EMGen™ RF Signal Generator Plug-In Card

Model 7003-003

Product Manual

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Revision Record

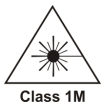
MANUAL, EMGEN-003 | Part #1741904, Rev. C

Revision	Description	Date
A	Initial Release	FEB, 2022
B	Updated format	SEP, 2022
C	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 EMGen™ RF Signal Generator Plug-in Card** is a modular signal generator with AM, FM, and pulse modulation, covering a frequency range of 4 kHz to 6 GHz. EMGen is designed for EMC testing, and quickly and accurately performs EMC tests without the need for an external modulation source. Using an internal modulator, EMGen provides CW, AM, FM, and pulse modulated signals.

The primary test signal of an Electric Magnetic Compatibility (EMC) immunity test system is generated by an RF signal generator. It produces a modulated or un- modulated RF signal at a certain frequency and signal level. The EMGen generators are designed for EMC test purposes in order to perform fast and accurate EMC tests without the need for external modulation sources.

Standard Configuration

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

- **EMCenter Modular RF Platform**; See Processor Requirements for more information.
- **EMGen Plug-In card 7003-002**
- **EMField Electric Field Generator:** The patented EMField is no less than a revolution in EMC immunity testing. A complete paradigm shift involves a combination of high-level integration and a field combining technique, making several discrete components like combiner, coupler, power meters, and cabling superfluous. This product is sold separately.

Other Optional Items

EMGen is fully supported by ETS-Lindgren TILE!™ (Totally Integrated Laboratory Environment), ETS-Lindgren EMQuest™ Data Acquisition and Analysis Software, and other test automation software packages. Contact ETS-Lindgren for additional information.

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

Modulation Types

- **AM modulation —** The EMGen supports AM modulation depths of 0 to 100% and modulation frequencies from 1 Hz to 100 kHz, covering the requirements of all relevant EMC standards.

- **FM modulation —** The EMGen supports FM modulation deviations of 1 Hz to 100 kHz and modulation frequencies from 1 Hz to 100 kHz.

- **Pulse modulation: 200 ns - 100 s —** The EMGen supports pulse modulation with ON- and OFF times ranging from 200 ns to 100 s with a resolution of 100 ns.

- **Pulse modulation settings —** The pulse interval (on/off) of the EMGen can be set from 200 ns to 100 s. This broad range allows for ultimate flexibility in the configuration of pulse modulation.

- **Gated Pulse —** In addition to standard pulse modulation the EMGen can also be used to perform Gated Pulse modulation. Gated Pulse testing is necessary to perform automotive radar pulse testing as prescribed in several automotive standards (E.G. Ford, General Motors and PSA).

Processor Requirement

Note: The 2-slot and 7-slot EMCenter require an ARM processor board with firmware version 3.3.3 or higher to operate the EMGen interface card. 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 EMGen 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 EMGen.

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

How to use Gated Pulse Modulation

Several automobile manufactures have written standards in which they subscribe the Automotive Radar Pulse tests. These tests consist of an N-number of pulses in a certain period of time. When the number of pulses is reached, there must be no more output for the remaining time during that period.

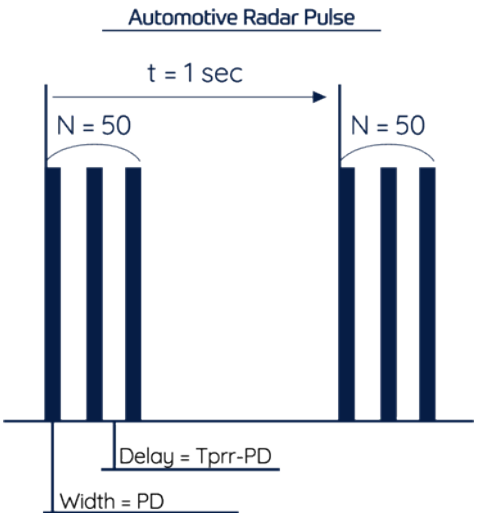
Explanation of Automotive Pulse Testing

Ford RI-114 Radar Pulse test (EMC-SC-2009) and PSA B21 7110 are using:

