EMSwitch™ RF Switch Plug-In Card

Models 7001-0XX

Product Manual

(NOTE: Not all models shown)

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Revision Record

MANUAL, EMSWITCH | Part #399343, Rev. K

Revision	Description	Date
A	Initial Release	JUN, 2014
B	Updated EMCenter models	JUN, 2014
C	Added Model 7001 005; updated EMSwitch Remote Relay	JUL, 2015
D	Updated Typical Data with main specifications	MAR, 2016
E	Updated physical specifications	DEC, 2016
F	Corrected specs on page 39-40; added replacement part information	MAY, 2020
G	Removed incorrect warranty info	SEP, 2020
H	Add 7001-004 Commands	JUN, 2022
J	Updated format	SEP, 2022
K	Update	FEB, 2024

Safety Information

High Voltage: Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.

Protective Earth Ground (Safety Ground): Indicates protective earth terminal. You should provide uninterruptible safety earth ground from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

Laser Warning: Denotes a laser (class 1M) is part of the operating system of the device.

Waste Electrical and Electronic Equipment (WEEE) Directive: (European Union) At end of useful life, this product should be deposited at an appropriate waste disposal facility for recycling and disposal. Do not dispose of with household waste.

Notes, Cautions, and Warnings

Note: Denotes helpful information intended to provide tips for better use of the product.

CAUTION: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.

WARNING: Denotes a hazard. Failure to follow instructions could result in SEVERE personal injury and/or property damage. Included text gives proper procedures.

Table of Contents

Introduction

The ETS Lindgren EMSwitch™ RF Switch Plug in Card is a general purpose multi-channel switch matrix used to switch the RF path of equipment for RF measurement applications, including immunity, emissions, and wireless measurements. EMSwitch is designed for use with the EMCenter™ Modular RF Platform.

The first relay of each EMSwitch card can be used as a standard relay or as a safety interlock relay. When being used as a safety interlock relay, the RF input signal to the RF amplifier can be switched off to prevent personnel from being subjected to high RF fields. For example, the RF interlock input can be connected to a switch mounted on the entrance door of the test chamber.

Standard Configuration

Standard configuration may vary by model; contact ETS-Lindgren for additional information.

- **EMCenter Modular RF Platform**

  o Some Models may require a specific processor; See Processor Requirements for more information.

- **EMSwitch Plug-In card**

  o EMSwitch cards switch RF signals up to 40 GHz, depending on the model, with powers up to 240 W (3 GHz) directly or any RF power switches indirectly. When high power RF amplifiers are used in a test system, the EMSwitch card can be connected to an optional EMSwitch Remote Relay Module.

- **Interlock**

  o When one of the relays is used as a safety interlock relay, it can be used to switch of the RF input signal to the RF amplifier. A switch mounted on the entrance door of the test chamber can for example, activate the RF interlock input. This can prevent personnel from being subjected to high RF fields. This interlock input is fully integrated in the hardware; software cannot overwrite this safety system.

EMSwitch Card Models

	Number of Relays	Frequency Band	Processor
7001-001	2x SPDT		
7001-002	4x SPDT	18 GHz	
7001-003	2x SP6T		
7001-005	1xSP6T		
7001-011	2x SPDT		
7001-012	4x SPDT	40 GHz	
7001-013	2x SP6T		
7001-015	1xSP6T		
7001-021	1x SPDT	12.4 GHz	
7001 022	1x SPDT	3 GHZ	
7001-023	2x SPDT		
7001-024	4x SPDT	50 GHZ	**ARM Only*** See [Processor Requirements](#) for more information
7001-025	1x SPDT		
7001-026	2x SPDT	67 GHZ	
7001-027	4x SPDT		

Other Optional Items

The **Model 7001-004 Remote Relay** is an optional 19-inch 2U rack mountable device to control up to four external (coax) relays using the touchscreen on the EMCenter or with one of these software products:

- o ETS-Lindgren TILE!™ (Totally Integrated Laboratory Environment)

- o ETS-Lindgren EMQuest™ Data Acquisition and Analysis Software

- o Other test automation software

It has an internal power supply to power 12 VDC/28 VDC relays.

ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren *Product Information Bulletin* included with your shipment for the following:

- Safety, regulatory, and other product marking information
- Steps to receive your shipment
- Steps to return a component for service
- ETS-Lindgren calibration service
- ETS-Lindgren contact information

Processor Requirement

Note: The 2-slot and 7-slot EMCenter require an ARM processor board with firmware version 3.3.3 or higher to some EMSwitch interface cards. 2-slot and 7-slot EMCenter systems utilizing an X86 processor board and/or firmware version 3.3.0 or older are **not supported** and will not communicate with the interface card.

