

# Specification of Hercules<sup>®</sup> C 500 / C 1000

Model-based Plasma Metrology System (SEERS) for Manufacturing Control

## PLASMA PARAMETERS:

Core parameters:

- **Electron collision rate** as effective collision rate for momentum transfer including stochastic heating
  - Measurement range (approximate):  
 $v_e = 10^7 - 5 \cdot 10^9 \text{ s}^{-1}$
- **Electron density** with a reduced model with given (predetermined) sheath thickness. Systematic deviations are possible, the repeatability is not concerned.
  - Measurement range (approximate):  
 $n_e = 10^9 - 10^{11} \text{ cm}^{-3}$
- Plasma bulk resistance
- RF peak voltage estimated from a given sheath width
- First harmonic of RF current

Other parameters:

## PRE-CONDITIONS:

Chamber:

- Cylindrical chamber geometry
- Sensor flange located above process wafer and not covered by other chamber parts

Excitation:

- Well-grounded chamber wall and liner
- Capacitive or at least unshielded inductive RF power coupling
- Excitation frequency:
  - C 500 series: 13.56 MHz up to 35 MHz
  - C 1000 series: 13.56 MHz up to 70 MHz

Pressure range:

- Pressure range depends on gas, reactor geometry, and RF power.
- Approximate upper limits:
  - 35 Pa (260 mTorr) typical
  - 50 Pa (380 mTorr) for electropositive gases

## TECHNICAL DATA:

Bandwidth:

500 MHz (C 500) / 1000 MHz (C 1000)

Sampling rate:

1 GS/s (C 500) / 2 GS/s (C 1000)

Number of channels:

1 channel

Temporal resolution:

100 ms – 1000 ms (10 S/s – 1 S/s)

Weight:

4.5 kg

Dimensions:

H: 210 mm, D: 250 mm, W: 210 mm

## HARDWARE:

- Ripac Vario Modul, 19" rack compatible
- AC/DC Converter CPA250 Series, maxpowerPRO
  - Technical data: AC / DC Converter CPCI 250 W
  - Input voltage range: 90 - 264 V AC
  - Frequency: 50 - 60 Hz
  - Main fuse: 2 x T2L/ 250 V, IEC 60127-2/III

- Controller unit: F14 – 3U Compact PCI® / Express Pentium® M SBC with F600 Side Card for SATA/Legacy I/O
  - 02F014-00 (R): Celeron M 373, 1 GHz, 512MB DDR2 DRAM, 1Gigabit/1 Fast Ethernet, 0 ... + 60 °C,
  - Front Connections: VGA, two USB 2.0 (Series A),
  - 2 x 10/100/1000 Base-T Ethernet (RJ45)
  - 02F600-003 (R), 3U CPCI extension, internal USB 2.0 connector with dongle
  - Hard disk: MHY02120BH, 120 GB Sata, 5400 rpm
- Digitizer card (Manufacturer: Acqiris):  
DC 135, Hercules® C 500, DC 140, Hercules® C 1000

#### SOFTWARE:

Operating system:

Basic system:

- Windows® XP Professional, US version 2002
- Hercules® PMX as SEERS implementation
- Hercules Master - GUI (Graphical User Interface) for configuration of Hercules® and data visualization

Interfaces:

- Modbus/TCP SEMI E54.9
- LAM Plug and Play (optional)
- TOOLweb® ToolSide Protocol (optional)
- SECS/HSMS SEMI E37 (optional)

## ENVIRONMENTAL SPECIFICATIONS HARDWARE:

### COMPACT PCI CONVERTER:

Operating temperature	$U_{i,nom}$ , $I_{o,nom}$ , cooling by forced air flow with 400 LFM derating from 50 to 70 °C of 2.5 % per °C	0 ... 50 °C
Storage temperature	Non operating	- 40 ... 85 °C
Relative humidity	Non condensing	10 ... 95 %
Shock	IEC/EN 60068-2-27, 11 ms	max. 20 g
Random vibration	IEC/EN 60068-2-64, 10 ... 2000 / 200 ... 2000	6 g <sub>rms</sub>
MTBF	MIL-HDBK-217F Notice 2, G <sub>B</sub> , 40 °C	279000 h

### CONTROLLER UNIT and SIDE CARD:

Operating temperature	Airflow: min 10 m <sup>3</sup> /h	0 ... 60 °C
Storage temperature	Non operating	- 40 ... 85 °C
Relative humidity	Non condensing	max. 95 %
Shock	IEC/EN 60068-2-27, 11 ms	max. 15 g
Vibration (sinusoidal)	IEC/EN 60068-2-6, 10 ... 150 Hz	2 g
Altitude		- 300 m ... 3000 m
Bump	IEC/EN 60068-2-29, 16 ms	max. 10 g