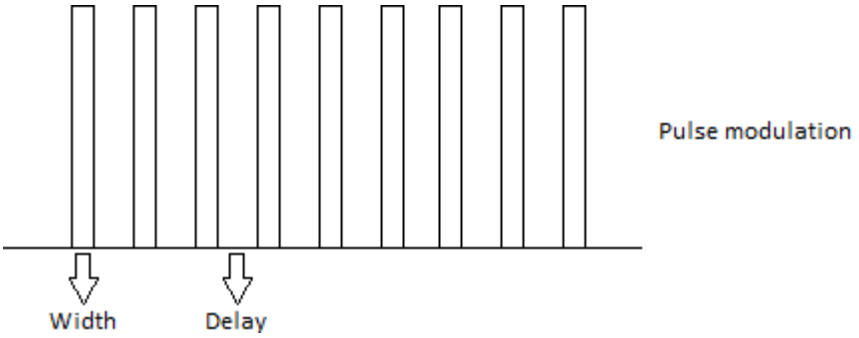
- Pulse Repetition Rate (PRR) = 300 Hz
- Pulse duration (PD) = 3 µs
- No. of pulses per second (N) = 50

GM GMW3097-2012 uses:

- Pulse Repetition Rate (PRR) = 300 Hz
- Pulse duration (PD) = 6 µs
- No. of pulses per second (N) = 50



The EMGen plug-in card is capable of generating the necessary RF bursts according to these automotive standards, using the Gated Pulse Modulation. Normal pulse modulation must be used to set the Pulse ON and Pulse OFF times (these are called, respectively, PULSe:WIDTh and PULSe:DELay, in the command set of the EMCenter system user interface).



The standards describe the pulse waveform by means of a Pulse Repetition Rate (PRR) and Pulse Duration. The EMGen plug-in card, on the other hand, uses Pulse ON and Pulse OFF (PULSe:WIDTh and PULSe:DELay) times.

As a result the PD and PRR numbers must be calculated to Pulse ON and Pulse OFF (PULSe:WIDTh and PULSe:DELay) times, according to the example below:

Example:

The Ford standard EMC-SC-2009 describes:

PRR = 300 Hz, PD = 3 µs. N =50 pulses per second.

So the period time of the Pulse Modulation is TPRR = 3,333 ms

For the EMGen this means:

The Pulse ON time, or PULSe:WIDTh equals PD = 3 µs

The Pulse OFF time, or PULSe:DELay equals TPRR – PD = 3,333 ms – 3 µs = 3,330 ms

Limitations:

The Pulse ON and OFF times apply to the specific limitations to the number of pulses per period for the Gated Pulse Modulation. The EMGen system user interface makes use of equations to intelligently adapt the buttons, prohibiting invalid settings. When the EMGen plug-in card is controlled externally by PC-software, these limitations must be controlled by the PC-software. The limitations are given by the following formulas;

$$N_{MAX} = \frac{Gateperiod - 1ms}{Pulse_{Width} + Pulse_{Delay}} - 1$$

The maximum number of pulses in one burst is limited by the settings of the pulse modulation. For example; using the Ford standard with a repetition rate of 300 Hz, a pulse width of 3µs and period time of 1 second, results in a maximum of 298 pulses.

$$Pulse_{Delay(MAX)} = \frac{(Gateperiod - 1ms) - (N \cdot Pulse_{Width})}{N}$$

The formula can also be rewritten to calculate the pulse parameters:

$$Pulse_{Width(MAX)} = \frac{(Gateperiod - 1ms) - (N \cdot Pulse_{Delay})}{N}$$

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.

CAUTION: The EMGen card is designed to be used ONLY with the EMCenter. Do not use the card in combination with any other system.

Changing Plug-In Cards

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 the EMCenter to a computer using Ethernet or GPIB.

9. 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.

10. 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.

Manual Control

Back Panel

- **Output 1 —** Signal generator from 9 kHz to 400 MHz Suitable for conducted immunity measurements.

