Option 2

Ground Uplighting with AL DOT

Wall to be illuminated

Gap to be maintained to allow for smooth colour mixing effect

Continuous glare shield to be supplied and fitted by installer

Allegro DOT L RGBW 0.3M

Option 1

Ground Uplighting with AL DOT

Other information:

- Official expected life time of product 80’000hrs L70 @25deg, depending on light colours required expect minimum 10yr-12yr lifetime.
- To extend the lifetime further you can dim the system down to an acceptable level.
- Remote device management (RDM) is available in this fitting. This means you can monitor the whole system and individual fittings, detect failures & monitor power consumption etc.
- Standard warranty is 5yrs

1.1. UPS SYSTEM

Service Life Factors for VRLA Batteries

INTRODUCTION

This technical paper from Constant Power Services provides information on battery service life and an understanding as to the differences between design and service life.

When discussing batteries with our customers, we find that car tyres are a good analogy; there are different types of tyres with different costs, suited to different applications. The tyre has a design life and a maximum number of miles that are expected of it. How the tyre is used affects its lifespan and occasionally you hit a nail and the tyre needs replacing prematurely.

OVERVIEW

The design life of a battery is generally stated by the manufacturer as 5 or 10 years, but other durations also exist. The design life of a UPS battery is typically 5 years for small UPS devices of less than 10kVA, and 10 years for larger UPS. This is not always the case and some UPS manufacturers offer 5 year batteries as a cost saving option throughout the UPS size range. The design life does not mean that the battery will operate irrelevant of conditions; in fact there are a number of caveats that mean the battery is unlikely to reach this age, and certainly will not have the performance of a new battery.

issues at that point in time or history and experience of similar sites and products. There are two types of recommendation.

Recommendation based on actual information, for example:

- Some battery blocks have been found low during discharge and require replacement.
- The battery has been damaged and has been isolated for safety.
- There is no battery back-up and the condition of the battery blocks means they must be replaced.
- The battery room temperature is too high and this will affect the battery life.
- There is corrosion on the battery terminals / links or indication of venting of gas / electrolytes.

Recommendation based on similar site conditions, for example:

- No controlled cooling, this may lead to battery problems in the future should the temperature increase.
- The battery is at an age where we suggest that budget should be set aside for a battery replacement in the near future.
- There are signs of aging on the battery that indicate it may require replacing in the near future.
- Recommendations based on the amount of previously replaced battery blocks.

Due to the high cost of battery replacements, Constant Power Services tries in all cases try to give advanced indication of the costs involved. We also see an increase of battery failures from 5 years and therefore we will typically quote for the replacement of a 10 year battery at 5 years taking into account budgets and the varying importance of this cost versus the cost of a potential power loss to the load due to battery failure.

Based on our experience, Constant Power Services can give general advice as to typical battery service life. It must be noted that due to the critical nature of UPS loads this is far more conservative than that given by battery manufacturers. One factor at play here is that due to the high battery voltage and high power there are normally no or few redundant battery strings. This lack of redundancy means that the open-circuit failure of any one cell could immediately shutdown the UPS system upon mains failure. As the frequency of individual battery cell failures increases with age, this risk goes up through the battery's life.

Typically, if a UPS battery is kept in a temperature controlled environment for its life we would expect the battery to require replacement at 6-8 years for a 10 year design life block. If a UPS battery is kept in an uncontrolled environment, we would expect the battery to require replacement at 3-6 years with temperature compensation and dramatically less without it.

Services

Battery Maintenance, Battery Testing and Replacement

UPS Battery Testing & Replacement

UPS batteries are chemical energy storage devices that deteriorate over time. They have a design life based on optimum site conditions and an expected number of charge-discharge cycles. A ten year design life battery will probably require replacement by year 7 however budgetary quotes are issued at 5 years or sooner depending on condition. Whilst many UPS and standby power systems automatically test their batteries, nothing beats a visual inspection and on-site testing.

As part of the preventative maintenance visits on-site discharge testing is carried out to assess and report on the actual performance of the battery set. This testing can be purchased as a one off service.

