

Request for Proposal

Electro-Magnetic Susceptibility Test System



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Space Test Division
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PART I. Overview

1. Overview of the project

- 1.1 KARI has a satellite assembly, integration and test center (hereinafter referred to as "SITC") for joint use by corporations and research institutes for the purpose of the effective development of domestic satellites. And basic facilities and equipment for satellite assembly and test have been supplied, installed and used.
- 1.2 The purpose of this project is to equip the **EMS (Electro-Magnetic Susceptibility) Test System** for EMI/EMC measurement including conducted susceptibility test system, radiated susceptibility test system.
- 1.3 All the descriptions in this RFP are minimum requirements and the supplier can suggest the better one to improve the overall performance and cost. But in this case, the proposal should clearly indicate the improvements from KARI's requirements.

2. Procedures of the project

- 2.1 The project shall be proceeded with five parts as follows:
 - 2.1.1 Organizations of conducted susceptibility test system and radiated susceptibility test system
 - 2.1.2 System design (reviews) and Factory acceptance test
 - 2.1.3 Transportation
 - 2.1.4 Installation at KARI
 - 2.1.5 Final acceptance test & training at KARI
- 2.2 The participants shall submit the detailed work schedule for article
 - 2.2.1 Specially, the work schedule at KARI shall be confirmed by KARI for avoiding overlap with KARI' other test schedules.

- 2.3 The participants shall submit **6 copies** of a detailed proposal to KARI according to the format and contents satisfying the requirements stipulated in this RFP.
- 2.4 The proposal shall include the followings;
 - 2.4.1 Bidder's qualification document
 - 2.4.2 Work schedule
 - 2.4.3 Compliance sheet to the requirement of this RFP
 - 2.4.4 Engineering work of overall system
 - 2.4.5 Design report, specification of components, detailed drawings
 - 2.4.6 Shipping, transportation, installation plan
 - 2.4.7 Acceptance test plan
 - 2.4.8 Training proposal
 - 2.4.9 Warranty and maintenance proposal
 - 2.4.10 Document list
 - 2.4.11 Price proposal
- 2.5 The language for proposal shall be English or Korean.
- 2.6 The proposal shall be delivered to KARI before the due date for submission
- 2.7 All proposals and documents submitted shall become the property of KARI.

3. Requisites of participants

- 3.1 The participants shall supply information about themselves.
- 3.2 The participants shall have experience of installation, operation and arranging of EMS Test System.
- 3.3 The supplier shall submit the business showings of the

manufacturing and installation of the EMS test system.

4. Scope of the contract

4.1 The following items shall meet the specifications which are described in PART II, Technical Requirements.

4.1.1 Conducted susceptibility test system 1 set (function generator, signal generator, oscilloscope set, active current & voltage probe set, RF switching unit, CS114 test system of MIL-STD-461F and 19" system rack)

4.1.2 Radiated susceptibility low frequency test system 1 set (signal generator, RF switching unit, power meter & sensors, field monitor & sensors, RS103 test system of MIL-STD-461F, 19" system rack)

4.1.3 Radiated susceptibility high frequency test system 1 set (signal generator, RF switching unit, power meter & sensors, field monitor & sensors, RS103 test system of MIL-STD-461F, 19" system rack automatic/manual antenna mast, measurement S/W and system controller)

4.1.4 Acceptance test at factory & KARI site

4.1.5 Project management, site operation, cooperation with KARI

4.1.6 Basic principle, operation, warranty, maintenance, and training for the equipment

4.1.7 Relevant books and manuals, documents (data sheet, drawings, operation manuals, calibration reports, test reports, and etc.)

4.1.8 Other necessary matters required for acquiring and installing the equipment

4.2 The EMS test system shall not have any problem for the installation

in KARI test site and connection with KARI's test equipment, in particular the power amplifiers. The supplier shall design the test system with consideration for these constraints.

