

# Annex



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## 1 Introduction

Direct mastering is a process where encoded data (according to the standardized CD or DVD format) from a Tape master or Image file is recorded optically on a photo resist coated substrate. The AM Direct is a full automatic mastering machine and only final punching is the last phase in this process to have a production ready stamper.

The direct recording process eliminates the electroforming step required for traditional glass mastering. Accordingly no hazardous chemical waste is created. This makes the AM Direct ideal for use in environmental sensitive areas.



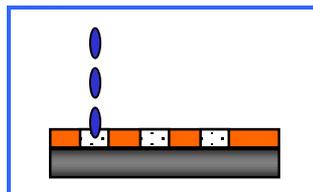
### 1.1 Process description

The AM Direct is an in-line, stand-alone optical recording system for pre-recorded CD and DVD formats. The output of the system is a stamper, and after coating and punching, it is ready for standard CD- or DVD replication lines.

The AM Direct consists of 6 process units combined in an inseparable frame, linked by a fully automatic Substrate Handling Unit (process steps 3 and 4 are done in one process unit).

Process steps AM Direct:

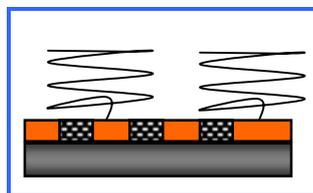
#### Step 1



#### Exposure (LBR)

recording at 405 nm.  
automated format switching.  
no access to optics required.

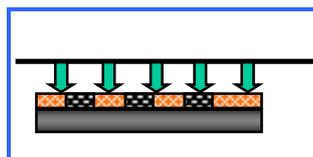
#### Step 2



#### Thermal treatment

polymerization of resist in previously exposed areas 'reversal bake'.

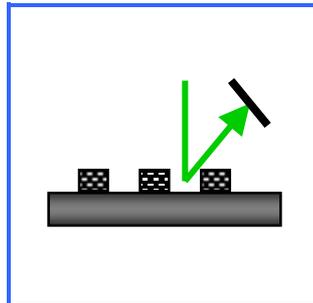
#### Step 3



#### Integral exposure to UV light, 380 nm

acid generation in previously unexposed areas.

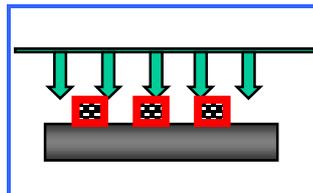
**Step 4**



**Substrate immersed in developer solution**

development controlled by 1<sup>st</sup> order diffraction.  
difference in dissolution speed between exposed (LBR) and acidic areas yields high contrast.

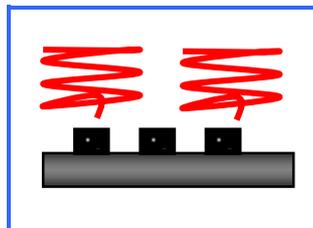
**Step 5**



**Whole substrate exposed to deep UV 250 nm.**

cross-linking of resist surface prevents thermal flow in following hard bake step.

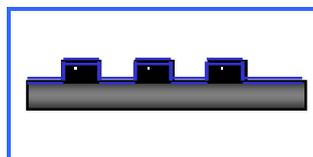
**Step 6**



**Thermal treatment**

5 min. at high temp.  
further cross-linking of resist yields thermo-baked 'bakelite' structure, hard bake.

**Step 7**



**Sputtering**

Create thin layer of nickel to strengthen stamper.

The optional off-line processes of the AM Direct are:

- Coating
- Punching

Options will only be supplied when specifically mentioned on „Scope of Delivery“ of the contract.

## 2 In-line manufacturing equipment

The AM Direct is standard equipped with 3X CD & 1R DVD speed encoding equipment and consist of:

### AM Direct (AMD 3100/00):

- LBR configuration with BSSL technology
- Start-up chemicals/consumables
- Start-up equipment consumables

### Cytris Direct (CMM 9111/00):

- CD input drive
- DVD ROM drive
- DLT tape drive
- Fast Ethernet switch
- NAS 1000GB storage capacity
- MSH-CMT

### 2.1 Options

Options are not included and will only be supplied when specifically mentioned on „Scope of Delivery“ of the contract.

Different copyprotection systems are available and discussable. Multiple copy protection systems can be combined and if license is required the copy protection will only be activated as soon the proper license is given.

#### 2.1.1 IFPI Code

IFPI codes are the responsibility of the customer. SINGULUS MASTERING advises to contact Philips Intellectual Property & Standards.

Information at: <http://www.licensing.philips.com>

SINGULUS MASTERING will insert the IFPI code in the LBR embedded SW when the IFPI code is given.

### 3 Auxiliary manufacturing equipment

Auxiliary manufacturing equipment will only be supplied when specifically mentioned on „Scope of Delivery“ of the contract.

#### 3.1 Air handling unit for AM Direct

At this unit, the temperature and humidity of the air are controlled by a chiller and a humidifier respectively.