During a maintenance visit the entire battery set will be put through a five stage process to ensure optimum performance during a power failure. The five stage Battery Care process includes:

1. Visual: check for a variety of conditions dependent on battery type:
- VRLA batteries - check for distortion caused by plate/pole growth, leakage or corrosion. - NiCads - check for leakage and corrosion.
- Flooded cells - check for plate colour, sediment level, electrolyte level, leakage and corrosion.
2. Measurements: take DC float voltage measurements - string and individual cells.
3. Mechanical: clean all batteries, confirm the minimum torque on all connections, top up electrolytes where possible (not sealed lead acid batteries).
4. Electrical Tests: Discharge test on the total battery bank, usually with the site load with voltage and current recordings taken.
5. Environment Checks: check the suitability of the local environment in terms of ambient temperature and any noticeable humidity and other environmental matters.

Finally a site report is issued with recommendations for future system monitoring or battery replacement.

2. VENTILATION SYSTEMS

2.1. JET FANS

2.1.1. ZITRON

Zitrón

TECHNICAL PROPOSAL: JET FANS

Customer: MORE JV, FCC Construcción SA, Salini Impregilo SPA and BeMo Tunnelling UK Ltd.
Project: A303 STONEHENGE TUNNEL
Ref.: 02-GB-21-03308 rev00
Date: 14/05/2021

JET FAN DATA

General data

Type	Jet Fan
Model	JZRi 12-37/4
Reversibility	100% Reversible
Remarks	*All fans will be identical*

Dimensional and technical data

Nominal Thrust (*)	N	1399	(*) Open Air and Air density 1,20 kg/m3
Effective Thrust (*)	N	1378	(*) Including accesories
Flow	m^3/s	36.9	
Outlet Velocity	m/s	32.7	
High temperature Resistance	°C-h	250 - 2	
Installed Power	kW	37	
Nominal Diameter (*)	mm	1200	
Maximum outside diameter	mm	1400	
Total length	mm	3900	aprox
Weight (Jet fan incl. silencers)	kg	1200	aprox

Sound power level	Hz	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
	dB(A)	98.5	96.4	100.8	97.4	97.4	94.7	91.3	86.2	105.9	102

2.1.2. FLÄKTWOODS

125JMT Reversible 2D silencers

Fläkt Woods Limited
Technical Data Sheet
Jetfoil - JMTS Reversible 2D Silencers

Fan Code	125JMTS/40/4/9/28/S/2.0D N
Fan Diameter / Size	1250 Size / mm
Fan Speed	1460 rpm
Blade Angle	28°
Percentage Duty	102 %
Requested Duty	1345 N
Actual Duty	1373 N
Velocity	30.5 m/s
Duty Shaft Power	36.78 kW
Motor Frame	200L [Class H]
Motor Rating.	42.6 kW [IE3]
Full Load Current.	78.7 A
Starting Current.	487.9 A
Motor Mounting	Pad
Electrical Supply	380-420 Volts 50 Hz 3 Phase
Start Type	DOL
Motor Winding	Standard
Enclosure	Standard All
Air Density	1.2 kg/m³ / 20 °C / 0 m / 50% RH
Smoke Venting	250°C / 2 Hours

De: Joe Foley (FläktGroup) <joe.foley@flaktgroup.com>
Enviado el: martes, 1 de junio de 2021 9:52
Para: Gonzalez Gabarda, Carlos
CC: Tom Gardner (FläktGroup); Jamie Slowgrove (FläktGroup); Mike OKelly (FläktGroup); González Martín, José Manuel
Asunto: RE: A303 Stonehenge Tunnel
Datos adjuntos: Routine Maintenance Schedule.pdf

Hi Carlos,

Please find attached an extract from our Operation and Maintenance Guide, which details the Routine Maintenance Procedures and the time-scales in which they should be performed.

In terms of Warranty, our Fans come with a 24 month Warranty as standard. We can also provide an option for extended warranty (up to 5 years as a maximum) if required.
If an extended warranty is purchased, you will need to document that routine maintenance has been performed, by completing a maintenance log book.

I hope this helps and will aid you with your call with HE. If anything else is required, please do not hesitate to ask.