PART II. Technical Requirements

1. System Configuration

1.1 Conducted Susceptibility Test System

No.	Item	Quantity	Remark
1	Function Generator	1 ea	
2	Signal Generator	1 ea	
3	Oscilloscope Set	1 set	
4	Active Current & Voltage Probe Set	1 set	
5	RF Switching Unit	1 ea	
6	MIL-STD-461F CS114 Test System	1 set	
7	19" System Rack	1 set	

1.2 Radiated Susceptibility Low Frequency Test System (9 kHz to 1 GHz)

No.	Item	Quantity	Remark
1	Signal Generator	1 ea	
2	Switching Unit	1 ea	
3	Power Meter	1 ea	
4	Power Sensor	2 ea	
5	Field Monitor	1 ea	
6	Field Probe	1 ea	
7	19" System Rack	1 set	

1.3 Radiated Susceptibility High Frequency Test System (1 GHz to 18 GHz)

No.	Item	Quantity	Remark
1	Signal Generator	1 ea	
2	Switching Unit	1 ea	
3	Power Meter	1 ea	
4	Power Sensor	2 ea	
5	Field Monitor	1 ea	
6	Field Probe	1 ea	
7	19" System Rack	1 set	
8	Automatic Antenna Mast	1 ea	
9	Manual Antenna Mast	2 ea	
10	Measurement S/W	1 set	

2. Specifications

2.1 Conducted Susceptibility Test System

2.1.1 Function Generator (1ea)

- Waveform modes : sine, square, pulse, triangle, ramp and arbitrary waveforms(up to 256 kSa)
- Modulation types : AM, FM, PM, PWM, FSK
- Output voltage : up to 10Vpp (into 50 Ω)
- Output DC offset : ± 5 mV to 5 V (into 50 Ω)
- Frequency range :10 μ Hz to 25 MHz @ sinewave
- Amplitude flatness : ± 0.15 dB up to 10MHz @ sinewave
- Total harmonic distortion : 0.04 % (typ.) up to 100kHz @ sinewave
- Phase noise : -115 dBc / Hz (typ.) 10kHz offset @ sinewave
- Ethernet/USB dual interface for remote control
- 19" Rack adapter included

2.1.2 Signal Generator (1ea)

- Frequency range: 9 kHz to 1.1 GHz
- Frequency Resolution of setting: 0.001 Hz
- Frequency sweep : min 0.001 Hz step size
- RF Power Level : -120 dBm to +18 dBm in $1 \text{ MHz} < f \leq 1.1 \text{ GHz}$
- Reverse power protection : 50W in $1 \text{ MHz} < f \leq 1 \text{ GHz}$
- Maximum permissible DC voltage : 35V
- Harmonics : -30 dBc in $1 \text{ MHz} < f \leq 1.1 \text{ GHz}$ (level $\leq 13 \text{ dBm}$)
- SSB Phase Noise: $< -141 \text{ dBc}$, (typ. -145 dBc) for $f = 100 \text{ MHz}$, level = 10 dBm, offset 20kHz
- Analog Modulation: AM, FM, PM, Pulse Modulation
- Pulse generator for modulation
- Interface: Ethernet/LAN, USB, GPIB
- 19" Rack adapter included

2.1.3 Oscilloscope Set (1 set)

1) Oscilloscope (1ea)

- Input channels: 4 channels
- Input impedance: $50 \Omega \pm 3.5 \%$, $1\text{M}\Omega \pm 1 \%$ /15 pF
- Analog bandwidth (-3 dB): 1 GHz
- Rise time/fall time: 280 ps, 10 % to 90 % at 50Ω
- Input VSWR : $1.25 \leq 2 \text{ GHz}$

- Vertical resolution: 16 bit (without reduction of the sampling rate) @10 kHz to 50 MHz
- Input sensitivity at 50 Ω : 1 mV/div to 1 V/div
- Channel-to-channel isolation : > 60 dB for ≤ 2 GHz
- Realtime sampling rate: max. 10 GSample/s on each channel
- Realtime waveform acquisition rate : > 1,000,000 waveforms/s
- Memory depth : 50 MSample on 4 channels (200 MSample on 1 channel)
- Waveform math support
- Interface: LAN, USB, GPIB

2) Passive voltage probes (4 ea)

- 500 MHz bandwidth, 10 M Ω || 9.5 pF input impedance
- 10:1 Attenuation factor, max. 400 V

3) Active High voltage differential probes (3 ea)

No	Bandwidth	Input impedance	Attenuation factor	Operating voltage	Quantity
1	100 MHz	8 M Ω 3.5 pF	100:1/1000:1	± 1400 V	1
2	200 MHz	5 M Ω 2.5 pF	25:1/250:1	± 750 V	2

4) Active current probes (1 ea)