This system provides air flow of 700-1200 m<sup>3</sup>/ h with air humidity of 55% at 21°C. The clean air flows through a HEPA filter into AM Direct to maintain class 100 (air purity) quality for the entire mastering process. The flow of clean air creates pressure within the system (machine), so that dust entering can be avoided.

This system is known as AHU 1121/00.



#### 3.2 DI Water System

The DI Water System is including a break tank and built as complete into a skid and offered as product of SINGULUS MASTERING. The Pure Water System has the capability to feed our AM Direct with pure water and has the important feature to recycle the used water.

The DI Water System is a very good alternative for those unwilling to invest into a large standard professional pure water installation. This option is cost efficient because of the recycle loop of waste water, which gives customers less chemical waste. The only waste which is generated is allowed to lead directly towards a city drain.

This system is known as PWS 1121/00.



### 3.3 Stamper coating module

Coating module to provide a protective coating on to the stamper surface.

This system is known as CSU 1101/00



### 3.4 Oven

After the protective coating is added on the data surface, the stamper must be dried with the use of a conventional oven.

This system is known as OVM 1101/00.



### 3.5 Inner / Outer punch equipment

The comp.150 has been designed to consistently achieve accurate high volume stamper centering and punching. Inner and outer diameter are punched in one process. Continued punching quality and reliability is guaranteed by robust construction and simple operation, resulting in excellent punch hole roundness. The self-aligning facility allows rapid exchange of punch and die assembly.

The ID punch and die can be changed independently to accommodate different centre hole size. Safety interlocks protect both operator and equipment during use and contribute to the comp.150 conforming to international safety standards. The compact comp.150 can be mounted on a purpose-built bench.



### 3.6 Multi Diameter Punch.

The mdp.38 has been specifically designed for companies requiring different inner diameter sizes. Various centre hole sizes can be punched starting from a pre-punched 15 mm hole. All common inner hole sizes are available from stock.

The punch and die exchange is rapid and the result is excellent punched hole roundness.

The mdp.38 is pneumatically operated, safe, reliable and conforms to international safety standards. The compact mdp.38 can be mounted on a purpose-built bench.



### 3.7 Compressed air unit

The Atlas Copco screw compressor can deliver compressed air at a rate of 545 l/min, 9 bar. The additional dryer and extra filters make the compressed air extra dry and clean to ensure the high performance of the air bearing functions at LBR.

Extra duct to convey the hot air generated at screw compressor to outside can be requested as an optional.

## 4 Consumables

Consumables will only be supplied when specifically mentioned on „Scope of Delivery“ of the contract.

### 4.1 Substrates

Substrates are separated packed and sealed per five pieces. One box consist of 25 substrates. The cartridges are designed for transportation of substrates.

#### CD nickel substrates

- Thickness: 295 ± 5 µm
- Diameter: 180 ± 0.1 mm

#### DVD nickel substrates

- Thickness: 295 ± 5 µm
- Diameter: 180± 0.1 mm

### 4.2 Process consumables

Process consumables (AMD 3800/00) excl. substrates used for regular production up to approx. 1000 stampers. The shell-life of chemicals is 12 Months.

Developer: 150 ml/substrate (diluted)

Ercopell: 20 ml/stamper

<b>Consumables, process</b>			
<i>Item number</i>	<i>Item description</i>	<i>Qtt</i>	<i>Un</i>
<b>4322 456 00041</b>	<b>consumables,process 6 mths</b>	<b>0</b>	
1313 050 00079	agent,ercopel activ 107 (5 ltr)	10	PCS
3922 064 41171	developer,az-400k (1ltr.)	50	L

### 4.3 Equipment consumables

Equipment consumables (AMD 3900/00) are filled up for approx. 6 Months.

<b>Consumables, equipment</b>			
<i>Item number</i>	<i>Item description</i>	<i>Qtt</i>	<i>Un</i>
<b>4322 456 00031</b>	<b>consumables,equipment 6 mths</b>	<b>0</b>	
3922 547 10041	sheet,lbr amd	1	PCS
3922 544 41961	target,am-direct	1	PCS
3922 064 21691	filter,wafergard f-16 0.1um	2	PCS
3922 064 55511	filter,opf 5301 0,1um	2	PCS
3922 031 02231	lamp,black-light blue	2	PCS

9281 865 05102	lamp,hok 4/120 se	1	PCS
<b>3922 547 10041</b>	<b>sheet,lbr amd</b>	<b>0</b>	
3922 060 06211	sheet,gel-pak 0.27mm	1	PCS

#### 4.4 Waste material

Following items are listed as waste for finished stamper product:

- Used filters and hoses.
- Ercopel (laquer for protective coater).
- Nickel (punch waste), is clean and can be recycled.