Kind Regards

Joe Foley
Technical Sales Engineer - Tunnels & Metros

Fläkt Woods Limited, trading as Woods Air Movement

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Email: joe.foley@flaktgroup.com
Address: Axial Way, Colchester, Essex, CO4 5ZD, UK
Registered in England and Wales (registered no. 233771)
www.woodsairmovement.com

Typical routine maintenance (to be carried out every 6 months) includes; Examining airways, examining motor, cleaning dirt build-up and re-lubricating bearings (if the lubrication interval has been exceeded).

The service life of the Fans is 22 years, based on the Fans being installed in a C3 environment. Product life cycle can be extended with the addition of an epoxy protection.

The coating service life has been calculating using several ISO standards.

ISO 14713 dictates the corrosion rate for each Environment Category:

- C1: <0.1 micron per year
- C2: 0.1 – 0.7 micron per year
- C3: 0.7 – 2 micron per year
- C4: 2 – 4 micron per year
- C5: 4 – 8 micron per year

Costing thickness of Galvanising is dictated by ISO 1461. ISO 1461 stipulates that steel of 6mm gauge and above, will have at least 85 microns of surface protection.

Assuming a C3 environment and 6mm steel, **the material service life is expected to be between 22 and 42.5 years**.

If additional surface coating is required, 2 levels of epoxy protection can be applied:

- **Basic** – 120 micron epoxy + 85 micron galv = 205 micron total surface protection
- **Enhanced** – 320 micron epoxy + 85 micron galv + 405 micron total surface protection

Painted Jet Fans references, installed in tunnels:

- Cross City Tunnel - Australia 2005
- Parramatta Rail Tunnel – Australia 2006
- New Tyne Crossing – UK 2010

ROUTINE MAINTENANCE SCHEDULE	EVERY 6 MONTHS	EVERY 12 MONTHS	COMMENTS
1. Examine airways into fan guards (if fitted)	*		Remove any debris that may have accumulated round the guards.
2. Examine motor cooling fins.	*		Remove any material/dirt build-up between the motor fins.
3. Examine motor fixings.	*		Re-torque arm-to-motor fixings if necessary (refer to Figure 1).
4. Examine impeller for dirt build-up,and for physical damage to the impeller and to stationary parts.	*		Remove material build-up. Report any damage to Flakt Woods Service Centre.
5. Check condition and tautness of fan safety support chains/ropes (if fitted).	*		Clean safety support chains/ropes. Replace them if there are any signs of deterioration or corrosion.
6. Examine and operate vibration sensors (if fitted), level switches (if fitted), and temperature sensors (if fitted).	*		Check operation using built-in sensor test features or dummy signals. Check that the fan is automatically switched off and/or provides a warning indication in the event of a fault (see also Paragraph 5.3).
7. Examine condition of safety guards (if fitted) and their fixings.	*		Clean safety guards. Replace them if there are any signs of damage.
8. Check operation of anti-condensation heaters (if fitted).	*		Switch off power to motor. Check that anti condensation heaters are energised (drawing their rated current).
9. Check fan operational vibration level (readings to be obtained at rotational frequency).		*	If the vibration level is more than 7.1 mm/s r.m.s. when fitted on vibration isolators (1.5mm/s r.m.s when hard mounted) the fan must be re-balanced after obtaining advice from Flakt Woods. (**Note**: these are alarm levels)
10. Examine the clearance between the fan impeller blade tips and the fan duct.		*	If the impeller blade tip clearances are below the minimum figure listed in Table 2 the cause must be investigated. Blade tip clearances can be adjusted by changing the number of washers under the motor support arms (see Figure 3). After adjustment ensure that the fixing screws remain of an adequate length to provide a safe and secure hold.
11. Check torque of fan-to-frame fixings.		*	Re-torque fixings (see Figure 3).
12. Examine torque of fan and ancillary equipment fixings.		*	It is essential to confirm that all fixings on the component parts of the fan assembly are properly fitted, are tight, and are fully driven home. Torque ratings for the various fixings on the assembly are given on Figure 3.
13. Check torque and movement of vibration isolators (if fitted).		*	Check freedom of movement. Re-torque fixings (see Figure 3).
14. Check motor voltage and current consumption		*	Ensure voltage and full load current readings are as specified on the motor nameplate.
15. Inspect paintwork.		*	Treat any areas of damage with suitable anti-corrosion paint.

