCS/SCADA systems.

M903E is based on Intel Atom processor and has the following distinctive features:

- continued support of 2 Ethernet ports (LAN 1, LAN 2 connectors);
- additional board for Ethernet communication adapter of PCI Express x1 standard (optional), with external adapter circuits brought out to separate LAN 3, LAN 4, SFP 1, SFP 2 connectors on the master front panel;
- mini PCI Express x1 connector (located inside the case) for connecting peripherals (WiFi cards, WiMax cards, GSM modems, GPS receivers, etc.);
- galvanically isolated ST-BUS with support for two protocols: ST-BUS (M) and ST-BUS (N) (the type is set via software) to work with modules of M900 and M500 series, respectively;
- slot for microSD cards (up to 32 GB);
- WATCHDOG timer;
- USB port;
- basic interface RS485/232/422;
- robust metal case (the device can be operated at temperatures of minus 40 to 60 °C).

2 Module components

The module consists of the following main functional blocks:

- processor unit (CPU) is an x86 x64 compatible computer. It features the Qseven form factor;
- communication adapter provides connection to Ethernet networks via RJ45 and SFP. The adapter is mounted on a separate board and connected via the PCI-E bus. The availability of this function is determined when ordering the module. The 1000BASE-T 10/100/1000 Mbps interface is used to connect the master module to a PC or Ethernet network. It is equipped with SFP 1 Gb/s ports (Ethernet interface 1000Base-X) and SFP modules (SFP type is determined when ordering the module). The basic version of M903E master module features two built-in Ethernet ports (LAN 1, LAN 2 connector); additional Ethernet channels (LAN3, LAN 4 connector), and SFP 1, SFP 2 are optionally selected when ordering the module;
- ST-BUS controller provides the transport protocol of the internal network of TREI-5B-05 devices when exchanging data with I/O modules. The module features a galvanically isolated ST-BUS. ST-BUS is a serial interface based on RS-485, through which the master module exchanges data with I/O modules. ST-BUS is always used for communication with smart modules;
- RAM (2 GB RAM) is designed for storing operating programs and intermediate current data in the module;
- WATCHDOG timer monitors CPU operation and, in the event of a malfunction, hard reset of the master module is implemented;
- temperature sensor controls temperature inside the device.

The master module is designed in a metal case.

The supply voltage is connected to V1+, V1- and V2+, V2- terminals. The module allows for power supply protection directly in the module; V1+ and V2+ circuits are coupled inside the module through diodes (which also protect against reverse polarity); V1- and V2- circuits are coupled. The functional diagram of the master module is shown in *Figure 1*.