To view the 2-slot or 7-slot EMCenter version information, navigate to the main screen and press the Info button. Slot 8 indicates the processor version of this EMCenter as shown in the graphic below.
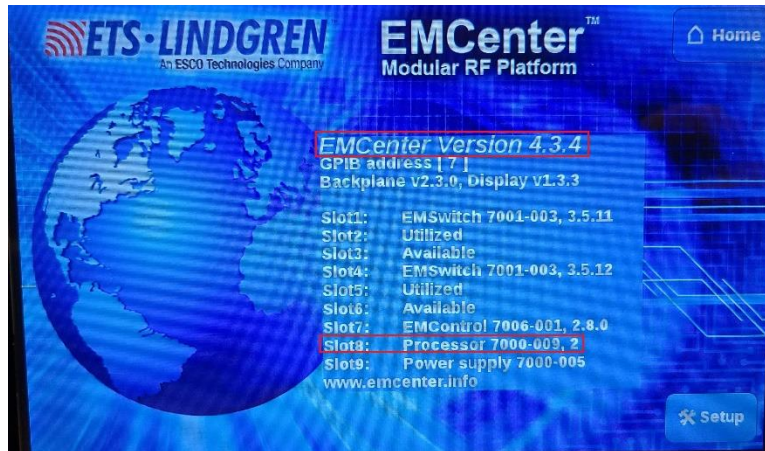
Note: If the EMCenter is not operating the 7000-008 or 7000-009 processor card, contact ETS-Lindgren to purchase a new 2-slot or 7-slot EMCenter or a new processor card compatible with EMSwitch.

Model Number	Processor Type
7000-008	EMCENTER PROCESSOR BOARD STD (ARM)
7000-009	EMCENTER PROCESSOR BOARD + GPIB (ARM)

Operation

Installation

! CAUTION: Before connecting any components, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

⚡ WARNING: Always unplug the unit before starting maintenance to prevent electrical shock. Maintenance includes removal of the plug-in cards or the top panel.

Changing Plug-In Cards

! Note: Due to the width of the 7001-003, 7001-005, 7001-013, and 7001-015 EMSwitch cards, two consecutive empty slots are required for installation.

1. **Before installing and inserting a new plug-in card make sure that the EMCenter is turned OFF and disconnect the AC Mains power cord.**

2. Determine in which empty slot of the EMCenter you want to install the Plug-in Card. Looking at the back of the EMCenter, the slots are numbered 1 through 7 from left to right.

3. Remove the blank panel from the slot by removing the two screws at the top of the blank panel and the two screws at the bottom. Be careful not to lose the screws.

4. Carefully insert the card into the slot of the EMCenter. Position the plug-in card into the slot and slowly push it, using the lower part of the plug-in card. When it reached the end of the rail, gently push and lock the plug-in card into the backplane socket.

5. Secure the card by tightening the four previous screws using a Pozi type screwdriver head PZ1.

6. Plug the interlock into the connector on the back of the EMCenter.

7. Connect the desired device(s) to the correct plug-in card port.

8. **Optional:** Connect additional local interlock to the correct plug-in card.

9. **Optional**: Connect the EMCenter to a computer using Ethernet or GPIB.

10. Re-connect the AC mains power cord and turn ON the EMCenter. It can now be started by tapping the touch screen. The EMCenter will automatically detect the newly installed card.

11. The card installation is complete and the EMCenter is now ready for use. You can control all cards through the touchscreen or sending remote commands.

Remote Relay

CAUTION: Before placing into operation, follow the information provided in *Safety Information* document.

For applications that require to switch higher power signals (>700 Watts), it is not possible to use internal relays of the switch cards; in those cases, special dedicated relays are needed in the test setup. For these external relays, EMSwitch™ Model 7001 004 Remote Relay, which is capable of driving two external relays, is available.

Model 7001 004 can drive any relay with a supply voltage of 12V, 24V, or 28V, and from SPDT to SP6T. For each relay a driver current of 0.5A is available, or 1A if only one relay is connected.

The type of relay and the usage of indicator contacts can be configured in software. The connection for relay 1 and relay 2 are identical.