3. SMOKE & FIRE DETECTION ALARM SYSTEMS

3.1. Linear Heat detector

3.1.1. Siemens OTS30S

OTS30XX(S)

FibroLaser™

Linear Heat Detector

(OTS = Optical Temperature Sensor / XX = 01, 02, 04, 06, 10)

Electrical data

operating voltage (24VDC Controller)	DC 12 ... 48 V
mains voltage (115/230VAC Controller)	AC 100 ... 240 V
power consumption	<25W (max. 45 W/60°C)
programmable inputs	4 (optional 40)
programmable outputs (potential-free)	12 (optional 106)
Communication	FibroNET (TCP/IP, Modbus TCP/RTU, RS485, RS232)

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Edition 01.2015

3.2. LHD SWITCH CONTROLLER

3.2.1. Siemens OTS30S-SD

OTS30XX(S)-SC

FibroLaser™

LHD Switch Controller

(OTS = Optical Temp. Sensor)
(XX = 01, 02, 04, 06, 10 / SC = Switch Controller)

Electrical data

operating voltage (24VDC Controller)	DC 12 ... 48 V
mains voltage (115/230VAC Controller)	AC 100 ... 240 V
power consumption (DC Controller)	<25W (max. 45 W/60°C)
programmable inputs	4 (optional 40)
programmable outputs (potential-free)	12 (optional 106)
communication interface	FibroNET (TCP/IP, Modbus TCP/RTU, RS485, RS232)

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4. FIREFIGHTING & FIXED FIREFIGHTING SUPPRESSION SYSTEMS

4.1. Fire pump

4.1.1. Wilo SiFire-EN-150/315-291-250/1,5EJ

Information for order placements
Brand: Wilo
Product description: SiFire-EN-150/315-291-250/1,5EJ
Net weight, approx.: 2369 kg
Article number: 4183787

Description: Fire-extinguishing system
SiFire-EN-100/315-272-132/1,5EJ

Operating data
Fluid media: Water 100 %
Fluid temperature: 10,00 °C
Requested flow: 280,00 m³/h
Requested head: 90,00 m
Max. delivery head: 103,33 m
Number of pumps: 1
Fluid temperature: 3...50 °C
Ambient temperature: 4...40 °C
Maximum operating pressure: 16 bar

Motor data
Mains connection: 3~400V/50 Hz
Rated power: 250 kW
Rated current: 413,9 A
Power factor: 0,91
Rated speed: 2980 1/min
Protection class switchgear: IP54

Jockey pump
Rated current: 3,8 A
Rated power: 1,5 kW
Impeller jockey pump: 1.4408
Pump housing jockey pump: 5.1301/EN-GJL-250
Shaft jockey pump: 1.4057
Static gaskets jockey pump: EPDM

4.1.2. Water Sprinkler System

KOMTES

AG SPRINKLER

SUBJECT: ***Law of Guarantees in Sales in Customer Goods***

CUSTOMER:

ORDER Nº :

Dear customer,

Products and equipment supplied by AG FIRE SPRINKLER company satisfy the Spanish Regulation 23/2003, de 10 de Julio de Garantías en la Venta de Bienes de Consumo (Law 23/2003, 10th of July concerning to Guaranty in Sales in consumer goods), which in its article 4, establishes the conditions of guaranty to the items that AG FIRE SPRINKLER supplies to its clients and which is established as indicated:

1. AG FIRE SPRINKLER establishes 2 years the minimum period of guaranty in all the products that it manufactures or distributes. This period means from the supply date of the materials (packing list date).
2. AG FIRE SPRINKLER guarantees its products according to the performance and features indicated in its catalogues and technical information. Those products under law, satisfy the minimum features the applicable law indicates.
3. For products and/or "special" actuations, AG FIRE SPRINKLER, under previous agreement with its customers, offer a guaranty extension for a period further than 2 year. This agreement will be registered.
4. The Guaranty covers any defect due to manufacturing in the supplied products, or any faulty material in the materials used in the manufacturing. Problems due to a misuse of the product, a faulty installation or due to the use of them for applications they have not been designed for are not covered by this Guaranty.
5. The period for doing the correspondent guaranty complain is 6 months from the supply date of the product, although, demands will be attended during 3 years in case the failure of the product is proved to have been occured during the two first years from the supply date
6. In case the product manifests any problem and it is clearly proved of being due to failures in the materials used, or due to a wrong manufacturing, the customer has the right to claim to KOMTES group, which can ask for a testing "in situ" of the product (optional)