No	Bandwidth	Sensitivity	Dynamic range	Rise time	Quantity
1	100 MHz	0.1 V/A	30 A (RMS) ± 50 A (peak)	3.5 ns	1

2.1.4 RF Switching Unit (1 ea)

- Base unit for EMS automatic test system
- Relay : 6 × coaxial relays(SPDT), failsafe, non-terminated
- Frequency Range: DC to 18GHz
- RF Connector : SMA female
- Insertion loss : < 0.7 dB
- Interface: LAN, USB, HDMI, Touch screen
- 19" Rack adapter included

2.1.5 BCI System for MIL-STD-461F CS114 (1 set)

- 1) Current Injection Clamp probe (1ea)
 - Frequency Range: 10 kHz to 400 MHz
 - Inner diameter: 40 mm
 - Input Power rating: 100 W for 30 min.(200 W for 5 min.)
- 2) Current Injection Probe Calibration Fixture (1ea)
 - Frequency Range: 10 kHz to 450 MHz
 - Compatible with current injection clamp probe
- 3) Current monitoring clamp probe (1ea)
 - Frequency Range: 1 kHz to 500 MHz
 - Inner diameter: 40 mm
 - Outer diameter : 98 mm
 - Height : 38 mm
 - Transfer impedance : 0 dBΩ with 50 Ω load impedance
 - Handling current : 200 A
 - Peak pulse current: 100 A

4) Current monitoring probe Calibration Fixture (1ea)

- Compatible with current monitoring clamp probe

5) Power RF attenuator (1ea)

- Frequency Range: DC to 3 GHz
- Attenuation : 20 dB
- Power rating : 150 W
- Connector : N type female to N type female

6) Power Load Resistor (1ea)

- Power rating: 150W
- Frequency Range: DC to 2.4GHz
- Connector : N type female

7) RF cable set for BCI test (1 set)

- BNC/N-type RF cables for BCI test system
- RF connectors and adapters for BCI test system

8) Directional Coupler (1 ea)

- Frequency : 9 kHz ~ 400 MHz
- Coupling factor : 40 ± 0.5 dB
- Handling power : 200 W min.

2.1.6 19" System Rack (1 set)

- Custom made by CS test system design
- 19", 24 HU Rack system, Line distribution unit & Exhaust fan included
- RF cable set for inside system rack, RF connectors and adapters, RF cables for conducted susceptibility test

- System controller included for test automation : windows 10, i7 or higher CPU, min. 4 GB memory, min 1T HDD
- The system rack shall have a space to equip KARI's power amplifiers. All the cables and accessories for connection between test system and power amplifiers shall be also included.

2.2 Radiated Susceptibility Low Frequency Test System (9 kHz to 1 GHz)

2.2.1 Signal Generator (1ea)

- Frequency range : 9 kHz to 1.1 GHz
- Frequency resolution of setting : 0.001 Hz
- Frequency sweep : min 0.001 Hz step size
- Aging : $< 1 \times 10^{-6}$ /year
- Specified level range : -120 dBm to $+13$ dBm @ $200 \text{ kHz} < f \leq 1 \text{ MHz}$
- Reverse power protection : 50 W in $1 \text{ MHz} < f \leq 1 \text{ GHz}$
- Maximum permissible DC voltage : 35 V
- Harmonics : < -30 dBc in $1 \text{ MHz} < f \leq 1.1 \text{ GHz}$ (level ≤ 13 dBm)
- SSB Phase Noise : < -141 dBc, (typ. -145 dBc) for $f = 100 \text{ MHz}$, level = 10 dBm, offset 20 kHz
- Analog Modulation : AM, FM, PM, Pulse Modulation
- Pulse modulator, pulse generator included
- Interface : Ethernet/LAN, USB, GPIB
- 19" Rack adapter included

2.2.2 Switching Unit (1ea)

- Base unit for EMS automatic test system
- 1 touch screen display
- Relay : 6 × coaxial changeover relays (SPDT), SSR(Solid-state relays), non-terminated
- Frequency Range: 9 kHz to 6 GHz
- RF Connector : SMA female
- Interface: LAN, USB, HDMI, micro SD card
- Remote control via LAN
- Digital I/O module: 16 × digital inputs, 16 × digital outputs
- 19" Rack adapter included