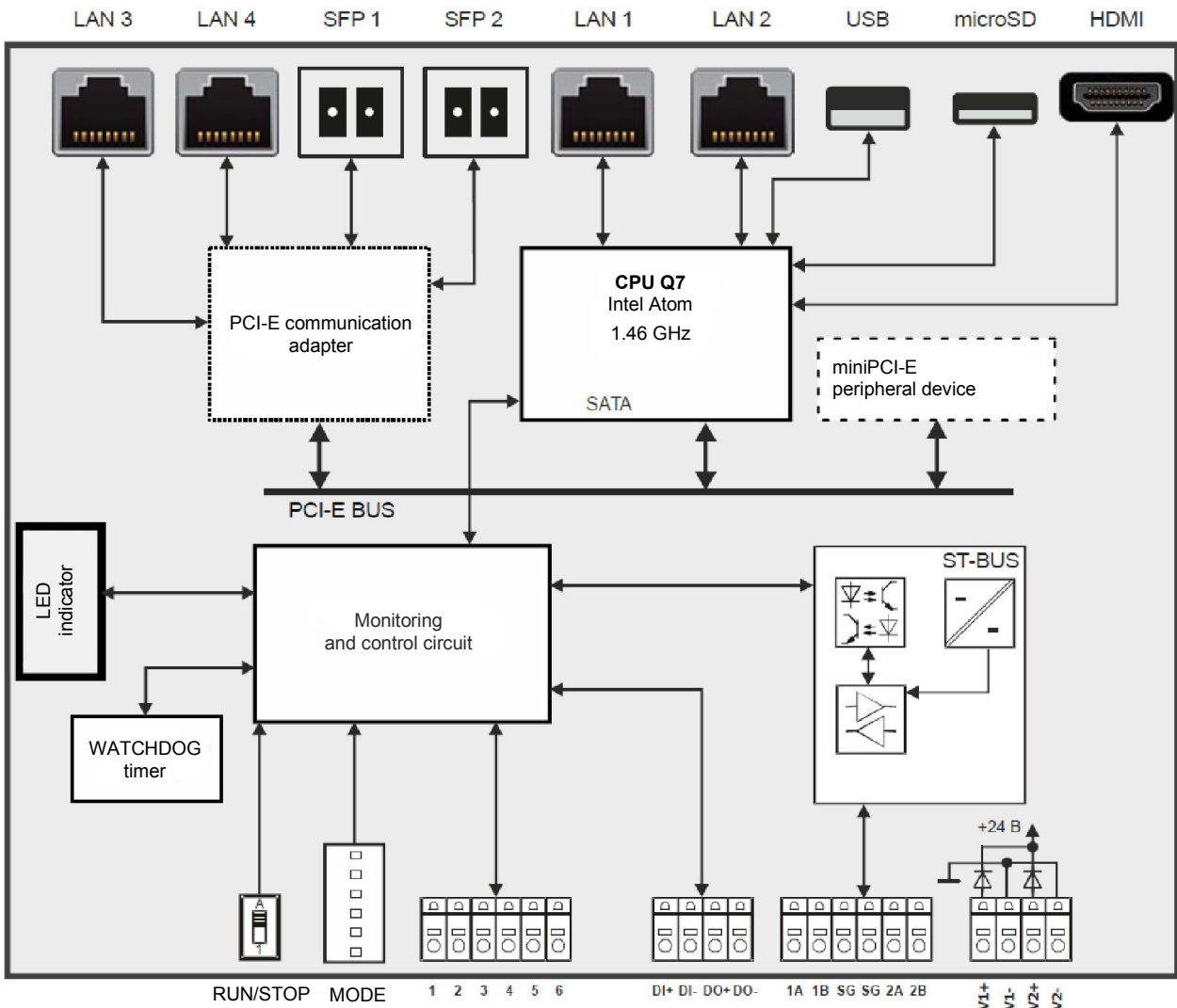


Figure 1 — Functional diagram of M903E master module

3 M903E master module specifications

See master module general specifications in Table 1.

Table 1

Parameter	Value
Processor type	E3800 Intel Atom
CPU clock speed	1.46 GHz
RAM amount, GB	2
ROM type and amount	SATA SSD, 4 GB (minimum)
External communication bus type	Ethernet (1000BASE-T 10/100/1000 Mb/s), SFP (1000Base-X)
ST-BUS physical implementation	RS-485 interface dual half-duplex
ST-BUS protocol type	ST-BUS(M), ST-BUS(N)

Table 1 (cont'd)

Parameter	Value
Data transfer rate via ST-BUS(N) protocol, kbps	1.2 / 2.4 / 4.8 / 9.6 / 19.2 / 38.4 / 57.6 / 115.2 / 250 / 625 / 1250 / 2500 / 5000
Data transfer rate via ST-BUS(M) protocol, kbps	1.2 / 2.4 / 4.8 / 9.6 / 19.2 / 38.4 / 57.6 / 115.2 / 250 / 625 / 1250 / 2500
Number of ST-BUS modules	Up to 255
Maximum length of ST-BUS, m	1200
Bus for connecting smart modules	ST-BUS, Ethernet
Master module redundancy	100 % redundancy
Built-in (partially) nonvolatile real-time clock	yes
Operability monitoring	WATCHDOG timer (0.1 s to 65 s, standard value 1.7 s)
Number of RS-485/422/232 interfaces	1 (type is set via software)
Operating system	QNX 6.5.0
Insulating strength relative to module internal circuits, V (DC), min	1000 for ST-BUS bus circuits, RS-485/RS-232 interface
DC supply voltage, V	24 (-15...+20 %)
Power consumption, W, max	15
Overall module dimensions, mm	164x128x61
Weight, kg, max	1.3
<p>Order code M903E — [-][-][-][-]</p> <p>[+][-][-][-] communication adapter*</p> <p>0 — no</p> <p>1 — yes</p> <p>[-][+][-][-] SFP1-module**</p> <p>0 — no</p> <p>1 — SFP-MM 2 km (1310 nm)</p> <p>2 — SFP-SM 20 km (1310 nm)</p> <p>3 — SFP-SM 40 km (1550 nm)</p> <p>[-][-][+][-] SFP2-module**</p> <p>0 — no</p> <p>1 — SFP-MM 2 km (1310 nm)</p> <p>2 — SFP-SM 20 km (1310 nm)</p> <p>3 — SFP-SM 40 km (1550 nm)</p> <p>[-][-][-][+] peripheral device (backup)</p> <p>0 — no</p> <p>[-][-][-][+] 0/1 operating temperature range, °C 0-60/-40-60</p> <p>Notes</p> <p>1 * features 2 Ethernet ports with an ability to install up to 2 SFP ports.</p> <p>2 ** to be ordered only if a communication adapter is installed.</p>	