Front and Back Panel Connectors

The front panel includes a key switch and an LED. If the EMSwitch™ Remote Relay is connected to a 220 V AC power supply and the on/off switch on the back panel is set to the I position, you can power on the remote relay by turning the key clockwise. The LED will illuminate.

The Remote Relay must be connected to a 220 V AC power supply via the mains lead, connected at the AC inlet on the back panel.

Relays

You can connect four relays to the remote relay. It is possible to connect relays with 1 input and 2, 3, 4, 5, or 6 outputs.

To connect external relays you must use the mating connector set included with the remote relay.

The **relay x drive** connectors on the back panel of the remote relay will switch the relays into position.

- For a 24 V relay, connect pin 1 (24 V DC output) to the Common of the relay power terminals.

- For a 12 V relay, connect pin 2 (12 V DC output) to the Common of the relay power terminals.

- Connect pin 3–8 to the power terminals 1–6 of the relay.

The number of power terminals to connect depends on the type of relay you use. For example, a 1–6 relay requires all of the pins, and a 1–3 relay requires three pins.

Readback Function

The **relay x readback** connectors on the back panel remote relay can verify if the external relay is set into position.

1. Connect pin 1 (3v3 out) to the indicator common of the relay.

2. Connect pin 2 to the first indicator of the relay.

3. Connect pin 3 to the second indicator; continue until complete.

The number of indicator terminals to connect depends on the type of relay you use. Pin 8 is not in use.

Set the readback function on or off in the EMCenter™ Modular RF Platform depending on the number of relay(s) with readback function that you use.

Set Up RS 232 Address

You can connect up to four external switch boxes to one EMCenter. Interconnect the switch boxes with straight RS 232 cables. The DIP switches on the back panel of the EMCenter allow you to set the individual addresses.

DIP Switch				EMSwitch Remote Relay Address
1	**2**	**3**	**4**	
On	On	On	—	Address 1
Off	On	On	—	Address 2
On	Off	On	—	Address 3
Off	Off	On	—	Address 4

Manual Control

Back Panel

The EMSwitch has the following Connections:

- SPDT 1x and 4x

- SP6T

- External Relay

Relay Number and Contact Definitions

| **7001-001, 7001-002, 7001-011, 7001-012**	
Relay number	Indicated below each relay, A to D.
Common	The center SMA connector of each relay, labeled **COM**.
Normally Open	The left SMA connector of each relay, labeled **NO**.
Normally Closed	The right SMA connector of each relay, labeled **NC**.
7001-003, 7001-005, 7001-013, 7001-015	
Common	The center connector; the six contacts are labeled J1 to J6.
7001-021	
Common	The center N connector, labeled **COM**.
Normally Open	The bottom N connector, labeled **NO**.
Normally Closed	The top N connector, labeled **NC**.

SPDT Connections

The connections of the SPDT (Single Pole Double Throw) relays are marked with "NO", "COM" and "NC" for respectively Normally Open, Common, and Normally Closed.

These terms indicate the position of the relay. When not activated, the relay connects the COM to the NC connector. When energized, the relay connects the COM to the NO connector.
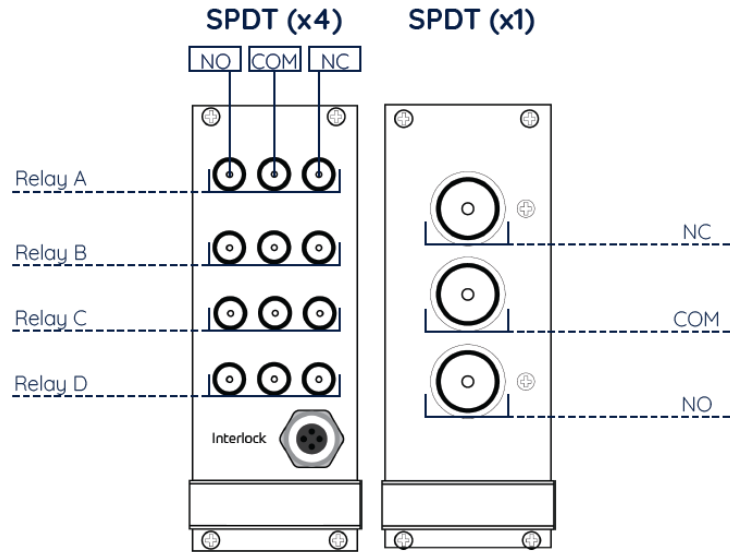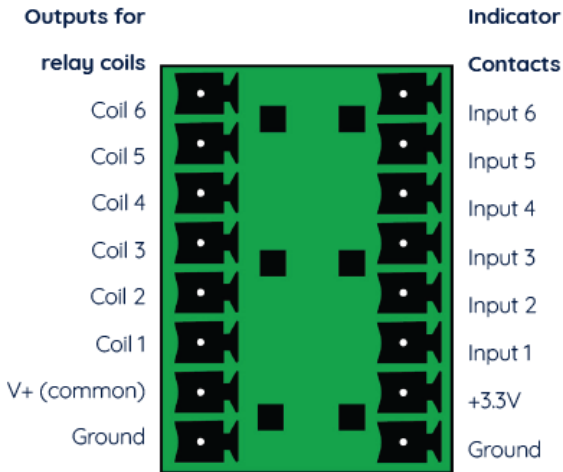
SP6T Connections