2.2.3 Power Meter (1ea)

- Measurement Channel : 2 channels
- Frequency Range : DC to 110 GHz (sensor dependent)
- Power measurement Range : 0.1 fW to 30 W average (sensor-dependent)
- Interface: GPIB, LAN, USB
- 5" touch display (800 x 480 pixel)
- 19" Rack adapter included

2.2.4 Power Sensor (2ea)

- Frequency Range: 8 kHz to 6 GHz
- Power measurement Range : 100 pW to 200 mW (−70 dBm)

to +23 dBm)

- SWR : < 1.13 (1.11) @ 20 kHz to 2.4 GHz
- Max Power : average 1 W (+30 dBm), max. 10 V dc
- Power sensor cable included
- Connector : N male

2.2.5 Field Monitor (1ea)

- Sensitivity : 0.4 to 1400 V/m (probe dependent)
- Frequency Response : 5 kHz to 60 GHz (probe dependent)
- Interface : GPIB, USB, LAN
- Input : up to 4 independent probes
- 19" Rack adapter included

2.2.6 Field Probe (1ea)

- Frequency range : 100 kHz to 6 GHz
- Amplitude Accuracy : ± 1.0 dB @ 10 MHz Without correction factors applied
- Operating Range
 - 0.5 to 800 V/m @ 100 kHz to 1 GHz
 - 0.5 to 600 V/m @ 1 GHz to 4 GHz
 - 0.7 to 800 V/m @ 4 GHz to 6 GHz
- Linearity, 0.5 to 800 V/m : ± 0.5 dB and ± 0.3 V/m
- Data returned from probe : X, Y, Z axes and composite
- Power requirements : Laser powered from interface
- Field probe interface included

2.2.7 19" System Rack (1 set)

- Custom made by RS test system design
- 19", 32 HU Rack system, Line distribution unit & Exhaust fan included
- RF cable set for inside system rack, RF connectors and adapters, RF cables for radiated susceptibility test
- The system rack shall be connected with the KARI's power amplifiers installed in amplifier room. All the cables and accessories for connection between test system and power amplifiers shall be also included.

2.3 Radiated Susceptibility High Frequency Test System (1 GHz to 18 GHz)

2.3.1 Signal Generator (1ea)

- Frequency range : 100 kHz to 20 GHz
- Frequency resolution of setting : 0.001 Hz
- Frequency sweep : min 0.001 Hz step size
- Aging : $< 1 \times 10^{-6}$ /year
- Specified level range : -120 dBm to $+11 \text{ dBm}$ @ $50 \text{ MHz} < f \leq 20 \text{ GHz}$
- Reverse power protection : 50 W in $1 \text{ MHz} < f \leq 1 \text{ GHz}$
- Maximum permissible DC voltage : 35 V
- Harmonics : $< -30 \text{ dBc}$ in $f > 1 \text{ MHz}$ (level $\leq 8 \text{ dBm}$)
- SSB Phase Noise :

- < -122 dBc (typ. -128 dBc) for $f = 1$ GHz, offset 20 kHz
- < -102 dBc (typ. -108 dBc) for $f = 10$ GHz, offset 20 kHz
- < -96 dBc (typ. -102 dBc) for $f = 20$ GHz, offset 20 kHz
- Analog Modulation : AM, FM, PM, Pulse Modulation
- Pulse modulator, pulse generator included
- Pulse Train Support
- Interface : Ethernet/LAN, USB, GPIB
- 19" Rack adapter included

2.3.2 Switching Unit (1ea)

- Base unit for EMS automatic test system
- Small status display
- Relay : 6 × coaxial changeover relays (SPDT), non-terminated, failsafe
- Frequency Range: DC to 40 GHz
- RF Connector : 2.92 mm female
- Interface: LAN, USB, HDMI, micro SD card
- Remote control via LAN
- 19" Rack adapter included

2.3.3 Power Meter (1ea)

- Measurement Channel : 2 channels
- Frequency Range : DC to 110 GHz (sensor dependent)
- Power measurement Range : 0.1 fW to 30 W average (sensor-dependent)

- Interface: GPIB, LAN, USB
- 5" touch display (800 x 480 pixel)
- 19" Rack adapter included

2.3.4 Power Sensor (2ea)

- Frequency Range : 50 MHz to 18 GHz
- Power measurement Range : 1 nW to 100 mW (–60 dBm to +20 dBm) @ continuous average
- SWR : < 1.20 (1.18) @ > 2.4 GHz to 8.0 GHz
- Max power
 - Average power : 0.2 W (+23 dBm), continuous
 - Peak power : 1 W (+30 dBm) for max 1 μ s
- Connector : N male