Touchscreen

Home Screen

On the EMCenter Home screen, press the EMGen status box that displays next to the installed slot number for the EMGen card.

EMControl Main Settings Screen

The EMGen Control screen will display, where you can change the following settings:

1. The **(Carrier) Frequency** button is used to set the desired carrier frequency of the EMGen. When selected it will pop up another screen. The new screen shows a numeric pad and some other options, which will be explained in more details in the Numeric Pad section.

2. The **(Carrier) Level** button defines the carrier output amplitude of the EMGen. This can be set in the same way as the Frequency button.

3. The **Carrier** button toggles the carrier signal between On (carrier signal is generated) and Off (no carrier signal is generated).

4. The **Down** and **Up** buttons are displayed under both Frequency and Level. The buttons can be selected to quickly change the frequency or level without the use of the numeric pad. The step size for each setting can be set in the frequency and level menus and the current value is displayed in the bottom right corner of the frequency and level buttons.

5. The **Modulation Type** button toggles the modulation type between AM and FM. When the currently selected type is turned On (using the State button), the other type is automatically turned Off. Note that the AM Depth and FM Deviation buttons switch out depending on which type is active.

6. The **(Modulation) Frequency** button is specifically for the modulation of the generated signal. This button shows the modulation frequency of the currently selected modulation type and can be used to change the modulation frequency of the currently selected modulation type (AM or FM).

7. The **Depth** button shows the modulation depth of the AM signal and can be used to change the modulation depth, and only appears when AM modulation is selected as the Modulation Type.

8. The **Deviation** button shows the frequency deviation of the FM signal and can be used to change the frequency deviation, and only appears when FM modulation is selected as the Modulation Type.

9. The **State** button shows whether the currently selected modulation type is On or Off and can be used to activate the AM or FM modulation. When one type is turned On, the other type is automatically turned Off if it was already On.

10. The **Pulse ON Time** button is used to define the time for which the pulse is active, when Pulse modulation is On. Pulse modulation can be turned Off by pressing the Pulse button.

11. The **Pulse OFF Time** button shows the time during which the pulse is OFF, when Pulse modulation is On. This pulse off time can be changed to a longer or shorter duration by pressing the Pulse OFF Time button.

12. The **Pulse** button toggles the pulse modulation On or Off.

13. The **Pulse Count** button shows the amount of pulses generated within the pulse gating period, and can be used to change the Pulse Count, when Pulse Gating is On.

14. The **Pulse Gating Period** button shows the pulse gating period (or duration) for which the pulses are generated, and can be used to change the pulse gating period, when Pulse Gating is On.

15. The **Pulse Gating** button toggles the pulse gating (pulse burst modulation) On or Off.

EMGen Configuration Screen

On the EMGen Control screen press **Config** to display the Configuration screen.

The step size for the parameters for frequency and power on the control screen can be set from this configuration screen. By selecting one of the step buttons, a numeric pad appears where the new value can be entered. By pressing the unit, the value will be entered.

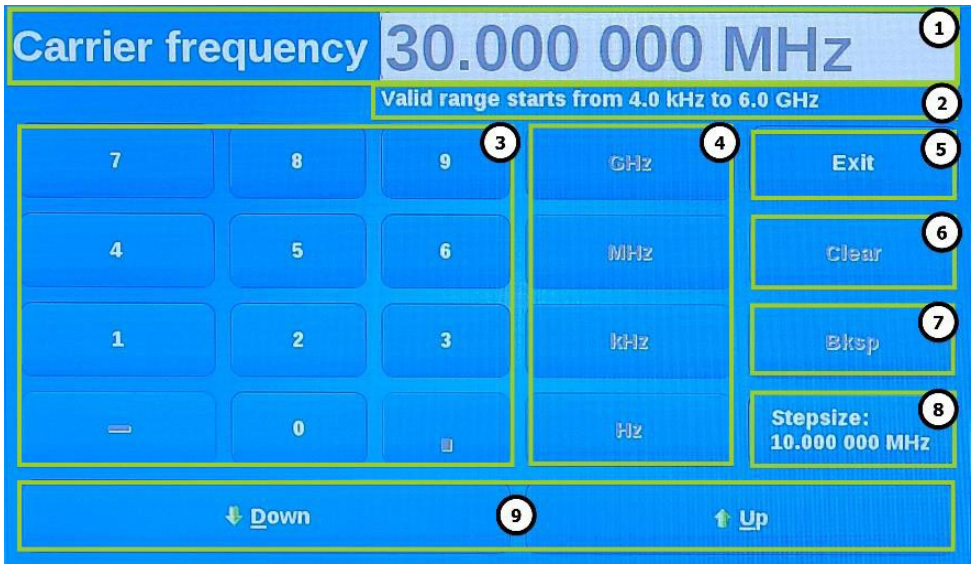
The **External reference** button toggles the External Reference clock input.