The center connector is the COM (Common). The other connections are numbered from one to six; this is visible in the illustration below and on the relay itself.
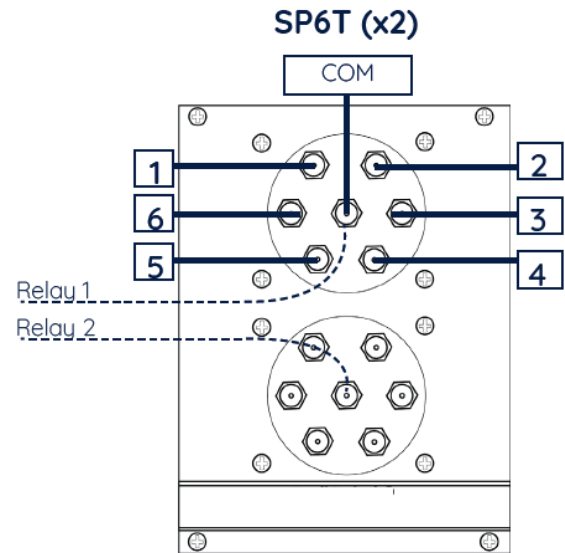
External Relay Plug-In Card

When the models with internal relays do not fit the needs (E.G. high-power switching), there is the **7001-004**; this plug-in card is designed to use with external relays and can drive up to two (2) SP6T relays. It provides a user selectable supply of 12V, 24V, or 28V, with a maximum current of 0.5A per relay

(voltage independent). The **7001-004** is also equipped with indicator contacts; these can provide feedback to the user on the state of the relay.

- **Connector**

    o **The 7001-004** is shipped with four (4) connectors* to mate with the plug-in card connectors. A 2x8-way terminal block is used for each relay driver. The left row is used for energizing the coils (please note that only one coil can be active at a time).

    o The right row is used for the readback contacts of the relays. The connections for the indicator contacts are optional and can be enabled or disabled in the configuration screen of the switch card.

- **Coil connections**

    o The relay coil(s) must be connected on the left row between the V+ (common) and one of the six coil connections. The V+ is a user selectable 12V, 24V, or 28V.

    o The voltage can be set in the configuration screen of the plug-in card.

    o **WARNING**: **Make sure that the correct voltage is set before connecting the relay. Wrong settings may result in permanent damage to the relay!**

    o The coil connections are open collector outputs, which connect the coil to ground when, activated, thus energizing the relay coil.
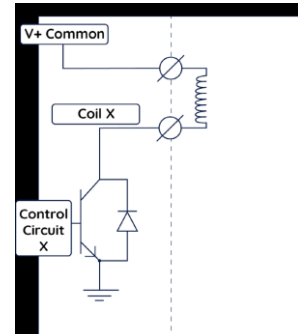
- **Indicator connections**

    o Some relays are equipped with indicator contacts; these contacts indicate the position of the relay. The indicator contacts can be connected on the right row. The indicator contacts can be connected between the +3.3V and the corresponding input channel (the input channel corresponds to the same coil number).
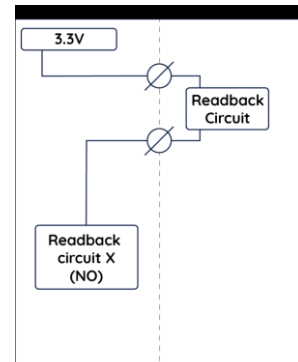
Interlock

The interlock connector provides two floating contacts, which require shorting for the first relay.