2.3.5 Field Monitor (1ea)

- Sensitivity : 0.4 to 1400 V/m (probe dependent)
- Frequency Response : 5 kHz to 60 GHz (probe dependent)
- Interface : GPIB, USB, LAN
- Input : up to 4 independent probes
- 19" Rack adapter included

2.3.6 Field Probe (1ea)

- Frequency range : 2 MHz to 40 GHz
- Amplitude Accuracy : ± 1.0 dB @ 10 MHz Without correction factors applied

- Operating Range : 2 to 1000 V/m
- Linearity, 2 to 1000 V/m : ± 0.5 dB
- Damage level : 1200 V/m CW
- Data returned from probe : X, Y, Z axes and composite
- Power requirements : Laser powered from interface
- Field probe interface included

2.3.7 19" System Rack (1 set)

- Custom made by RS test system design
- 19", 32 HU Rack system, Line distribution unit & Exhaust fan included
- RF cable set for inside system rack, RF connectors and adapters, RF cables for radiated susceptibility test
- The system rack shall have a space to equip KARI's power amplifiers. All the cables and accessories for connection between test system and power amplifiers shall be also included.

2.3.8 Automatic Antenna Mast (1ea)

- Adaptors for up to 5 horn antennas
- Polarization, height & positioning control
- Adjustable height : 0.7 m ~ 1.5 m
- Max horizontal movement : 1458 mm
- Control options : HMI touch screen, remote control module via fiber optic

2.3.9 Manual Antenna Mast (2ea)

- Manual antenna mast shall be able to install the 9120F and 3106B Horn Antenna.
- Adaptor for 3106B included

2.3.10 System Control and Measurement S/W (1set)

- measurement of radiated and conducted susceptibility
- use in product certification and testing during development
- in line with military standards
- fully automatic control of EMS test system components
- integrated calibration concept
- flexible report generator (HTML, RTF, PDF)
- software operates as a virtual instrument
- direct power injection measurements
- several antenna polarizations
- generic device drivers support
- System controller included for test automation : windows 10, i7 or higher CPU, min. 4 GB memory, min 1T HDD

3. Acceptance Test and Training

3.1 System Performance Test

3.1.1 Performance test of the EMS test system shall be conducted before delivering to customer.

3.1.2 Following items shall be verified and reported to customer.

- Interoperability with KARI's equipment (power amplifiers and

spectrum analyzer) in EMS test system

- Functional and performance test in fully integrated EMS test system(not individual equipment) including new automatic control software : signal generation, monitoring, remote & automatic control, data reporting, user convenience, heat exhaust, etc.

3.1.3 System performance test is based on the CS114/RS103 test of the MIL-STD-461F. Recommendations for different technical verification with clear reasons are accepted. Supplier shall support all necessary equipment and test facility.

3.1.4 Supplier shall provide detailed test procedures, items and methods to KARI before performance test, and test reports after performance test.

3.2 Site Acceptance Test

3.2.1 Following acceptance tests shall be performed for all delivered test systems in KARI site.

- Unpacking
- Visual inspection
- Installation of the test system in EMC chamber of KARI
(Including the installation and connection of KARI's equipment)
- System automatic control by software
- Performance check for acceptance

3.2.2 EMS test system shall be fully operated and verified its performance as followings;

- Signal generation (current /voltage signal, electric field signal)

- Monitoring of signals (current/voltage, power, electric field)
- System control by software (remote & automatic)
- Data reporting and presentation
- Test shall be performed according to the CS114/RS103 test of MIL-STD-461F.

3.2.3 Detailed test procedures, items and methods shall be provided by supplier, and confirmed by KARI before acceptance test.

3.3 Training for operation

3.3.1 Supplier shall provide operation manuals, procedures or relevant documents for training.

3.3.2 Training of EMS test systems shall be provided by well-experienced engineer for more than 1 weeks.

4. Remarks

- 4.1 Warranty : 1 years warranty for test system, 3 years warranty for measurement equipment
- 4.2 All test system and test equipment shall be powered by single phase 220V, 60 Hz, 16A.
- 4.3 Test system shall not include any RoHS Material to harm user's health.
- 4.4 Supplier shall provide acceptance test results(reports) of EMS test system to KARI.