When the demand is accepted, AG FIRE SPRINKLER will offer to the customer the following options:

6.1 Repair of the product at charge of AG FIRE SPRINKLER

6.2 Return of the product and replacement of it for another with similar features and in perfect working will be made at no charge and returned freight prepaid.

6.3 Termination of the contract, return of the product and replacement of it is on charge of KOMTES group freight prepaid, go and return.

6.4 Reduction in the price previously agreed with the customer will be applied. This agreement will be registered.

7. According to the article 4 previously mentioned, of the Guaranty Law, AG FIRE SPRINKLER does not assume responsibilities which are not included in those usually established between seller and customer, in particular cannot apply retention in the price agreed, deferred payments to client convenience, and any other penalization not included in the said Law.

8. The Guaranty offered by AG FIRE SPRINKLER in its products, is a plus value. This distinguishes us and is applied to the initial customer, with whom the supply contract is signed, as well as to the owners/users of these products, in the same conditions previously descripted.

9. AG FIRE SPRINKLER does not accept responsibilities not included in the Law 23/2003, or included in the previous paragraphs, as consequence, AG FIRE SPRINKLER reserves the right to take legal actions in any competent court to assert their rights or settle disputes.

We are available for further information,

Burgos, xxxxxxxxxx

The Hydro EN pump sets for automatic sprinkler systems are made in compliance with the requirements of the following standards:

- EN 12845; Automatic sprinkler systems;
- IEC/EN 60034; Rotating electrical machines
- EN 1092-1 and EN 1092-2; Flanges and their joints – Part 1 & 2
- EN 61439-1; Low voltage switchgear and control gear assemblies part 1
- EN 61000-6-1; Electromagnetic compatibility - immunity - domestic and light industry environment – Part 6-1
- EN 61000-6-2; Electromagnetic compatibility - immunity - industrial environment – Part 6-2
- EN 61000-6-3; Electromagnetic compatibility - emission - domestic and light industry environment – Part 6-3
- EN 61000-6-4; Electromagnetic compatibility - emission - industrial environment-– Part 6-4
- EN 60204-1 (except 7.3); Safety of machinery-Electrical equipment of machinery - Part 1

4.1.3. Foam System

INSPECTION AND MAINTENANCE

MONTHLY

1. Check if the extinguishing system is in the proper location.

2. Verify that the system activation valve is not clogged and that the system shows no signs of physical damage or conditions that may prevent operation.

3. Verify that the nitrogen pilot cylinder safety seal is not broken.

4. Check that the pressure in the nitrogen cylinders is at 200 bar. Any cylinder that reads less than 200 bar must be replaced with a fully charged one (see RECHARGE instructions if cylinder replacement is necessary).

5. Check that all normally closed cylinder valves on the cylinders are closed.

SEMI-ANNUAL INSPECTION

Repeat the 5 steps of the monthly inspection. In addition to the steps of the biennial inspection:

1. Check the hydrostatic test date on the crown of the nitrogen cylinders. The cylinder must be tested in accordance with current regulations.

2. Visually inspect the hoses connecting the nitrogen cylinders and the unions to the proportioner and generators for damage.

3. Examine the generators to see that they are well positioned and solid.

4. Check the tank pressure relief valve for damage or corrosion.

5. Verify that the normally closed cylinder valves that will open on discharge are not damaged to ensure proper operation.

ANNUAL INSPECTION

Repeat the steps of the inspections monthly and semi-annual.

1. Check the level of the water and foam tanks using the level taps.

WARNING: BEFORE OPENING THE FILL INTAKE, VERIFY THAT THE PRESSURE GAUGE ON THE NITROGEN CYLINDERS AND THE WATER TANKS READ ZERO.

