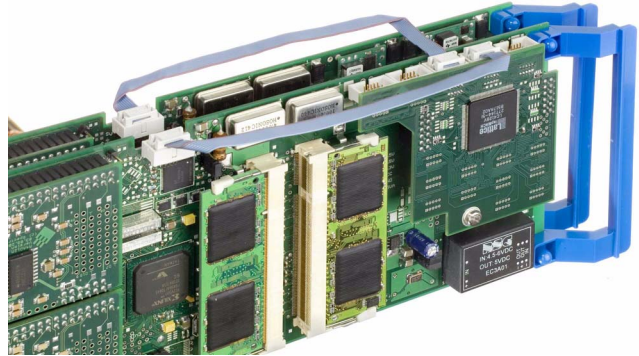# M2i Synchronization Star-Hub

- **For all M2i.xxxx and M2i.xxxx-exp boards available**
- **No clock delay between channels**
- **Supports up to 16 boards in one system**
- **Multiple systems synchronization**
- **Clock and trigger synchronization**
- **Piggyback module for M2i boards**
- **All cables included**
- **Easy-to-program software interface**
- **Later synchronization of already delivered cards as slaves possible**
- **Later extension of systems possible**

## General Information

The Star-Hub modules allow the synchronization of up to 16 M2i boards in one system or even the synchronization of multiple systems each equipped with several boards. The synchronization option was designed for system setup with no phase delay between channels.

The connection of the boards is automatically recognized and checked by the driver at load time. The programming of the Star-Hub is included in the standard board interface and consists of only a few additional commands.
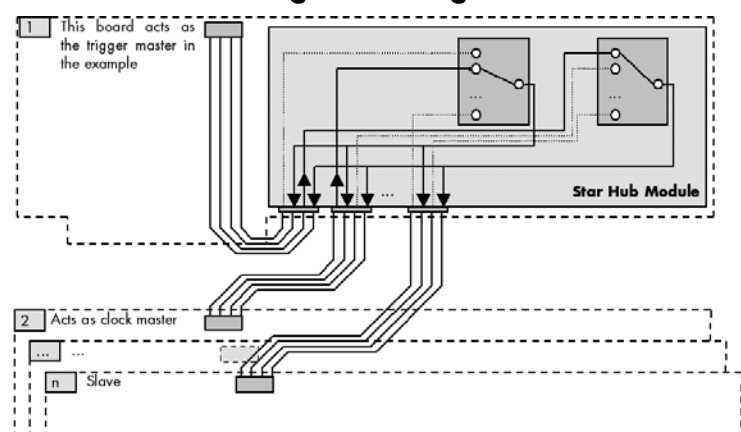
## Synchronization in one system

Two versions of the Star-Hub are available: a 5 card version (Star-Hub 5) and a 16 card version (Star-Hub 16). The 5 card version as shown in the picture doesn't need an additional system slot while the 16 card version occupies the adjacent system slot.

It is possible to synchronize boards of the same type with each other as well as different types. The module acts as a Star-Hub for clock and trigger. Each board is connected with a small cable of the same length, even the master board. That minimises the clock skew between the different boards. Any board inside this system can be the clock master. All clock sources of this board can be used, be it internal clock, reference clock or external clock.

Any one or even several boards can be used as trigger sources for the complete system. The trigger source of all boards can be combined with logical OR or logical AND. All trigger modes that are available on the master boards are also available if the synchronization Star-Hub is used.

Synchronized cards do not need to run with the same sampling rate. Indeed it is possible to run any of the cards with a divided sampling clock that is still synchronized with the fastest clock. This allows to synchronize even cards of different speed grades without slowing down the fast cards. For sure it is also possible to synchronize different card types with each other, for example A/D running synchronuous with D/A or A/D combined with Digital I/O.

## Hardware block diagram of single Star-Hub



## System synchronization

It is even possible to synchronize several systems with each other having the same advantages that the standard Star-Hub gives. The need for a system synchronization can be given if:

- The number of channels that fit into one system should be exceeded
- Data should be stored continuously to hard disk RAID array and the limits of the PCI/PCI-X or PCIe bus doesn't allow to place all cards in one system
- Extensive online calculations have to be made for several channels and the bus bandwidth is not capable of streaming data for all channels or the CPU power is not sufficient

This system synchronization can be done using special System Star-Hubs. Each system is then equipped with one System Star-Hub which is connected with a Master System Star-Hub. In this setup the master system generates clock and trigger as described before. All slave systems only receive clock and trigger information and ca not be used as clock or trigger sources.

The complete system can be extended step by step by adding new systems with a Slave System Star-Hub or by adding new cards to one system. This extension can be continued until the maximum number of supported cards is reached. However it is still possible in this configuration to use the slave systems as independent synchronised systems allowing again all possibilities of the standard one system Star-Hub.