Chemical waste can be recycled through the Pure Water System (optional) or by other means. Treatment is necessary for the following waste:

Chemicals description	weight/stamper
<b>Developer section</b>	
KOH	2.3 g
Rinsing water	2.5 l
<b>Laquer section</b>	
Ercopell	1 g

## 5 Spare parts

Spare parts (AMD 3700) will only be supplied when specifically mentioned on „Scope of Delivery“ of the contract.

<b>Spares, AM Direct</b>			
<i>Item number</i>	<i>Item description</i>	<i>Qty</i>	<i>Un</i>
<b>4322 456 00021</b>	<b>spares,am-direct</b>	<b>0</b>	
3922 546 23541	pre-amp,1st order	2	PCS
3922 064 41141	nipple,hose m5	2	PCS
3922 045 04401	cable,socket connector	1	PCS
3922 053 05631	disk,detection sensor	1	PCS
3922 060 06171	cup,vacuum sga 7 si	4	PCS
3922 060 06191	cup,suction high temperature	4	PCS
3922 062 06941	sensor,reflex	1	PCS
3922 062 07081	cable,glassfibre	1	PCS
3922 063 08631	switch,proximity inductive	1	PCS
4322 451 00051	switch,pressure	1	PCS
4322 451 00091	switch,vacuum	1	PCS
3922 063 12782	valve,solenoid	1	PCS
3922 063 14692	valve,solenoid	1	PCS
3922 063 14702	valve,double solenoid	1	PCS
3922 064 16741	valve,magnetic 3/2way	1	PCS
3922 064 16751	valve,magnetic 2/2way	1	PCS
3922 070 03441	sensor,flow 2mm	1	PCS
<b>3922 546 23541</b>	<b>pre-amp,1st order</b>	<b>0</b>	
3922 541 92312	pcb,dev.order pre-amp	2	PCS
2422 034 15068	tag,solder for hole sqr. 0.9mm	14	PCS
4022 101 80030	spacer,3mm	6	PCS
9337 921 60682	diode,photo osd 60-5t	2	PCS

## 6 Projects

Each contract will be carried out under the super-vision of one of our Project Managers. This person will be your first contact person within SINGULUS MASTERING and means that communication is clear. The Project Manager is responsible from contract until the „scope of delivery“ is accepted by means of an official document signed by both parties. In case a site letter is made at date of acceptance, it will be under full responsibility of the Project Manager. The complete project will be hand-over to our Service department as soon the „scope of delivery“ is signed and/or the site letter is finished.

Project Management will discuss with the end user the best way how to approve the project and will help, if required, the end user, with making decisions regarding Mastering, Galvanics, Utilities and/or Test equipment.

### 6.1 Pre-installation

Before installation, the site will be inspected under super-vision of SINGULUS MASTERING. Upon the approval of the inspection report and arrival of the equipment on site, the crew will travel on site.

The pre-installation will be carried out, depending on the „scope of delivery“ by a sub-contractor hired by SINGULUS MASTERING.

Task of the sub-contractor consist of:

- *Unpacking*  
Must be done together with the end user and all items needs to be checked and signed for receive on the shipping documents. Only then missing items can be claimed at SINGULUS MASTERING.
- *Positioning*  
Together with the end-user, equipment will be positioned at final destination according the floorplan. SINGULUS MASTERING will provide transportation wheels for this and it is end-user responsibility having other proper transportation equipment (pallet truck and fork lift truck for 5000kg and with fork length of twom) on site.
- *Final connections*  
Together with the end-user by means of a plumber and electrician, connections will be made from delivered equipment to customer point of use connection according the floor plan.

**Note:** The customer is not allowed to open the package(s) (equipment) sent by SINGULUS MASTERING. If the package(s) is/are opened prior to the arrival of SINGULUS MASTERING installation crew, SINGULUS MASTERING will claim missing items.

**Note:** SINGULUS MASTERING will provide carriers (for smooth floors only) to transport the main system to its final position. These carriers remain property of SINGULUS MASTERING and must be returned to SINGULUS MASTERING after transportation.

**Note:** Equipment supplied by SINGULUS MASTERING must be stored in a lockable storeroom before installation. The storeroom is used for unpacking of the equipment by the engineers and must be located as close as possible to the process room.

## 6.2 Installation

Under responsibility of SINGULUS MASTERING, engineers will install the delivered equipment on site, start-up the process and demonstrate the process yield according to the agreement.

**Note:** The customer crew must be continuously available for assistance and practical training during the installation.

**Note:** Office space with furniture, telephone telefax and internet access should be available for the engineers during the installation period.

## 6.3 Start-up and Site Acceptance Test

After installation, final cleaning of the facility (provided by the customer) is necessary in order to obtain the required environment conditions.

During process start-up and final acceptance, only mastering crew and SINGULUS MASTERING engineers are allowed to enter the process room.