If the interlock is open, the first relay will illuminate red on the EMCenter™ Modular RF Platform screen and the relay cannot be used. Use the supplied connector to wire to the emergency switch of your site. Connect the two pins of the connector.

Note: For replacement interlock connectors, contact ETS-Lindgren to order part number **1608925**.
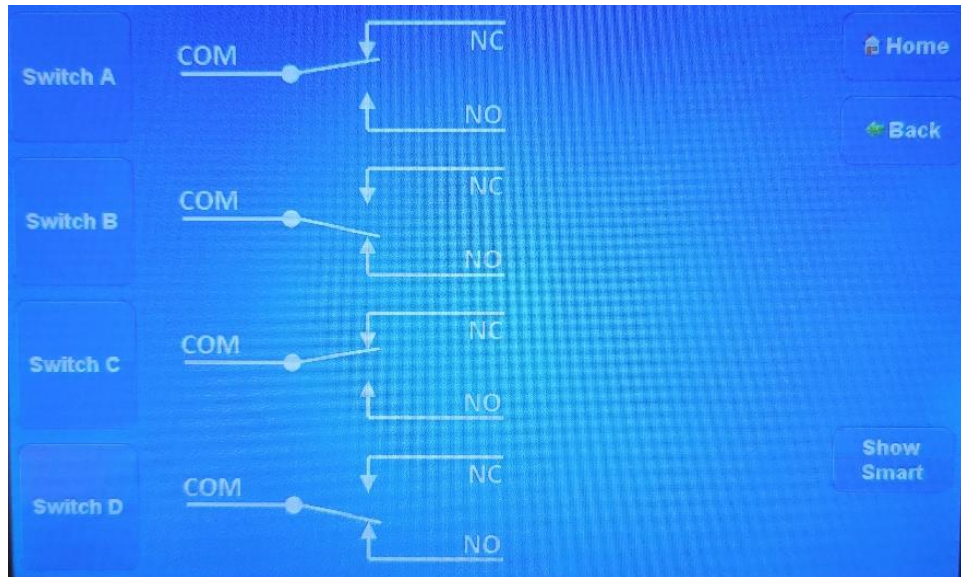
Touchscreen

Home Screen

To change relay position settings, on the Home screen press the status box to the right of the slot number for the installed EMSwitch plug in card. This will display the following switch screen:

EMControl Main Settings Screen

(COM — Common; NO — Normally Open; NC — Normally Closed)

Press a switch button (**switch A**, **switch B**, and so on) to toggle between **NO** and **NC**. In case of a failure, an error will be displayed in the screen.
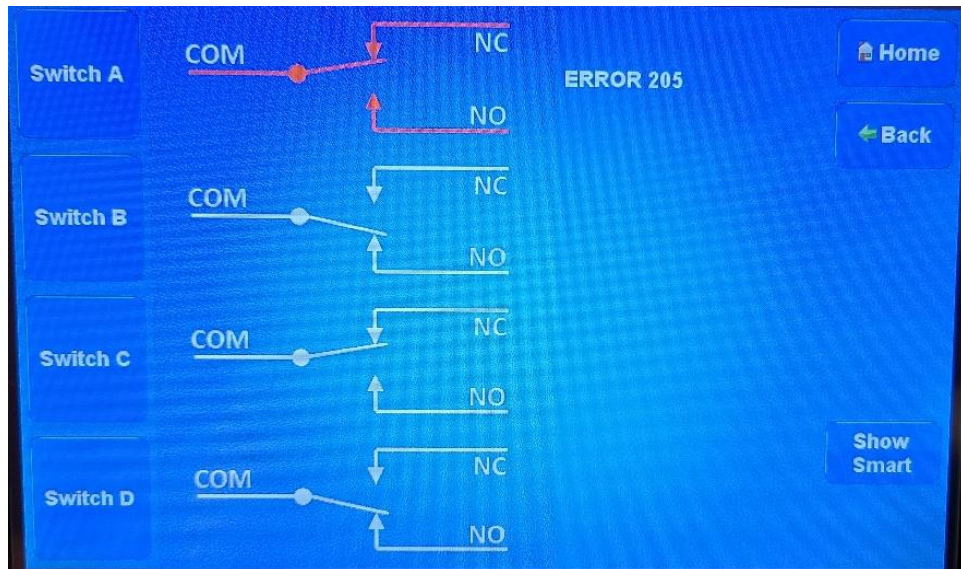
Safety Interlock Relay

Relay A on each EMSwitch plug in card can be used as a safety interlock relay. As long as the connector is shorted (by an external interlock switch), the relay can be activated. However, as soon as the interlock circuit opens, relay A will return to the idle position.