OFF = Internal clock is used

ON = External Reference clock input is used

Number Pad

The numeric pad is used for multiple values and functions such as Frequency, Level, or Stepsize. On the numeric pad, new values can be entered for the selected parameter. After selecting the desired unit (for example “Hz”), the control screen will reappear.



1. The **parameter box** shows the value of the chosen parameter. This value can be changed using the numeric pad.
2. The **valid range** shows the minimum and maximum values that can be selected. Be aware that when parameters are changed the valid range may change too.
3. The **numeric pad** sets the correct numerical value and + /- sign.
4. The **Unit** buttons set the unit type of the parameter's value if applicable.
5. The **Exit** button exits the numeric pad.
6. The **Clear** button clears the settings of the parameter box.
7. The **Backspace** button deletes the last character typed in the parameter box.
8. The **Stepsize** button indicates the actual step size.
9. The **Down** and **Up** buttons change the step size.

Remote Control

To use the EMGen remote commands, read the manual document ***399342 EMCenter*** for examples and a full command list.

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.

Replacement and Optional Parts

Note: ETS-Lindgren may substitute a similar part or new part number with the same functionality for another part/part number. Contact ETS-Lindgren for questions about part numbers and ordering parts.

Part Number	Part Description
7003-003	EMGen Plug-in Card

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

Electrical Specifications

AM Accuracy	0.5%
AM Modulation Depth:	0 to 100%
AM Modulation Resolution:	0.1 %
Amplitude Accuracy:	± 1.0 dB ± 0.01 dB/dB
Amplitude Resolution:	0.01 dB
FM Accuracy	0.5 %
FM Modulation Depth	1 Hz -100 kHz
FM Modulation Resolution	0.1%
Frequency Accuracy:	1 ppm
Frequency Range:	4 kHz – 6 GHz
Frequency Resolution:	1 Hz
Harmonics:	< -40 dBc (typical < -50 dBc)
Modulation Frequency Range:	10 Hz–100 kHz
Modulation Type:	CW, AM, FM, Pulse and Gated Pulse
Non-Harmonic Spurious:	< -60 dBc (4 kHz – 400 MHz) < -50 dBc (400 MHz – 6 GHz)
Output Level Settling Time:	< 1 ms
Output Level:	**Minimum:** –70 dBm **Maximum:** +13 dBm (+7.0 dBm when using AM)

Pulse Modulation On/Off Ratio:	> 100 dB
Pulse Modulation Range:	200 ns–100 s
Sub harmonics	< -90 dBc

Physical Specifications

Depth:	220 mm
Height:	100 mm (3U: 3.93 in)
Output Connector:	Output,(1) SMA
Width:	40 mm (One slot)

Environmental Specifications

Temperature Operating Range:	0°C to 35°C (50°F to 95°F) (up to 40°C or 104°F with reduced specifications)
Relative Operating Humidity:	10% to 90% (non-condensing)

Power Specifications

Power Consumption:	< 30 W
Supply Voltage:	12 V

Appendix A: EC Declaration on Conformity

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

Product Models: **EMGen RF Signal Generator Plug In Card**

Directives: EMC Directive 2014/30/EU
Low Voltage Directive 2014/35/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.

Safety: EN 61010-1:2010, Safety requirements for electrical equipment for measurement, control, and laboratory use.

Technical Construction Files are available upon request.