## 7 Testing, commissioning and certification

### 7.1 Preliminary Acceptance Test

Prior to delivery, the manufacturing equipment is tested at SINGULUS MASTERING. The customer is entitled to certify this test after prior notification. SINGULUS MASTERING will issue a „Certificate of Preliminary Acceptance Test at SINGULUS MASTERING BV of the manufacturing equipment“ once the test result is satisfactory. The equipment will then be prepared for shipment.

#### 7.1.1 PAT procedure

In order to demonstrate the performance of the equipment SINGULUS MASTERING will produce and test the following:

- **1 (one) serie of 5 (five) CD stampers, 74min**
- **1 (one) serie of 5 (five) DVD stampers**
  
- Only consumables supplied by SINGULUS MASTERING will be used as input for the system and standard image files are used as input media. Equipment will be operated as according to the procedures defined in the Manuals.
  
- Both CD and DVD stampers and/or replica will be measured and inspected following the specifications in header 11 and/ or Red Book, Blue Book specifications.
  
- Rejection of stampers/replica's from manufacturing process facility errors, complementary manufacturing equipment errors or operator errors is not included in this test.
  
- Both CD and DVD format series must be made without any mechanically discontinuance with the exception of above mention points.

#### CD results

- 5x Full Data discs
- The test result from at least 4 of 5 produced CD stampers should be within spec.

#### DVD results

- 3x DVD5 Full Data
- 1x DVD9 L0 OTP Full Data
- 1x DVD9 L1 OTP Full Data
- The test result from at least 4 of 5 produced DVD stampers should be within spec.
- 3 (three) DVD5 stampers will be further processed to replica and all should be within spec.

## 7.2 Final Acceptance Test

After installation SINGULUS MASTERING will, in co-operation with customer trained crew, put the equipment into operation and will render it for commissioning. SINGULUS MASTERING will issue a „Certificate of Final Acceptance Test and transfer of the manufacturing equipment“ once the test result is satisfactory. This document must be signed by both parties, buyer and seller and need to issued in duplicate. Only after signing this document SINGULUS MASTERING BV allows the end user to start running commercial jobs with the supplied equipment.

**Note:** As soon commercial jobs are runned with the supplied system SINGULUS MASTERING will consider the supplied equipment as accepted.

### 7.2.1 FAT procedure

In order to demonstrate the performance of the equipment SINGULUS MASTERING will produce and test the following:

- **1 (one) serie of 5 (five) CD stampers, 74min**
- **2 (two) series of 5 (five) DVD stampers**
  
- Only consumables supplied by SINGULUS MASTERING will be used as input for the system and standard image files are used as input media. Equipment will be operated as according to the procedures defined in the Manuals.
  
- The CD/DVD stamper/replica test protocol can only be accomplished with test equipment available on customer site. It is customer responsibility to have reliable test equipment available on site. If minimum needed test equipment is not available the delivered equipment must be considered as accepted without electrical specifications.
  
- Both CD and DVD stampers and/or replica's will be measured and inspected following the specifications in chapter 11 and/ or Red Book, Blue Book specifications.
  
- Rejection of stampers from Manufacturing Process Facility errors, Complementary Manufacturing Equipment errors or Operator errors is not included in this test.
  
- If a series of 5 products dissatisfies the SINGULUS MASTERING engineer, this serie can be redone and the results of this dissatisfactory serie, will not be taken into the yield calculation.
  
- Both CD and DVD format series must be made without any mechanically interruption with the exeption of above mention points.

**CD results**

- 5 (five) CD Full Data stampers will be further processed to replica.

**DVD results**

- 10 (ten) DVD (mixed on customer request) stampers will be further processed to replica.

**General**

When both CD and DVD format series achieve a yield of 90% (ninety percent) on replica, the equipment will then be considered ready for transfer. This will be evidence by a protocol as described.

**Note:** SINGULUS MASTERING can decide to manufacture the replica's at an other facility, appointed by SINGULUS MASTERING, to finalize the above mention specifications, if third party equipment is not part of the "scope of supply" and is not performing according expectations.

Certificate of  
**Preliminary Acceptance Test**  
at SINGULUS MASTERING BV of the manufacturing equipment

With reference to the agreement

made between

**Singulus Mastering International GmbH**

and

*Buyers name*

Herewith we certify that we have functionally tested the manufacturing equipment defined in header 7 of this document and that we found this equipment in accordance with the requirements and specifications of the Preliminary Acceptance Test.

This certificate has been issued in duplicate.

Eindhoven,  
Date:

**Singulus Mastering International GmbH**    *Buyers name*

Name:

Name:

Signature:

Signature:

Certificate of  
**Final Acceptance Test and Transfer**  
of the manufacturing equipment

With reference to the agreement

made between

**Singulus Mastering International GmbH**

and

***Buyers name***

Herewith we certify that the manufacturing equipment and process as defined in the contract has been transferred and accepted according to the procedure as laid down in header 7 of this document.

The overall yield of the AM Direct produced was shown to be        %.

This certificate has been issued in duplicate.