Note: If you do not want to use this relay as a safety relay, the connector must be shorted in order to use it as a standard relay.

When the safety interlock relay is activated, the power supply to the first relay of the card will be interrupted (fully hardware controlled), causing the relay to switch to the normally open position. The EMCenter will detect this interlock status and display a message. For safety reasons, the software is not able to overrule this interlock condition.

After the interlock has been closed again, the relay will switch automatically to its original condition.

Sample Interlock Error Screen

The interlock hardware is implemented in a redundant way for maximum safety. The interlock relay can be used to interrupt the signal path between the signal generator and the power amplifier. An interlock switch mounted on the door of the test chamber can be used to activate the safety relay, preventing personnel from being subject to high field strengths when entering the test chamber.

Relay Errors

The EMSwitch plug in card checks for the following error conditions of the internal relays:

1. **Over temperature** — A temperature sensor close to each relay checks for excessive heating of the relay. A **high temperature** error will display if the relay temperature exceeds 85°C (185°F).

2. **Relay errors** — The EMSwitch checks the following error conditions of the internal relays.

3. **Switching error** — Each internal relay has a set of control contacts, which are used to check if a relay has changed position. A switching error message will appear if this check fails.

4. **Interlock open for safety interlock relay** — When the interlock of relay A is opened, this will result in a **safety interlock open** error.

Remote Control

To use the EMSwitch remote commands, read the [manual document](#) *399342 EMCenter* for examples and a full command list.
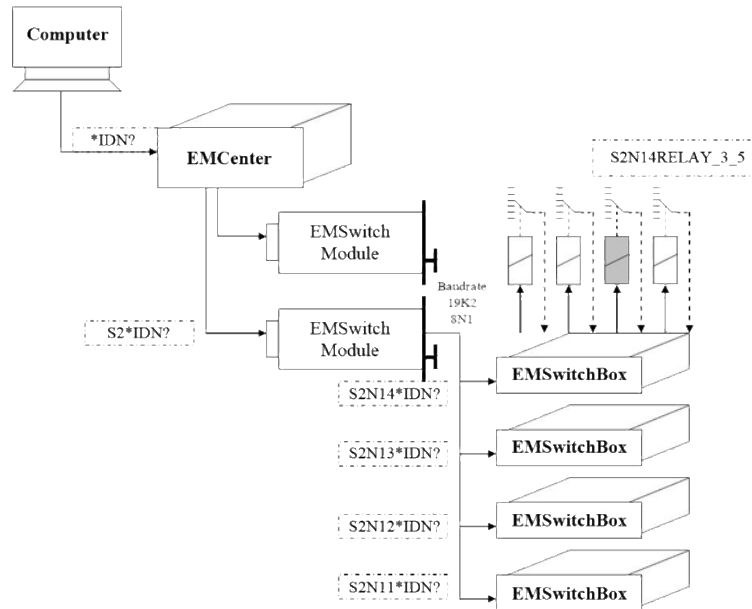
EXAMPLE: SET EXTERNAL RELAY

To set the external relay 3 from the EMSwitch Remote Relay with address 4, connected to the EMSwitch card at slot 2, position 5: **S2:N14RELAY_3_5**

Character	Definition
S	Device character of EMSwitch card
2	Board number of EMSwitch card
N1	Indicates EMSwitch card to pass message to external interface
4	Address of EMSwitch Remote Relay (configurable with DIP switches)
RELAY_	Message to switch relay
3	Number of switch on EMSwitch Remote Relay
_	Separator
5	Instruction to put switch in position 5

Maintenance

CAUTION: Before performing any maintenance, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.

WARNING: Maintenance of the EMCenter is limited to external components such as cables or connectors. If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.

If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.

Fiber Optic Maintenance

Fiber optic connectors and cables can be damaged from airborne particles, humidity and moisture, oils from the human body, and debris from the connectors they plug into. Always handle connectors and cables with care, using the following guidelines.

CAUTION: Before performing any maintenance, disconnect fiber optic cables from the unit and turn off power.