2. Open the fill port and collect a sample of the foam solution for analysis.

3. Close the filling port again.

4. The pressure gauge on all nitrogen cylinders should indicate a full charge of 200 bar. A pressure less than 200 bar requires the cylinder to be replaced.

5. After completing all the steps, prepare the system for a download by following the final checklist for the annual inspection.

FINAL CHECKLIST FOR ANNUAL INSPECTION

- Cylinder valvesnormally closed used in nitrogen cylinders - Closed
- Shut-off valve - Open
- Cylinder valvenormally closed used in system activation - Closed
- Nitrogen cylinder pressure gauges must indicate a pressure of 200 bar.
- All patch cords have been visually checked for good condition with no appreciable damage.

5. Drainage pumps & systems

5.1. SEWAGE

5.1.1. WILO FA 30.78D

Project: Created on: 30/12/1899
Project number: Q-ES013091-MAJA-0.xml Created by:

wilo

Technical data with motor
Submersible sewage pump FA 30.78D T 50.1-8/45G

Pump							
Pump type		FA 30.78D		Installation type		Suspension device	
Impeller Ø	max. possible	740	mm			DN300N/2RK	
	standard	675	mm	Free passage		100	mm
	designed	675	mm	Suction port	Pressure rating	PN10	
	min. possible	585	mm		Rated diameter	DN400	
Nominal speed		740	1/min		Standard	EN1092-2-S	
Frequency		50	Hz	Discharge port	Pressure rating	PN10	
Impeller type		Three-channel			Rated diameter	DN300	
Impeller construction		Closed			Standard	EN1092-2-D	
Weights							
Weight of pump end		max. 640	kg	Weight of unit		max. 2710	kg
Weight of motor		1980	kg				
Materials							
Pump housing		EN-GJS-500-7		Suction ports		EN-GJL-250	
Stationary wear ring		1.4462/1.4470					
Impeller		EN-GJS-500-7					
Mobile wear ring		1.4308					
Motor							
Motor name		T 50.1-8/45G		Number of poles		8	
Rated power		132	kW	Rated speed		740	1/min
Power input with rated power						141,6	kW
Rated voltage						400 ~3	V
Current input with rated power						258,8	A
Efficiency with rated power						93,2	%
cos phi with rated power		0,79		Rated frequency		50	Hz

6. TUNNEL SERVICES BUILDINGS SYSTEMS

6.1. HVAC SYSTEM

6.1.1. Mitshubishi i-NEXT DX

i-NEXT DX

TECHNICAL DATA

VERSION (1)		U / O					U / O				
MODEL		012 M1 S					018 M1 S				
SIZE		E1					E2				
COOLING CAPACITY (2)		100%	80%	60%	40%	30%	100%	80%	60%	40%	30%
Total	kW	10,4	8,32	6,24	4,16	3,04	21,8	17,4	13,1	8,72	6,39
Sensible	kW	10,2	8,17	6,18	4,15	3,04	20,2	16,4	12,3	8,26	6,39
SHR (3)		0,98	0,98	0,99	1,00	1,00	0,93	0,92	0,93	0,94	1,00
Total power input (Comp. + Fans)	kW	2,82	2,00	1,27	0,78	0,53	6,5	4,83	3,22	1,91	1,41
"EC" SUPPLY FANS	n.			1					1		
Air flow	m³/h	2800	2433	2065	1698	1500	4100	3364	2629	1893	1500
Nominal external static pressure	Pa	20	20	20	20	20	20	20	20	20	20
Maximum external static pressure	Pa	77	--	--	--	--	314	--	--	--	--
Power input (4)	kW	0,29	0,21	0,13	0,09	0,07	0,52	0,35	0,22	0,12	0,08

COMPRESSOR		Rotary					Scroll				
BLDC compressor	n.			1					1		
On/Off compressors	n.			0					0		
Cooling Capacity Control				Modulating					Modulating		
Compressors power input	kW	2,53	1,79	1,15	0,69	0,46	5,98	4,48	3	1,79	1,33