Place: *Place of installation,*

Date:

**Singulus Mastering International GmbH**     ***Buyers name***

**Name:**

**Name:**

**Signature:**

**Signature:**

## 8 Required crew, training and documentation

### 8.1 Required crew

SINGULUS MASTERING indicate in the following overview what type and how many of crew is needed in order to operate the AM Direct in full production.

### 8.2 Required crew

The following crew is required for operation of an AM Direct:

Shifts	Type of person	Working force	Knowledge level
2 shifts of 8 hours	Technical supervisor	0.5	Trained process technician
	Operator	1	Trained
2 shifts of 8 hours	Technical supervisor	0.75	Trained process technician
	Operator	2	Trained
3 shifts of 8 hours	Technical supervisor	1	Trained process technician
	Operator	3	Trained

### 8.3 Training

The basic- and practical training on the AM Direct is proximally 10 days. All training is given in English and split into 2 parts.

Basic training:

Basic training will be given in the SINGULUS MASTERING competence centre based in Eindhoven. This part of the training is mainly theoretical and comprises an introduction to the system, all aspects of the process, knowledge of the equipment and utilities (when applicable).

Practical training:

Practical training will be mainly given on site during the installation. In this training experience will be gained to run the manufacturing process.

### 8.4 Documentation

Online Information System:

The Online Information System is only available on CD-ROM and consist of:

- User manual.

- Process manual.
- 1st & 2nd Line maintenance manual.
- TPD (Technical Product Information) for part numbers, drawings and schematic drawings.

This Online Information System with the manuals provides detailed instructions and procedures to enable the equipment to be operated in a safe and efficient manner. They describe all functional tasks and procedures in details such as:

- Preparation.
- Initiation.
- Monitoring.
- Control.
- Shutdown.

Documentation for training:

If a training course is undertaken, additional documentation will be provided as supplement. This documentation generally comprises technical information and course notes.

## 9 Utility requirements

### 9.1 Civil/ structural

#### Required space

AM Direct (with all options)	Floor: 50m <sup>2</sup> Minimum ceiling height: 2.8m Minimum door opening: 2.2 x 1.8m (HxW)
General	The route for equipment transport during installation must accommodate the dimensions: 3.0 x 1.8 x 2.2m (LxWxH)

#### Floor specifications

General	<p>Minimum load capacity: 2.5kN/m<sup>2</sup></p> <p>Floor leveling in accordance with: DIN 18202, table3, class 3.</p> <p>The floor should be suitable for application of an almost vapour-tight floor finish.</p> <p>The floor covering should be chemical resistant with a smooth surface for easy cleaning. The recommended floor covering would be conductive epoxy, suitable for the entire operation area.</p>
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#### Abstract from DIN 18202, table, class 3

Class	Vertical measurements as limits in mm with measuring points distances in [m].	0.1m	1m	4m	10m	15m
3	Finished grounds, eg floor pavement serving as foundation for coverings. Coverings, tile coverings, PVC flooring and glued coverings.	2mm	4mm	10mm	12mm	15mm

## 9.2 Environment

### Vibration criteria

The critical parts of the Laser Beam Recorder are mounted on a granite base plate supported by a pneumatic vibration-isolation system.

In case the LBR is placed in an environment prone to vibration, the vibration velocity level should be checked to verify whether it exceeds the linearly measured r.m.s. value in the relevant frequency band. (The measuring procedure can be obtained from SINGULUS MASTERING).

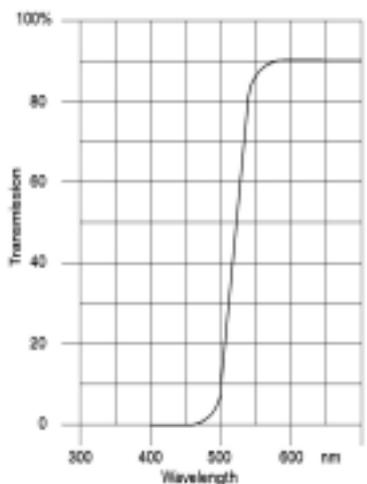
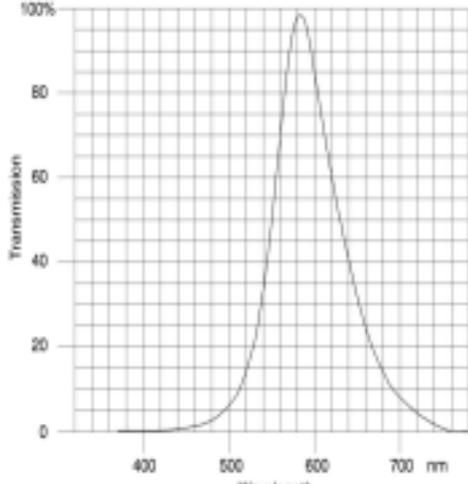
### Specifications

The floor vibration velocity must be measured in all 3 directions	
Horizontal	left/right
Horizontal	front/back
Vertical	up/down
Frequency range	DC / 500 Hz
Method small bandwidth	> 500 point FFT (fast Fourier transform) analyses
Measuring time	24 h (24 measurements)
Average method	Continuous peak holds
Measuring result <b>no</b> vibration velocity peaking	> 10 $\mu\text{m/s}$
Acceleration less than $4\text{mm/s}^2$	2 - 10 Hz
Displacement smaller than 0.001 mm	10 - 200 Hz

### Lighting

During opening top covers for maintenance, yellow light should be used to prevent pre-exposure of the photo-resist.

