SWITCHERGEAR
GEAR TO CONTROL YOUR POWER SWITCHES

Module NETETH

Single-port Ethernet Interface
Ethernet PHY and MAC with TCP/IP controller

REFERENCE MANUAL

Features

Standard module for SwitcherGear

Single-port Ethernet, IEEE 802.3

10BASE-T and 100BASE-TX

Link auto-negotiation (speed 10/100, duplex half/full)

Globally unique EUI-48 node address (Ethernet MAC address)

Ethernet controller

- *Implements TCP/IP*
- *Up to 8 sockets*
- *Reduces load on MCU*

12-way pluggable screw terminal

Suggested C2000 peripherals: SPI, GPIO

Applications

General purpose Ethernet interface

Ethernet based fieldbus protocols, e.g. Modbus TCP

General Description

The NETETH module is a single-port Ethernet interface for the SwitcherGear modular controller system.

Ordering Information

Order Code	***Description***
NETETH	*SwitcherGear module, single-port Ethernet interface.*

Module Quick Start

1. **Set the configurable features.**

   Determine the feature settings that are required for the system under control. If necessary, change the default solder jumper settings. Refer to the Configuration section.

2. **Review the allocation of the MCU interface signals.**

   Confirm that the MCU interface signals connect to appropriate pins on the host MCU. Refer to your SwitcherGear configuration document and Table 3.

3. **Insert into the base slot.**

   Refer to your SwitcherGear configuration document for the location of modules.

4. **Connect the external wiring to the system connector.**

   Refer to Table 1 for the pin-out of the system connector.

Standard Interfaces

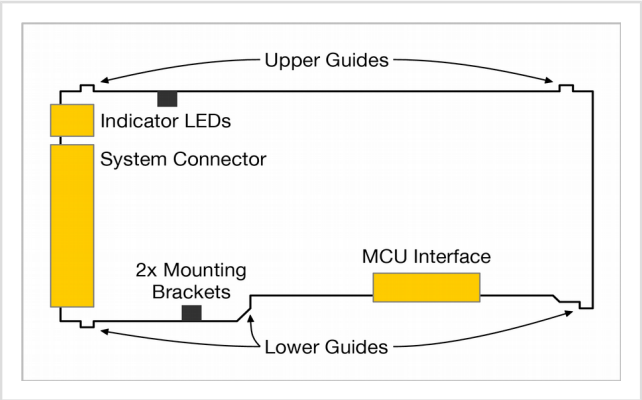

Figure 1: Parts of a SwitcherGear module.

System Connector

A 12-way pluggable terminal strip connector is used to connect Ethernet wiring to the NETETH module. Table 1 shows the pin-out of this connector.

The connector can be keyed by inserting the supplied red coding keys into the slots on the header. The corresponding moulded key on the plug must be removed to allow insertion into the header.

Indicator LEDs

Four miniature indicator LEDs on the front panel show the status of the Ethernet link, including link establishment, activity, speed and duplex. Refer to Table 2 for details.

MCU interface

The MCU interface connects analogue and digital signals between the module and the host MCU.

Table 1: System connector

Pin	Signal	Description
1 (Top)	TX+	Positive line of Ethernet transmit twisted-pair
2	TX−	Negative line of Ethernet transmit twisted-pair
3	-	(Not used, but has signal termination for unused twisted-pair 1)
4	-	(Not used, but has signal termination for unused twisted-pair 1)
5	RX+	Positive line of Ethernet receive twisted-pair
6	RX−	Negative line of Ethernet receive twisted-pair
7	-	(Not used, but has signal termination for unused twisted-pair 2)
8	-	(Not used, but has signal termination for unused twisted-pair 2)
9	-	-
10	-	-
11	-	-
12 (Bottom)	FIELDGND	-

Table 2: Indicator LEDs

Appearance	Left Column		Right Column	
	Colour	Description	Colour	Description
● ●	Green	**Link status** ON Link established OFF Link not established	Green	**Link activity** Flash on transmit and receive activity
● ●	Green	**Link Speed** ON 100 Mbps OFF 10 Mbps	Green	**Link Duplex** ON Full duplex OFF Half-duplex
● ●	-	-	-	-
● ●	-	-	-	-