4 Design and operation of M903E master module

4.1 Operating modes

The operating mode of the master module determines the operating mode of the controller. The controller operating mode in case of master module backup is determined by correct configuration and operating modes of both master modules.

The controller functions in one of the following modes:

- technological mode;
- configuration mode;
- executive mode.

The controller operating mode is set by the position of switches on the front panel of M903E master module. The operating mode can be selected only during executive system starting.

Technological mode

In this mode, only operating system with support for network interfaces is loaded on the controller. Technological mode can be used to ensure safe conduct of the following operations, including via Ethernet using an engineering station:

- updating of controller command and configuration files;
- software installation;
- ROM contents archiving;
- hardware diagnostics.

Configuration mode

Configuration mode can be used in operations as follows:

- configuration of I/O modules;
- calibration of I/O channels;
- checking operability of I/O channels;
- loading an application into smart modules and operator consoles.

Executive mode

In this mode, the executive system, which includes the target task core and communication tasks for various purposes, is launched via the controller.

It provides loading, debugging, and real-time execution of a technological program for facility monitoring and control. Data exchange with external devices and SCADA systems via various interfaces is provided.

In executive mode, all configuration mode operations are also available.

In case of a voltage drop, the current database (up to 1 MB) is saved. The saved application database is restored, and the module statuses remain unchanged during warm start of the controller. During cold start, the application database is not restored, and the I/O modules are reset.



WARNING! The output channel statuses are reset during cold start or when resetting the I/O module.

If the technological application is shut down (via a debugger), the controller goes into configuration mode. In this case, connection with the debugger is maintained.

I/O modules are initialized and polled after loading of the correct application has been finished.

A hardware reset timer (Watchdog timer) starts via software. The Watchdog timer restart time is set via software as well, – from 0.1 s to 65 s, with a standard value of 1.7 s. If a non-recoverable fault of master module software tasks (failure) or “freezing” of the technological task (when using Watchdog timer) occurs, the Watchdog timer performs zero reset of all discrete outputs and hard reset of the master module.

4.2 Front panel elements

The front panel of the master module includes:

- MODE switch, which determines the operating modes of the module (the purpose of all switches is software-based);
- ST-BUS connector for data exchange with I/O modules;
- LAN 1, LAN 2 connector (connection to PC, external local network or operator station);
- LAN 3, LAN 4, SFP 1, SFP 2 connector (optional);
- connector with power supply connection terminals;
- connector with connection terminals for RS-485/422/232 interfaces and discrete I/O;
- USB connector for USB 2.0 interface devices;
- microSD slot;
- RUN/STOP module status switch.

4.3 Display and diagnostics

Current status LED display is located on the front panel of M903E master module.

M903E master module runs diagnostics of its own resources and shared controller resources.

The following module malfunctions are diagnosed:

- program execution time-out — Watchdog with a restart time of 1.7 s;
- ST-BUS break or errors during data transmission via ST-BUS;
- application errors;
- external communications errors;
- abnormal termination of running software services.

