

Tehnične specifikacije za *Sistem za generacijo Supraharmonikov*

1. PREDMET JAVNEGA NAROČILA

Predmet Javnega naročila je *Sistem za generacijo supraharmonikov*

Lokacija dostave: Univerza v Mariboru, Fakulteta za elektrotehniko, računalništvo in informatiko, Koroška cesta 46, 2000 Maribor, Slovenija, IME
Rok dobave: najpozneje 80 dni od dneva začetka veljavnosti pogodbe.
Garancijski rok: 2 leti od dneva podpisa prevzemnega zapisnika.

Za vso ponujeno opremo velja, da mora zanjo v času garancijskega obdobja proizvajalec opreme omogočiti dostop do vseh posodobitev programske opreme brez dodatnih stroškov. Vsi popravki, servisni paketi ter nadgradnje in podpora morajo biti zagotovljeni s strani proizvajalca strojne oz. programske opreme.

Ponudnik mora za opremo zagotoviti:

- da so vsi ponujeni moduli/komponente združljivi in medsebojno povezljivi,
- da je mogoče vse zahtevane module/komponente povezati v enoten in brezhibno delujoč sistem v skladu s tehničnimi specifikacijami,
- odpraviti vse napake, ki bi se pojavile zaradi morebitne medsebojne nezdržljivosti ali nepovezljivosti oz. zaradi neustrezne povezave v enoten, brezhibno delujoč sistem.

V ponujeno ceno opreme mora biti vključena podpora pri uporabi in pri razvoju. Lahko je opravljena oddaljeno z uporabo ustreznih spletnih orodij, ter tehnična dokumentacija.

V ponudbi mora biti zajet ves drobni material, ki je potreben za priključitev in delovanje naprave, tudi če ni izrecno naveden.

Technical specifications for System for supraharmonics generation

1. SUBJECT-MATTER OF THE PUBLIC CONTRACT

Subject-matter of the public contract is the *System for supraharmonics generation*

Delivery location: University of Maribor, Faculty of Electrical Engineering and Computer Science, Koroška cesta 46, 2000 Maribor, Slovenia, IME
Delivery time: no later than 80 days from the date of entry into force of the contract.

The guarantee period: 2 year from the day of signature of the take-over protocol. The equipment manufacturer is obliged to provide access to all software updates at no additional cost during the guarantee period. All patches, service packs, upgrades and support must be provided by the hardware or software manufacturer.

The tenderer of the equipment must guarantee:

- that all modules/components offered are compatible and connectable,
- that all required modules/components can be integrated into a single and seamlessly functioning system in line with technical specifications,
- to eliminate all errors resulting from a possible incompatibility or mismatch, or from improper connection to a single, seamlessly functioning system.

The offered must include at least basic support in use and development. Support and basic training can be executed remotely using appropriate online tools. All technical documentation, development documentation, and a user manual, all in English, must be included in the price.

The tender must include all the fine material, necessary for connecting whole system, even if it is not explicitly stated.

TEHNIČNE ZAHTEVE – Sistem za generacijo supraharmnikov

- Univerza v Mariboru naroči sistem za generacijo supraharmnikov na več napetostnih nivojih
- Sistem mora omogočati generacijo supraharmnikov od 100 V do 30 kV. Pri 30 kV mora omogočati tok vsaj 20 mA. Na 230 V RMS mora omogočati tok pri dveh kanalih ločeno vsaj 80 A RMS.
- Sistem mora omogočati generacijo sinusa pri 25 kV s frekvenco vsaj 30 kHz.
- Sistem mora omogočati obratovanje 24/7 na nazivnih vrednostih.
- Vgrajen generator signala mora omogočati generacijo treh kanalov, ki so med seboj za 120° zamaknjeni. Vsak izhod mora omogočati seštevanje signalov na način, da se doseže 50 Hz s seštetim supraharmnikom v velikosti vsaj 20% osnovnega signala.
- Sistem mora omogočati vzpostavitev 3 fazno simulacijo NN omrežja do moči 15 kVA

TECHNICAL REQUIREMENTS – System for supraharmionics generation

- The University of Maribor is ordering a system for the generation of supraharmionics at multiple voltage levels.
- The system must enable the generation of supraharmionics from 100 V up to 30 kV. At 30 kV, it must support a current of at least 20 mA. At 230 V RMS, it must provide a current of at least 80 A RMS per channel on two independent channels.
- The system must be capable of generating a sinusoidal signal at 25 kV with a frequency of at least 30 kHz.
- The system must support continuous 24/7 operation at rated values.
- The integrated signal generator must support the generation of three channels mutually phase-shifted by 120°. Each output must allow signal summation so that a 50 Hz fundamental can be combined with a supraharmionics component of at least 20 % of the fundamental signal amplitude.
- The system must enable the setup of a 3-phase low-voltage (LV) grid simulation with a power of up to 15 kVA.

ZAHTEVANO	REQUIRED
1 MV OJAČEVALNIK 30 kV	1. MV AMPLIFIER 30 kV
Visokonapetostni sistem je namenjen generiranju supraharmionikov na srednje napetostnem nivoju do vsaj 30 kHz. Ojačevalnik mora omogočati izhodno napetost vsaj od 0 do ±30 kVDC oziroma ACp ter tok vsaj do ±20 mA. Pasovna širina mora znašati vsaj DC 30 kHz (-3 dB).	The high-voltage system is intended for the generation of supraharmionics at the medium-voltage level up to at least 30 kHz. The amplifier must provide an output voltage of at least 0 to ±30 kV DC or AC peak (ACp) and a current of at least ±20 mA. The bandwidth must be at least DC to 30 kHz (-3 dB).