The following is the transmission curve of the window protection screen around the AM Direct.

TRANSMISSION CURVE	RELATIVE SPECTRAL DISTRIBUTION YELLOW FLUORESCENT LAMPS
	
General lighting, white	500 lux, yellow

### Type of electrical outlets

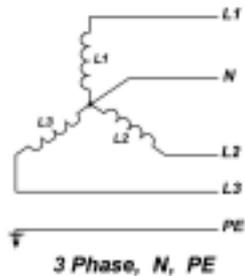
Point of use	3-Phase, Neutral, Protective Earth (3P/N/PE) 1-Phase, Neutral, Protective Earth (1P/N/PE)
1P/N/PE	Dual Outlets (wall sockets). The height should conform with the local regulations, preferably 1.2 m above floor level
3P/N/PE	Outlets with power switch (fixed or with wall sockets). The height should conform with the local regulations, preferably ceiling height for the main system.

### Note

The customer must provide all outlets, cables and plugs within the local regulations and the cable, for 3P/N/PE connection from the outlet with power switch to SINGULUS MASTERING equipment, must have an extra length of 2m.

### 9.3 AM Direct requirements

#### Electrical power

AM Direct	230V/ 400V, $\pm 10\%$ 50Hz/ 60Hz 3-Phase Neutral Protective earth Fuse protection: 25A circuit breaker Power consumption: 3kVA Heat load to room: 3kW	 <p style="text-align: center;">3 Phase, N, PE</p>
Cytris console	230V 50Hz/ 60Hz 1 Phase Neutral Protective earth Fuse protection: 12A circuit breaker Power consumption: 0.5kVA Heat load to room: 0.2kW	

#### Compressed air

AM Direct	Pressure: >8 Bar at point of use Consumption : 350 NI/min Oil content: < 0.01 ppm Filtration: < 0.01 ppm Dew point air dryer: -70 °C	
	An air dryer is standard delivered as part of the scope and need to be placed between point of use and final connection of the AM Direct and need 230VAC, provided by customer. The air dryer will not be purchased in case a compressor unit is ordered at SINGULUS MASTERING.	

### Argon

AM Direct	Pressure: $1 \pm 0.1$ Bar Purity : Argon 99.99% Oxygen: < 10 ppm N <sub>2</sub> : < 80 ppm Solid particles: Class 100 Consumption: 4 Nml/stamper(at 1 Bar, 20 °C) or 3.4 Nml/min
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### DI water

AM Direct	Pressure: $3 \pm 0.5$ Bar Temperature: $22 \pm 2$ °C (variation 1 °C/hour) Resistivity: > 15 MΩcm at 22 °C Filtration: 0.2 µm at point of use Consumption: 10 l/h
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### Clean air

AM Direct	Air flow: 700 – 1200 m <sup>3</sup> /h adjustable 1000 m <sup>3</sup> /h nominal Air conditions: $21 \pm 1$ °C $55 \pm 5$ %RH Drift velocity: Max. 2 %/h Pre-filter: EU 3 - 80/25-66 L = 195 End-filter: EU 7 - Hi-Flo TF-85-66
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## Connections

	<p>Compressed air: PX-9 hose, connector KD-3/8, Contra connector KS-PX9, Supplier is Festo.</p> <p>Argon: PU-4 hose, connector KD-1/8.</p> <p>DI water in: 8mm ID hose.</p> <p>Waste water: 8mm ID hose.</p>
	<p>An air-hood will be delivered with a connection of <math>\varnothing</math> 250mm.</p>

## Environmental

<p>Mastering room</p>	<p>Temperature: <math>21 \pm 1</math> °C (without AHU)  <math>18 - 24</math> °C (with AHU)          Humidity: <math>55 \pm 5</math> %RH (without AHU)  <math>40 - 70</math> %RH (with AHU)          Drift velocity: Max. Minimum of 5 times per hour or 2 %/h          Required floor space: Min. 50 m<sup>2</sup>          Height: Floor to false ceiling- min. 2800mm          Floor: Load capacity 2.5 kN/m<sup>2</sup>          Free from excessive vibrations          Level and flat          Resistant to chemicals          Easy to clean          Non-dust emitting          Lighting: White 600 lux          Yellow 500 lux</p>
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## 9.4 DI water system requirements