### HARD DISK:

Operating temperature	5 ... 55 °C (ambient)	5 ... 60 °C
Storage temperature	Non operating	- 40 ... 65 °C
Relative humidity	Operating (non condensing) Non operating (non condensing) Maximum wet bulb	8 ... 90 % RH (non condensing) 5 ... 95 % RH (non condensing) 29 °C (operating), 40 °C (non operating)
Shock	Operating Non operating	3185 m/s <sup>2</sup> (325 g) (duration 2 ms) 8820 m/s <sup>2</sup> (900 g) (duration 1 ms)
Vibration	Operating Non operating	9.8 m/s <sup>2</sup> (1.0 g) (5 ... 500 Hz) 49 m/s <sup>2</sup> (5.0 g) (5 ... 500 Hz)
Altitude	Operating Non operating	-300 m ... 3000 m -300 m ... 12000 m
Power requirements		5 V ± 5 %

***DIGITIZER CARD:***

Operating temperature	Airflow: min 108 m <sup>3</sup> /h	0 ... 40 °C
Storage temperature	Non operating	- 40 ... 65 °C
Relative humidity	Non condensing	5 ... 95 %
Shock	Half-sine pulse	30 g
Vibration	Random	5 ... 500 Hz

**SAFETY and EMC**

<b><i>Compact PCI Converter:</i></b>	<b>Norms / Standards</b>	
Approvals	EN 60950 (TÜV), UL 1950, cUL 1950	
Protection degree		IP 20
Electric strength test voltage	Class I, I/case (basic insulation)	1.5 kV AC
Electric strength test voltage	Class I, I/O (reinforced insulation)	3 kV AC
Electric strength test voltage	Class I, O/case (functional insulation)	0.5 kV AC
Electrostatic discharge	IEC/EN 61000-4-2, level 3 (contact/air)	4/8 kV, criterion B
Electromagnetic field	IEC/EN 61000-4-3, level 3	10 V/m, criterion A
Electric fast transients/burst	IEC/EN 61000-4-4, level 3 (direct/capacitive)	1/2 kV, criterion B
Surge	IEC/EN 61000-4-5, level 3 (L/L, L/C)	1/2 kV criterion B
Conducted disturbances	IEC/EN 61000-4-6, level 2	3 V, criterion A
Electromagnetic Emission	CISPR 22/EN 55022, conducted / radiated	Class A / A

<b><i>Controller unit and Side Card:</i></b>	<b>Norms / Standards</b>	
General board standards	CompactPCI® Core Specification PICMG 2.0 R3.0 CompactPCI® Express Specification EXP.0 R1.0	
Flammability rating	UL 94V-0	
Electromagnetic emission	EN 55022 (radio disturbance) EN 61000-4-2 (ESD) EN 61000-4-4 (burst)	
Environment	IEC/EN 60068-2-1 IEC/EN 60068-2-2 IEC/EN 60068-2-30	

<b>Digitizer Card:</b>	
Low Voltage Safety (Council Directive 73/23/EEC)	EN 61010-1: 1993 A2: 1995
Electromagnetic Compatibility (Council Directive 89/336/EEC)	EN 61326-1: 1997 A1: 1998
Electromagnetic Emission	EN 55011: 1998, EN 61326-1: 1997 Class A
Industrial Environment	EN 61000-4-2 1995 (ESD) EN 61000-4-3 1996 (Electromagnetic fields) EN 61000-4-4 1995 (Burst) EN 61000-4-5 1995 (Surge) EN 61000-4-6 1996 (Conducted disturbances) EN 61000-4-8 1993 (Magnetic fields) EN 61000-4-11 1994 (Voltage dips and short interruptions)

<b>Hercules®:</b>	<b>Norms / Standards</b>
Product safety guideline	SEMI S2-93A
Safety requirements for electrical equipment	EN 61010 - 1 / IEC 61010 - 1
Electro-magnetic Compatibility	Emission: Class B EN 61326 -1 : 1997 A1: 1998, A2: 2001 A3: 2003, EN 55011, EN 55022, EN 61000-3-2: 2000, EN 61000-3-3: 1995 A1: 2001, Immunity: Class B EN 61326 -1 : 1997 A1: 1998, A2: 2001, A3: 2003, EN 61000-4-11, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6
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