The following malfunctions of shared controller resources are diagnosed:

- 24 V supply voltage drop;
- faults and errors of computer-process interface modules.

The diagnosed information falls into 4 groups (see *Figure 2*):

- master module operating mode (primary/backup/debugging);
- “Master”: master module errors (error code or “ok”);
- “Communication”: modules communication errors (module number or “ok”);
- “Modules”: diagnostics obtained from I/O modules (faulty module number or “ok”).

Diagnostic results are recorded in a nonvolatile archive, and are available for viewing in the UnimodPro technological program.



Figure 2 — M903E master module display

Основной	Primary
Мастер	Master
Связь	Communication
Модули	Modules

4.4 Configuring I/O ports and operating modes

The I/O ports and operating modes of M903E master module are configured via software. Similarly, the operating mode and the exchange protocol for RS-485/232/422, ST-BUS, Ethernet interfaces are software-defined.

4.5 Connecting external circuits

Options for connecting external circuits to the RS connector are shown in figures 3-5.

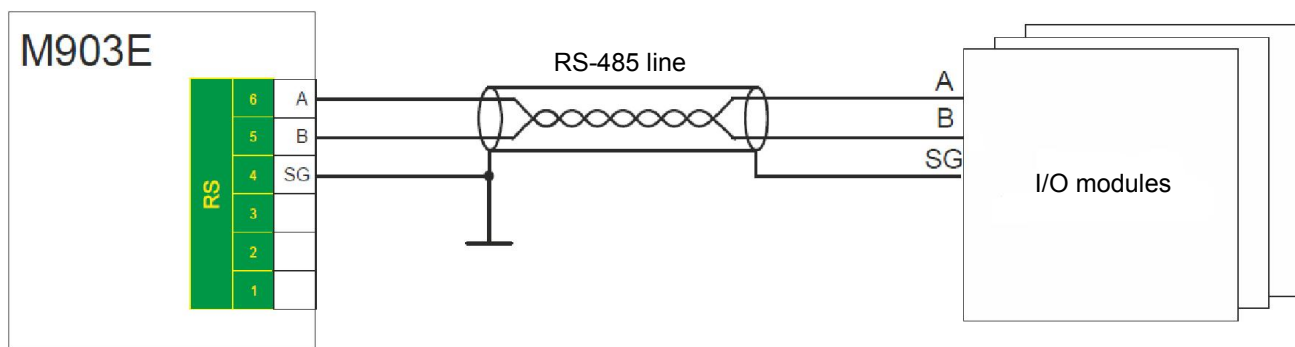


Figure 3 — Connecting external circuits to RS-485 interface

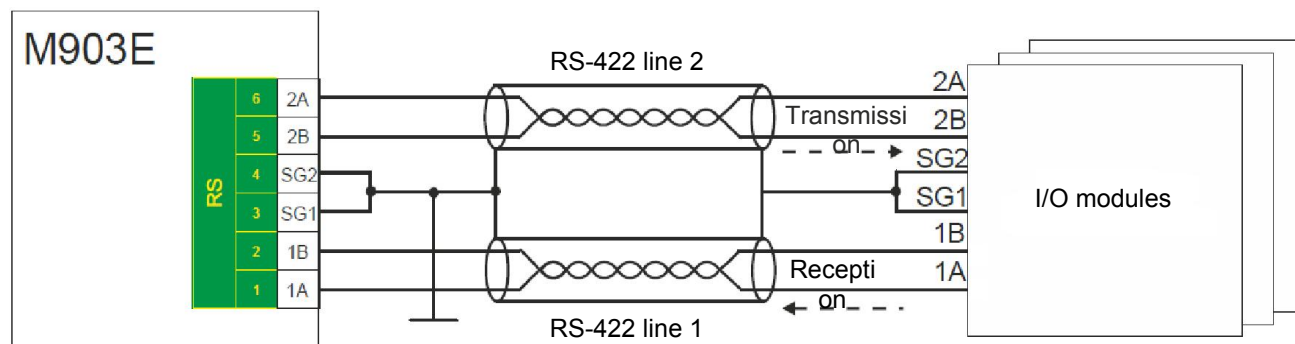


Figure 4 — Connecting external circuits to RS-422 interface (full duplex)