### Electrical power

DI Water System	230VAC, +6%, -10% 50Hz/ 60Hz 1-Phase Neutral Protective earth Fuse protection: 16A circuit breaker Power consumption: 0.25kVA Heat load to room: 0.25kW
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### Feedwater

DI Water System	Water quality: Potable tap water Conductivity: < 2000 $\mu$ S/cm for max. Performance Temperature: 2 – 35 °C Fouling index: Progard 1:<5 Progard 2:<12 If progard index >12, additional prefiltration is recommended Total chlorine: Progard 1:<1 ppm Progard 2:<3 ppm Minimum feedwater pressure: 1 bar (15 psi) Maximum feedwater pressure: 6 bar (90 psi)
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### DI water

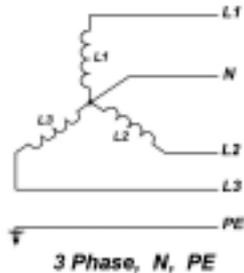
DI Water System	Daily need: 100 to 200 liter Product flow rate $\pm$ 15% : 10 l/h 7°C < T < 30°C
	Resistivity of product water: typically 10 to 15 M $\Omega$ -cm (compensated to 25°C) (only with use of pre-filter) Conductivity of product water: < 0.2 $\mu$ S/cm (compensated to 25°C) typically 0.067 to 0.10 $\mu$ S/cm
	TOC typically: < 30 ppb Bacteria count: < 10 cfu/ml Silicate content: < 99.9% retention Water recovery: 24%

### Connections

DI Water System	To be provided by the customer. Height preferably $\pm 50$ cm above floor level. Hose pillar for hose 8 mm id.
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## 9.5 Air Handling Unit requirements

### Electrical power

AHU 1000-10-6-X	230V/ 400V, +6%, -10% 50Hz/ 60Hz 3-Phase Neutral Protective earth Fuse protection: 25A circuit breaker Power consumption: 6kVA Heat load to room: 1kW	 <p>3 Phase, N, PE</p>
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### Cooling water

AHU 1000-10-6-X	Minimum pressure difference: 1.5 Bar Maximum temperature: 25 °C Flow: 2.2 m <sup>3</sup> /h Tap water quality: Free of iron/ containing glycol or antifreeze
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### DI water

AHU 1000-10-6-X	Maximum pressure: 3 Bar Consumption: 10 l/h
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### Drain

AHU 1000-10-6-X	Drainage: 20l/h
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## Connections



Cooling water inlet: 19mm ID hose.  
Cooling water outlet: 19mm ID hose.  
DI water: 10mm ID hose.  
Drain: 10mm ID hose.  
Clean air:  $\varnothing$  250mm

## 9.6 Spin coater requirements

### Electrical power

SCU 1101/00	230, VAC 50Hz/ 60Hz 1-Phase Neutral Protective earth Max. Current: 2.5/ 5 Amp Power consumption: 500 Watt	The SCU 1101/00 has a mains power On/ Off switch located at the rear and must have a separate EMO button installed according to regulations.
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### Ambient temperature

SCU 1101/00	The SCU 1101/00 is designed for an ambient temperature of: 15°C - 25°C
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### Extract/ Ventilation

SCU 1101/00	It is user's responsibility to ensure adequate extraction/ ventilation is provided where required. Follow the manufacturer's instructions for the chemical/s used.
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### Clean Dry Air

SCU 1101/00	When using liquids (especially chemicals) the connection (Inlet CDA) must be connected to a continuous supply of CDA. This maintains an overpressure in the drive shaft bearing to protect against liquid ingress. Required supply: 2 – 5 l/min.
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### Drain

SCU 1101/00	Standard “GF” connection: 1¼”/ 32mm. The drain outlet must drain to a chemically compatible drain or drain store.
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### Connections

	
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## 9.7 Oven requirements

### Electrical power

OVM 1101/00	230, VAC ±10% 50Hz/ 60Hz 1-Phase Neutral Protective earth Power consumption: 1.400 Watt (during heating)
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### Extract/ Ventilation

OVM 1101/00	It is user's responsibility to ensure adequate extraction/ ventilation is provided where required. Follow the manufacturer's instructions for the chemical/s used. Connection point: Ø 100mm.
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### 9.8 Dimensions

	Excl. packing				Incl. packing			
	W	D	H		W	D	H	
	mm	mm	mm	kg	mm	mm	mm	kg
AM Direct	2600	1700	1700	1750	2830	2190	1920	2460
Cytris Console	600	800	900					
AHU 1000-10-6-X	1500	1040	2100	650	3300	1340	1260	468
Pure Water System	2150	750	2200		900	2320	2370	
Oven	550	480	680	35	710	590	770	52
Transport wheels**					450	650	570	109

Approximate values

\*\*Transport wheels are property of SINGULUS MASTERING and must be returned after use.