Table 3: MCU interface

Pin	Signal	Description
D0	CSn Ethernet	SPI chip select signal for Ethernet controller, active-low input.
D1	SCLK	SPI clock, input.
D2	SIMO	SPI slave-in master-out signal, input.
D3	SOMI	SPI slave-out-master-in signal, output.
D4	CSn MAC Addr	SPI chip select signal for node address device, active-low input.
D5	INTn	Interrupt signal for Ethernet controller, active-low output.
D6	RSTn	Reset signal for Ethernet controller, active-low input.
D7	-	-
D8	-	-
D9	-	-
D10	-	-
D11	-	-
A0	-	-
A1	-	-
A2	-	-
A3	-	-

Refer to Table 3 for details of the digital and analogue signals provided by the MCU interface of this module.

Refer to the SwitcherGear Configuration Document for your specific SwitcherGear unit for information on the routing of signals between the installed modules and the host MCU.

Configuration

PHY Mode

The Ethernet media dependent interface (MDI) can operate in either 10 Mbps or 100 Mbps speed mode, and in either half-duplex or full-duplex mode.

The mode settings of the NETETH module must match the mode setting of the Ethernet link partner (the device at the other end of the Ethernet cable). This can be achieved in two ways.

The most common way is to enable auto-negotiation mode and allow the devices to negotiate to the best mode settings that both support.

Table 4.

Table 4: Configuration of Ethernet PHY mode using the PMODE solder jumpers. O = jumper open-circuit, S = jumper short-circuit.

Auto	Speed	Duplex	PMODE		
	Mbps		2	1	0
Yes	10 / 100	Half / Full	O	O	O
Yes	100	Half	O	S	S
No	100	Full	S	O	O
No	100	Half	S	O	S
No	10	Full	S	S	O
No	10	Half	S	S	S

Solder Jumpers

Modules are supplied with all solder jumpers in the open state. These default feature settings are highlighted in grey in the configuration tables.

If a different configuration is required for your application, you must change the solder jumper settings before using the SwitcherGear.

Solder jumpers allow configuration of SwitcherGear modules. They function like a switch to control the features of the module. Jumpers consist of two adjacent pads on the rear side of the module circuit board. The jumper can be shorted (switch closed) by making a solder bridge across the pads. The jumper can be opened (switch open) by removing the solder bridge.

The solder jumpers are intended for one-time-only configuration. No warranty is provided for damage to solder jumpers. Only skilled personnel who are trained in correct soldering technique should undertake the configuration of the solder jumpers. Incorrect technique or excessive temperature can result in the pads of the solder jumper detaching from the circuit board, rendering the jumper permanently open-circuit.

Observe the following precautions when configuring solder jumpers:

- Anti-static handling procedures.
- Turn off power before removing or inserting modules.
- Use a fine-tip soldering iron with adjustable temperature.
- Use only lead free solder and compatible tools.
- Use the minimum temperature required to perform the task.
- Do not heat the jumper for more than 5 seconds. Allow to cool before re-applying heat.
- To remove solder from a jumper, use a narrow (e.g. 1.5 mm) fluxed solder wicking braid.

Functional Description

The NETETH Module for SwitcherGear implements a single-port Ethernet interface for the controller. A Wiznet W5500 Ethernet controller on the module implements the physical layer interface that connects to the local area network (LAN), and also a SPI interface that connects to the host microcontroller. A non-volatile memory device, also accessible on the SPI bus, is programmed with a unique 6-byte MAC address for use with the Ethernet controller.

The physical interface implements both 10 Mbps Ethernet (10BASE-T) and fast 100 Mbps Ethernet (100BASE-TX). It can also operate in half-duplex or full-duplex modes. The Ethernet controller can be configured to operate at a particular speed and duplex, or it can be configured to negotiate these settings with the Ethernet PHY connected at the other end of the Ethernet cable (the “link partner”). The latter setting is preferred, and is the default setting. See Section PHY Mode for details.