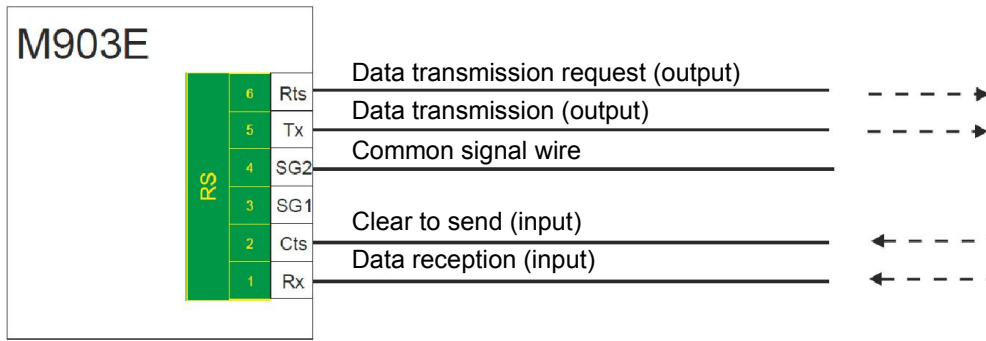


Figure 5 — Connecting external circuits to RS-232 interface

Options for connecting external circuits to ST-BUS line are shown in Figure 6.

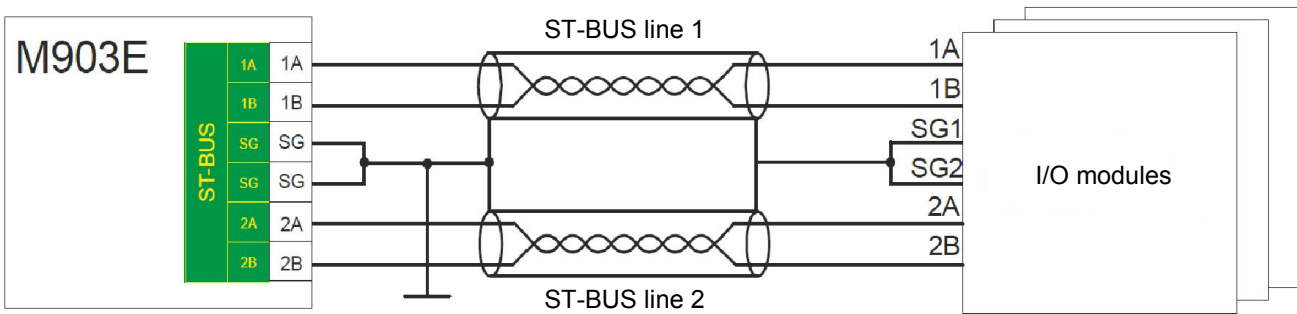


Figure 6 — Connecting external circuits to ST-BUS line (double half-duplex)

4.6 Redundancy

A diagram for continuous 100 % redundancy of master modules with Ethernet (SFP) lines redundancy is shown in Figure 7. Redundancy may also be of combined type, i. e. with one Ethernet line and one SFP line. If Ethernet (SFP) lines redundancy is not necessary, then one Ethernet (SFP) line is enough.