- **When disconnecting fiber optic cables, apply the included dust caps to the ends to maintain their integrity.**

- **Before connecting fiber optic cables, clean the connector tips and in-line connectors.**

- **Before attaching in-line connectors, clean them with moisture-free compressed air.**

- **Failure to perform these tasks may result in damage to the fiber optic connectors or cables.**

Service Procedures

Contacting ETS-Lindgren

Note: Please see www.ets-lindgren.com for a list of ETS-Lindgren offices, including phone and email contact information.

Sending a Component for Service

For the steps to return a system or system component to ETS-Lindgren for service, see the *Product Information Bulletin* included with your shipment.

Calibration Services and Annual Calibration

See the *Product Information Bulletin* included with your shipment for information on ETS-Lindgren calibration services.

Specifications

Note: The first switch on each EMSwitch card can be used as a true interlock switch.

Performance Specifications

	Number of Relays	Frequency Band	RF Switching Capacity
7001-001	2x SPDT	18 GHz	DC to 3 GHz: 240 W 3 to 8 GHz: 150 W 8 to 12.4 GHz: 120 W 12.4 to 18 GHz: 100 W
7001-002	4x SPDT		
7001-003	2x SP6T		
7001-005	1xSP6T		
7001-011:	2x SPDT	40 GHz	DC to 6 GHz: 80 W 6 to 12.4 GHz: 60 W 12.4 to 18 GHz: 50 W 18 to 26.5 GHz: 20 W 26.5 to 40 GHz: 10 W
7001-012:	4x SPDT		
7001-013:	2x SP6T		DC to 6 GHz: 40 W 6 to 12.4 GHz: 30 W 12.4 to 18 GHz: 25 W 18 to 26.5 GHz: 15 W 26.5 to 40 GHz: 5 W
7001-015:	1xSP6T		
7001-021:	1x SPDT	12.4 GHz	DC to 1 GHz: 700 W 1 to 2 GHz: 500 W 2 to 3 GHz: 400 W 3 to 8 GHz: 250 W 8 to 12.4 GHz: 200 W

Lifetime Relays

- **SPDT relays, SMA or 2.92mm (k**) — 10,000,000 cycles

- **SP6T relay SMA** — 5,000,000 cycles

- **SP6T relay 2.92mm (k)** — 2,000,000 cycles

- **N type relay** — 1,000,000 cycles

Electrical Specifications

All EMSwitch™ RF Switch Plug in Cards perform to the following electrical specifications:

Note: The supply voltage for the Model 7001 004 Remote Relay is 230 VAC.

- **Supply Voltage (Volts)** — Through EMCenter

- **Power Consumption (Max Watts)** — 30 W

Physical Specifications

	Exterior Dimension	RF Connectors	Remote Control External Relays
7001-001	One slot	SMA type	Fiber optic link
7001-002			
7001-003	Two slots		
7001-004 (H x W x D)	2U x 250 mm x 82.6 mm 2U x 9.8 in x 19 in	SMA type	
7001-005	Two slots	SMA type	
7001-011	One slot	k type 2.92 mm	
7001-012			
7001-013	Two slots		
7001-015			
7001-021	One slot	N type	

Environmental Specifications

All EMSwitch cards perform to the following environmental specifications:

- **Temperature Range** — 0°C to 40°C (32°F to 104°F)

- **Relative Humidity** — 10% to 90% (non-condensing)

Typical Data

Specifications of plug-in cards with SMA connectors

Specification	SMA, 18 GHZ, SPDT relays				
Life Time	10.000.000 cycles				
Frequency	GHz	0 to 3	3 to 8	8 to 12.4	12.4 to 18
VSWR		1.10	1.20	1.20	1.40
Insertion Loss	dB	0.15	0.20	0.25	0.35
Isolation	dB	80	75	65	60
Average Power	W	240	150	120	100

Specification	SMA, 18 GHZ, SP6T relays				
Life Time	5.000.000 cycles				
Frequency	GHz	0 to 3	3 to 8	8 to 12.4	12.4 to 18
VSWR		1.20	1.30	1.40	1.50
Insertion Loss	dB	0.20	0.30	0.40	0.50
Isolation	dB	80	75	65	60
Average Power	W	240	150	120	100

Specifications of plug-in cards with 2.92 mm connectors

Specification	K 2.92 mm, 40 GHz, SPDT relays					
Life Time	10.000.000 cycles					
Frequency	GHz	0 to 6	6 to 12.4	12.4 to 8	18 to 6.5	26.5 to 0
VSWR		1.30	1.40	1.50	1.70	1.9
Insertion Loss	dB	0.30	0.40	0.50	0.70	0.8
Isolation	dB	70	60	60	55	50
Average Power	W	80	60	50	20	10