<p>2 HV vir enosmerne napetosti</p> <p>Naprava mora omogočati izhodno napetost vsaj do 60 kV ter izhodno moč 600 W. Sistem mora omogočati HV preizkuse, meritve prebojnih napetosti, izolacijske teste ter raziskave električne trdnosti materialov. Omogočati mora stabilno DC delovanje, natančno regulacijo izhodne napetosti in zaščito pred preobremenitvijo ter kratkim stikom.</p>	<p>2. HV DC Voltage Source</p> <p>The device must provide an output voltage of up to at least 60 kV and an output power of 600 W. The system must support high-voltage testing, breakdown voltage measurements, insulation tests, and research into the dielectric strength of materials. It must enable stable DC operation, precise output voltage regulation, and protection against overload and short-circuit conditions.</p>
<p>3 Močnostni ojačevalnik- 2 kosa</p> <p>Močnostni ojačevalnik za generiranje supraharmnikov v nizkonapetostnih elektroenergetskih omrežjih. Omogočati mora delovanje v AC, DC in AC+DC načinu z izhodno frekvenčno pasovno širino vsaj do 50 kHz (-3 dB) DC. Maksimalna izhodna napetost mora znašati vsaj 260 VRMS oziroma vsaj 400 Vp. Sistem mora omogočati nizko harmonsko popačenje vsaj THD 0,02 % pri 1 kHz, visoko stabilnost regulacije ter možnost kratkotrajnih sunkovitih obremenitev vsaj do 150 A. Sistem mora imeti dva izhoda po 80 A vsak.</p>	<p>3. Power Amplifier – 2 pieces</p> <p>The amplifier must support operation in AC, DC, and AC+DC modes, with an output frequency bandwidth of at least DC to 50 kHz (-3 dB). The maximum output voltage must be at least 260 V RMS or 400 V peak (Vp). The system must provide low harmonic distortion of maximum THD 0.02 % at 1 kHz, high regulation stability, and the capability to handle short-term peak current loads of up to 150 A. The system must have two outputs, each rated at 80 A.</p>
<p>4 Multimeter 8,5 digit</p> <p>Merilni sistem je visoko natančni multimeter, namenjen meritvam napetosti in analizi supra harmonikov v nizko in srednje napetostnih sistemih. Sistem mora omogočati ločljivost do 8,5 mest ter natančne AC meritve vsaj do frekvence 300 kHz. Omogočati mora visoko točnost pri merilnem območju 100 V, AC točnost pri frekvencah 300 kHz mora znašati vsaj $\pm(0,4\% \text{ odčitka} + 0,01\% \text{ območja})$.</p>	<p>4. Multimeter 8,5 digit</p> <p>The measuring system is a high-precision multimeter designed for voltage measurements and supraharmonic analysis in low- and medium-voltage systems. The system must provide a resolution of up to 8.5 digits and accurate AC measurements up to at least 300 kHz. It must offer high accuracy in the 100 V measuring range, with AC accuracy at 300 kHz of at least $\pm(0.4\% \text{ of reading} + 0.01\% \text{ of range})$.</p>
<p>5. Regenerativni 4-kvadrantni simulator</p> <p>Močnostni regenerativni 4-kvadrantni omrežni simulator in močnostni ojačevalnik, namenjen simulaciji elektroenergetskih omrežij ter raziskavam kakovosti električne energije. Sistem mora omogočati izhodno napetost vsaj do 350 V L-N načinu oziroma 600 V v medfaznem načinu. Omogočati mora izhodni enofazni tok vsaj do 90 A in izhodni trifazni tok vsaj do 30A. Izhodna moč mora bit 15 kVA. Sistem mora omogočati</p>	<p>5. Regenerative 4-Quadrant Simulator</p> <p>A high-power regenerative four-quadrant grid simulator and power amplifier intended for the simulation of electrical power systems and power quality research. The system must support an output voltage of at least up to 350 V in L–N mode or 600 V in line-to-line mode. It must provide a single-phase output current of at least up to 90 A and a three-phase output current of at least up to 30 A. The output power must be 15 kVA.</p>

<p>polno 4-kvadrantno delovanje, kar omogoča tako oddajanje kot absorpcijo energije v vseh kvadrantih delovanja napetosti in toka. Sistem mora podpirati AC/DC in AC+DC načine delovanja ter mora omogoča simulacijo frekvenčnih sprememb, napetostnih prehodnih pojavov, anti-islanding zaščit in testiranje pretvornikov močnostne elektronike. Zaradi regenerativnega delovanja omogoča vračanje energije nazaj v omrežje</p>	<p>The system must enable full four-quadrant operation, allowing both the delivery and absorption of energy in all voltage and current operating quadrants. It must support AC/DC as well as AC+DC operating modes and enable the simulation of frequency variations, voltage transients, anti-islanding protection, and testing of power electronic converters. Due to its regenerative capability, it must allow energy to be fed back into the grid.</p>
<p>6 Generator signalov</p>	<p>6. Signal generator</p>
<p>Signalni generator mora imeti vsaj 3 izhodne kanalne. Omogočati mora interno seštevanje signalov, da se doseže seštevek 50 Hz + supraharmonek na vsakem kanalu posebej. Sistem mora omogočati vertikalno ločljivost 16 bitov, vzorčenje do 2.5 GSa/s ter frekvenčno ločljivost 1 μHz. Izhodna amplituda mora znašati vsaj od 1 mVpp do 10 Vp.</p>	<p>The signal generator must have at least 3 output channels. It must support internal signal summation to achieve a combination of 50 Hz + supraharmonics on each channel individually. The system must provide a vertical resolution of 16 bits, a sampling rate of up to 2.5 GSa/s, and a frequency resolution of 1 μHz. The output amplitude must range at least from 1 mVpp to 10 Vp.</p>