## 10 Compliance, Directives & Standards

As a global supplier, Singulus Mastering B.V. continuously strives for a higher level of compliance of their manufacturing equipment. Although harmonization of directives and standards gradually moves on, compliance requirements still vary distinctly per region.

During design and manufacturing Singulus Mastering B.V. chooses for an approach that includes:

- Application of internationally recognized directives and standards where possible.
- Third party approval/certification where required.
- Use of approved/certified components if available.

A comprehensive list of applied directives and standards appears on the EC Declaration of Conformity for Machinery, which will be supplied upon delivery of the equipment.

In general, the following applies:

### Safety:

- European Directive for Machinery safety.
- EN-ISO 12100-1, Safety of machinery  
Basic concepts, general principles for design, Part 1: Basic terminology, methodology.
- EN-ISO 12100-1, Safety of machinery  
Basic concepts, general principles for design, Part 2: Technical principles.
- EN 418, Safety of machinery  
Emergency stop equipment, functional aspects – Principles for design.
- EN 954-1, Safety of machinery  
Safety-related parts of control systems, Part 1: General principles for design.
- EN 1037, Safety of machinery – Prevention of unexpected start-up.
- EN 1050, Safety of machinery – Principles for risk assessment.
- EN-IEC 60447, Basic and safety principles for man-machine interface, marking and identification – Actuating principles.
- EN-IEC 60825-1, Safety of laser products Part 1  
Equipment classification, requirements and user's guide.

### Electrical:

- European Directive for Low voltage equipment.
- EN-IEC 60204-1, Safety of machinery  
Electrical equipment of machinery, Part 1: General requirements.
- European Directive for Electromagnetic compatibility.
- EN-IEC 61000-6-2, Electromagnetic compatibility  
Part 6-2: Generic standards – Immunity for industrial environments.

- EN-IEC 61000-6-4, Electromagnetic compatibility  
Part 6-4: Generic standards – Emission standard for industrial environments.
- North American Standard  
Electrical Equipment for Laboratory Use; Part 1 (UL61010A-1).
- North American Standard  
Safety Requirements for Electrical Equipment for Measurement, Control and  
Laboratory Use (CAN/CSA-C22.2).

## 11 PROCESS INPUT/OUTPUT SPECIFICATIONS

### 11.1 Process input

Subject to data processing equipment in use:

- Media Morpicks ACE for CD/ DVD encoding.
- Data transport must be done via MSH.
- Other encoding equipment on special request only.

### 11.2 Process output

The final stamper yield will meet or exceed the following specifications or refer to the Red and Blue Book specifications.

#### Electrical/ signal aspects

Performance

Electrical signal aspect of CD		
Parameter	Requirement	Format
Track pitch	1.5 – 1.7 $\mu\text{m}$	
Linear velocity	1.2 - 1.4 m/s	
I11T	Average: > 0.60	Replica
I3T	Average: > 0.30 > 0.70	Replica
PPC	Average: > 0.046	Replica
Asymmetry	Average: +5 % t/m –15 %	Replica
RN	Average: < 20 Peak: < 30	Replica
BLER	Average: < 10 Peak: < 50	Replica
E32	None allowed	Replica
XT	< 0.50	Replica
Jitter	< 35 ns	Replica

## Performance

<b>Electrical signal aspect of CD</b>		
<b>Parameter</b>	<b>Requirement</b>	<b>Format</b>
Track pitch	1.5 – 1.7 $\mu\text{m}$	
Linear velocity	1.2 - 1.4 m/s	
I11T	Average: > 0.50	Stamper
I3T	Average: > 0.30 > 0.70	Stamper
PPC	Average: > 0.046	Stamper
Asymmetry	Average: +5 % t/m –15 %	Stamper
RN	Average: < 20 Peak: < 30	Stamper
BLER	Average: < 20 Peak: < 100	Stamper
E22	None allowed	Stamper
XT	< 0.50	Stamper
Jitter	< 35 ns	Stamper

## Performance

<b>Electrical signal aspect of DVD</b>		
<b>Parameter</b>	<b>Requirement</b>	<b>Format</b>
Asymmetry	-5% to +15 %	Replica
I13/ I14 (RES)	> 0.15	Replica
I14/ I14H (I14N)	> 0.60	Replica
Jitter compensated (JC)	< 8.0 %	Replica
RNSd	< 16	Replica
PIE	Average: <50 Max: <100	Replica
POF	None allowed	Replica

## Performance

<b>Electrical signal aspect of DVD</b>		
<b>Parameter</b>	<b>Requirement</b>	<b>Format</b>
Asymmetry	-5% to +15 %	Stamper
I13/ I14 (RES)	> 0.15	Stamper
I14/ I14H (I14N)	> 0.60	Stamper
Jitter compensated (JC)	< 8.0 %	Stamper
RNSd	< 16	Stamper
PIE	Average: <50 Max: <100	Stamper
PIF	Max: < 30	Stamper
POF	None allowed	Stamper