The physical interface does not implement auto-MDIX, which is a feature used to automatically detect and swap the transmit and receive wiring for certain use scenarios and in case of cabling issues. However, if the feature is present on the link partner, then it will perform the functionality.

Applications Information

Wiring to Standard Ethernet Cables and Connectors

The NETETH module uses screw terminals for the connection of Ethernet signal wiring, instead of the commonly used 8P8C connector (known as RJ-45). Screw terminals provide a more reliable connection for industrial applications where pollution and vibration are present.

Standard CAT5 cabling should be used for wiring of the Ethernet signals. The 8P8C connector must be cut from one end of the cable. Table 5 and Figure 2 show how the coloured twisted-pair wires of the cable should be connected to the system connector of the NETETH module.

Table 5: Mapping between Ethernet signals and standard wire colours for CAT5 and CAT6 cables.

CATx Wire Colour	NETETH System Connector	
T568A	Pin	Signal
White / green stripe	1	TX+
Green solid	2	TX–
White / orange stripe	5	RX+
Orange solid	6	RX–

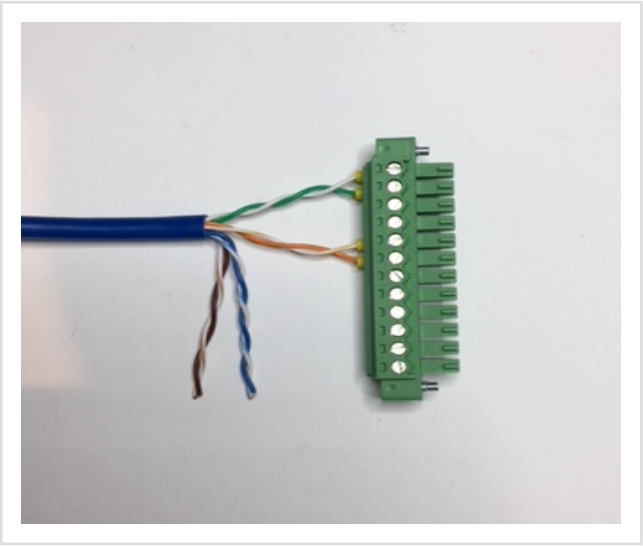

Figure 2: Wiring of a CAT5 cable to the pluggable screw terminal of the NETETH module System Connector.

The twist in the twisted-pair wires should be maintained all the way to the screw terminals.

Unused pairs in the CAT5 cable may be connected to pins 3/4 and 7/8, which are not functional but are impedance terminated.

Host MCU

Texas Instruments C2000

When using a C2000 microcontroller, the serial interface signals of the module should be connected to either a SPI peripheral or a multi-channel buffered serial port (McBSP, which has a SPI mode). The CSn signals can be driven by either a strobe pin under the control of the SPI resource, or a GPIO pin under user control. This allocation is summarised in Table 6.

Table 6: C2000 pins allocation for serial interface

Serial Interface Pin	**C2000 Pin Allocation**	
	SPI Perpheral	**McBSP Peripheral**
SCLK	SCLK	CLKX
SIMO	SIMO	DX
SOMI	SOMI	DR
CSn **(peripheral control)**	SPISTE	FSX
CSn **(user control)**	GPIO	GPIO

SwitcherWare Library

The SwitcherWare Library from Denkinetic includes methods to handle the low-level hardware configuration and provide a simple-to-use interface to the NETETH module.

Warnings

The length of cables connected to the module system connector must not be longer than 30 m.

Absolute Maximum Ratings

Stresses above these ratings may cause permanent damage. These are stress ratings only – functional operation is not implied. Exposure to absolute maximum conditions for extended periods may affect reliability.

Parameter	Conditions		Max	Unit

Electrical Characteristics

The following specifications apply for V_{DC} = 24 V, T_A = 25 °C, unless otherwise noted.

Parameter	Conditions	Min	Typ	Max	Unit
ETHERNET					
Differential Impedance, RX and TX			100		Ω
Isolation Voltage			1500		VAC

Revision History

Revision	Date	Changes From Previous Release
1	6 Apr 2018	▪ Original release.