# System Synchronization block diagram
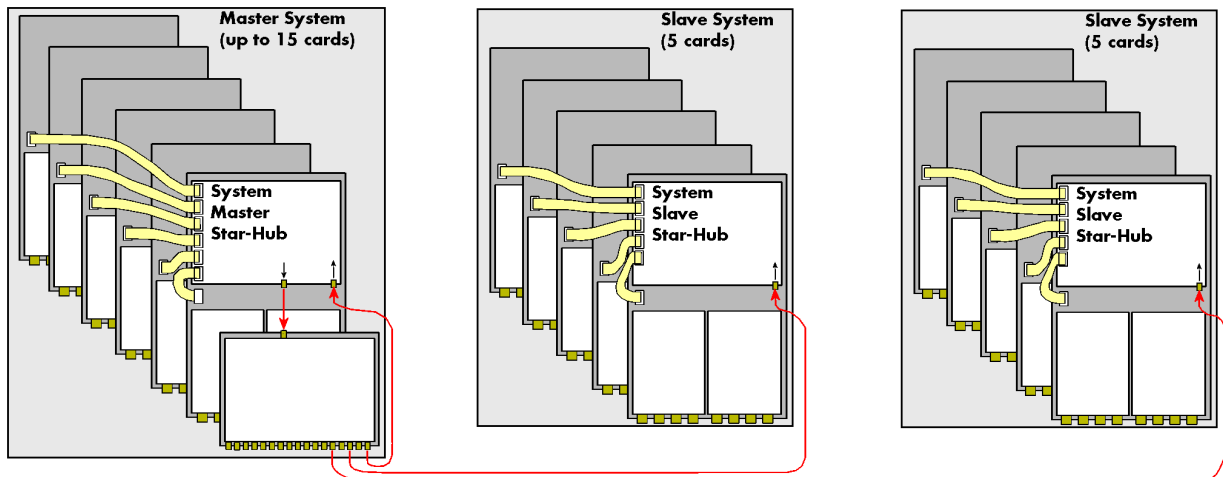


The master system generates trigger and clock information for all systems. Trigger and clock signals are routed to the slave systems as well as to the master itself using shielded coax cables. The system-connection lines have equal length. Within each system a System Star-Hub distributes the signals to each connected card. These cables again have all the same length.

## Technical Details

| | Star-Hub 5 | Star-Hub 16 | System Star-Hub Master | System Star-Hub Slave 5 | System Star-Hub Slave 16 |
|---|---|---|---|---|---|
| Max sync cards in system | 5 | 16 | 15 | 5 | 16 |
| Max synchronized systems | n.a. | n.a. | 17 (including master) | n.a. | n.a. |
| Additional space needed | - | 1 slot (space only) | 1 additional PCI slot needed | 1 slot (bracket and space only) | 1 slot (bracket and space only) |
| internal sync cables included | 5 | 16 | 15 | 5 | 16 |
| system sync cables included | - | - | - | 1 set (2 cables) of 2m | 1 set (2 cables) of 2m |
| Clock master | Any card in system | Any card in system | Any card in system | System Star-Hub Master clock | System Star-Hub Master clock |
| Divided clock on cards | possible | possible | possible | n.a. | n.a. |
| Trigger master | Any card in system | Any card in system | Any card in system | System Star-Hub Master trigger | System Star-Hub Master trigger |
| Trigger OR/AND conjunction | possible | possible | possible | n.a. | n.a. |
| Differing memory setup | possible | possible | possible | n.a. | n.a. |
| Minimum sampling rate | no additional limits | no additional limits | no additional limits | limits to minimum external clock | limits to minimum external clock |

## Maximum number of channels in example configurations

| | Card type in example | Sampling rate per channel | Star-Hub 5 | Star-Hub 16 | Multiple Systems Slave Star-Hub 5 | Multiple Systems Slave Star-Hub 16 |
|---|---|---|---|---|---|---|
| Max number of cards in total | | | 5 cards | 16 cards | 95 cards | 271 cards |
| 8 bit A/D channels | M2i.2031 | 100 MS/s | 20 channels | 64 channels | 380 channels | 1084 channels |
| Medium fast 12 bit A/D channels | M2i.3122 | 10 MS/s | 40 channels | 128 channels | 760 channels | 2168 channels |
| Fast 12 bit A/D channels | M2i.3027 | 100 MS/s | 10 channels | 32 channels | 190 channels | 542 channels |
| 16 bit A/D (SE or fully differential) | M2i.4652 | 3 MS/s | 40 channels | 128 channels | 760 channels | 2168 channels |
| Slow 16 bit A/D channels (SE) | M2i.4731 | 500 kS/s | 80 channels | 256 channels | 1520 channels | 4336 channels |
| Fast digital I/O channels | M2i.7020 | 125 MS/s | 160 channels | 512 channels | 3040 channels | 8672 channels |
| Fast D/A channels | M2i.6111 | 125 MS/s | 20 channels | 64 channels | 380 channels | 1084 channels |

## Order Information

**Options**

| Order no. | Option |
|---|---|
| M2i.xxxx-SH5 (1) | Synchronization Star-Hub for up to 5 cards in one system, only 1 slot width, all sync cables included |
| M2i.xxxx-SH16 (1) | Synchronization Star-Hub for up to 16 cards in one system, all sync cables included |
| M2i.xxxx-SSHM (1) | System-Star-Hub Master for up to 15 cards in the system and up to 17 systems, sync cables included |
| M2i.xxxx-SSHS5 (1) | System-Star-Hub Slave for up to 5 cards in one system, all sync cables included |
| M2i.xxxx-SSHS16 (1) | System-Star-Hub Slave for up to 16 cards in one system, all sync cables included |

[1] : Just one of the options can be installed on a card at a time.
[2] : Third party product with warranty differing from our export conditions. No volume rebate possible.