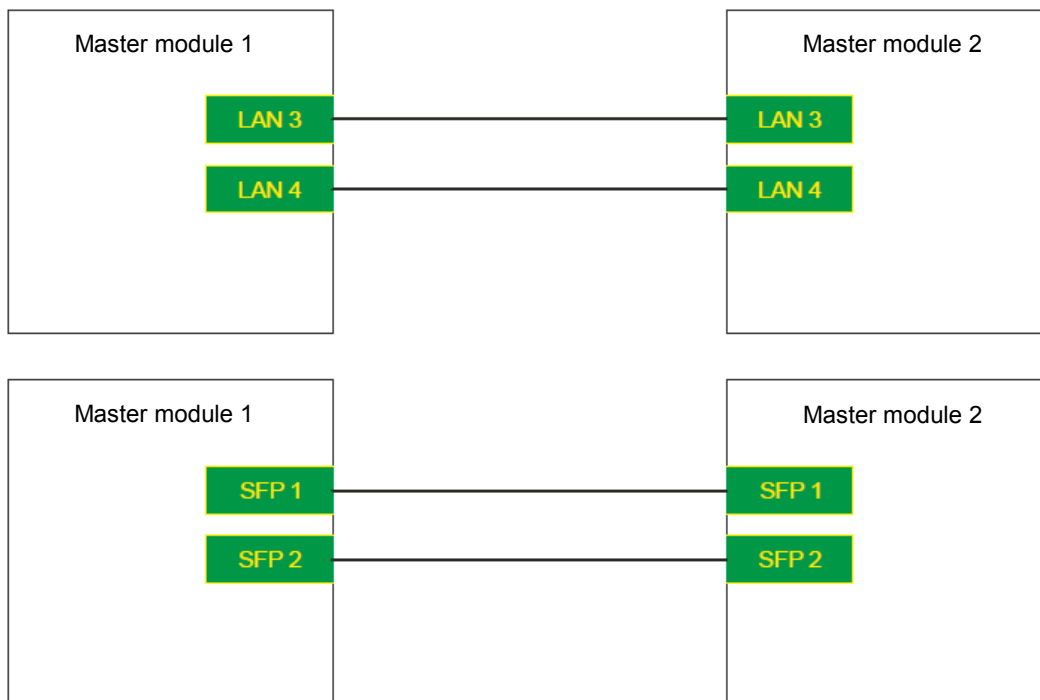


Figure 7 — Diagram for master modules redundancy via Ethernet and SFP

A diagram for master modules redundancy with operating mode selection via an external switch and Ethernet lines redundancy is shown in *Figure 8*. If Ethernet lines redundancy is not necessary, then one Ethernet line is enough.

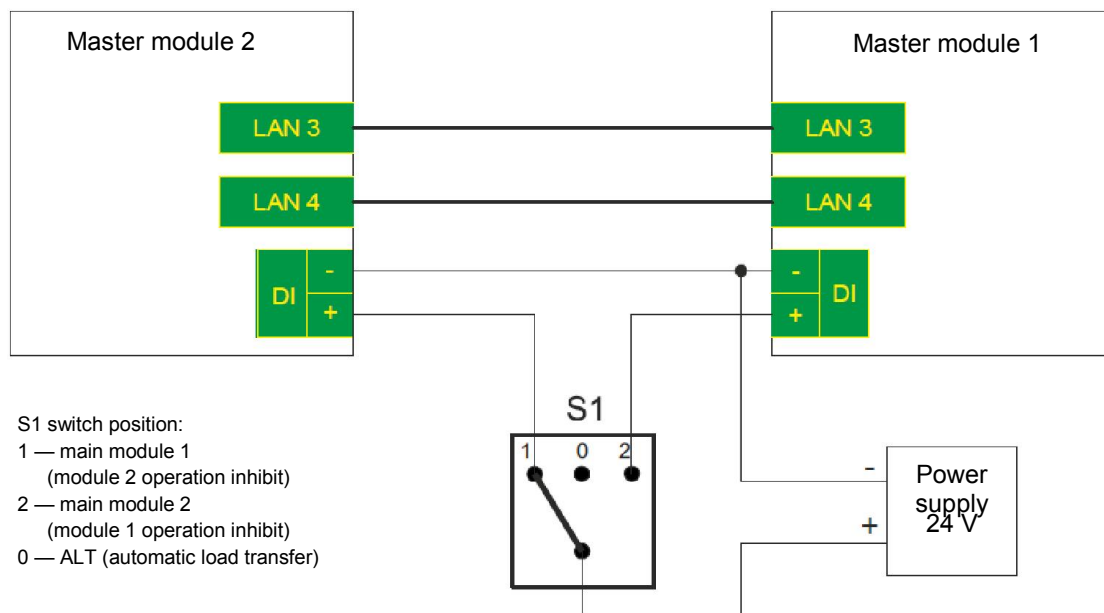


Figure 8 — Diagram for master modules redundancy via an external switch

5 Intended use

Operating limits



WARNING! Do not make connections or switching in hot mode with master module on.