Specification	K 2.92 mm, 40 GHz, SP6T relays					
Life Time	2.000.000 cycles					
Frequency	GHz	0 to 6	6 to 12.4	12.4 to 8	18 to 6.5	26.5 to 0
VSWR		1.30	1.40	1.50	1.70	2.2
Insertion Loss	dB	0.20	0.40	0.50	0.70	1.1
Isolation	dB	70	60	60	55	50
Average Power	W	40	30	25	15	5

Power Handling

The RF power rating is the capability of handling RF power (CW power) through closed contacts. The RF power should be removed (turned off) before switching the relay.
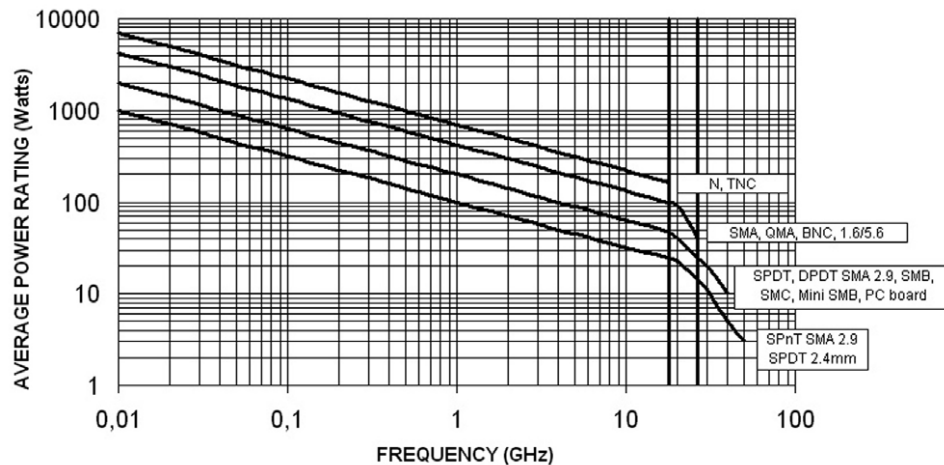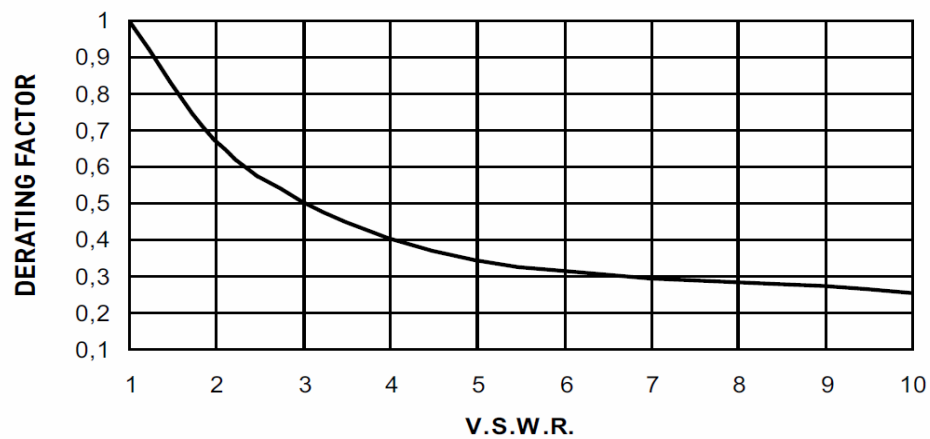
Power ratings assume the following specifications; see the power handling data chart above.

- Unity VSWR (matched load)

- Room temperature (25°C / 77°F)

- Sea level pressure (14.7 psi)

- Cold switching

Changes to these specifications require power derating; see the VSWR data chart below.

VSWR

The average power input must be reduced for load VSWR above 1:1.

Appendix A: EC Declaration on Conformity

ETS-Lindgren Inc. declares these products to be in conformity with the following standards and provisions:

Product Models: **EMSwitch RF Switch Plug In Card**

Directives: EMC Directive 2014/30/EU
RoHS Directive: 2015/863/EU

Emission: EN 61326-1:2013, Class A1
Electrical equipment for measurement, control and laboratory use.

Immunity: EN 61326-1:2013, Industrial level, performance criteria A
Electrical equipment for measurement, control and laboratory use.

Technical Construction Files are available upon request.