TECHNICAL DATA

VERSION (1)		U / O					U / O				
MODEL		022 M1 S					030 M1 S				
SIZE		E3					E4				
COOLING CAPACITY (2)		100%	80%	60%	40%	30%	100%	80%	60%	40%	30%
Total	kW	23,9	19,1	14,3	9,56	6,73	39,3	31,4	23,6	15,7	11,9
Sensible	kW	23,9	18,9	14,3	9,16	6,73	39,3	31,4	23,6	15,7	11,9
SHR (3)		1,00	0,98	1,00	0,95	1,00	1,00	1,00	1,00	1,00	1,00
Total power input (Comp. + Fans)	kW	6,74	4,93	3,24	1,96	1,39	11,4	8,01	5,33	3,09	2,21
"EC" SUPPLY FANS	n.			1					1		
Air flow	m³/h	5500	4442	3384	2326	1700	10000	8135	6271	4406	3500
Nominal external static pressure	Pa	20	20	20	20	20	20	20	20	20	20
Maximum external static pressure	Pa	1000	--	--	--	--	586	--	--	--	--
Power input (4)	kW	0,78	0,42	0,25	0,14	0,07	2,04	1,13	0,51	0,27	0,16
COMPRESSOR		Scroll					Scroll				
BLDC compressor	n.			1					1		
On/Off compressors	n.			0					0		
Cooling Capacity Control				Modulating					Modulating		
Compressors power input	kW	5,96	4,51	2,99	1,83	1,32	9,32	6,9	4,82	2,82	2,05

TECHNICAL DATA

VERSION (1)		U / O					U / O				
MODEL		047 M1 S					042 M2 D				
SIZE		E5					E5				
COOLING CAPACITY (2)		100%	80%	60%	40%	30%	100%	80%	60%	40%	30%
Total	kW	54	43,2	32,4	21,6	16,8	49,2	39,4	29,5	19,7	14,6
Sensible	kW	53,1	43,2	32,4	21,6	16,8	49,2	39,4	29,5	19,7	14,6
SHR (3)		0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Total power input (Comp. + Fans)	kW	15,6	10,8	7,12	4,25	3,08	13,9	9,93	6,5	3,87	2,84
"EC" SUPPLY FANS	n.	1					1				
Air flow	m^3/h	12000	9881	7761	5642	4700	12000	9924	7848	5772	4700
Nominal external static pressure	Pa	20	20	20	20	20	20	20	20	20	20
Maximum external static pressure	Pa	420	--	--	--	--	477	--	--	--	--
Power input (4)	kW	2,27	1,4	0,77	0,36	0,23	2,05	1,29	0,72	0,34	0,22
COMPRESSOR		Scroll					Scroll				
BLDC compressor	n.	1					2				
On/Off compressors	n.	0					0				
Cooling Capacity Control		Modulating					Modulating				
Compressors power input	kW	13,4	9,43	6,35	3,89	2,85	11,9	8,64	5,79	3,53	2,62

TECHNICAL DATA

VERSION (1)		U / O					U / O				
MODEL		068 M2 D					094 M2 D				
SIZE		E7					E8				
COOLING CAPACITY (2)		100%	80%	60%	40%	30%	100%	80%	60%	40%	30%
Total	kW	78,9	63,1	47,3	31,6	22,9	105	84	63	42	32,3
Sensible	kW	78,9	63,1	47,3	31,6	22,9	100	81,1	61,5	40,9	32,3
SHR (3)		1,00	1,00	1,00	1,00	1,00	0,95	0,96	0,97	0,97	1,00
Total power input (Comp. + Fans)	kW	22,1	15,8	10,5	6,2	4,34	30,5	21,2	14,1	8,44	6,07
"EC" SUPPLY FANS	n.	2					2				
Air flow	m^3/h	20000	15999	11997	7996	5800	22000	17956	13912	9868	8000
Nominal external static pressure	Pa	20	20	20	20	20	20	20	20	20	20
Maximum external static pressure	Pa	649	--	--	--	--	576	--	--	--	--
Power input (4)	kW	3,51	2	0,98	0,42	0,23	3,72	2,24	1,13	0,54	0,35
COMPRESSOR		Scroll					Scroll				
BLDC compressor	n.	2					2				
On/Off compressors	n.	0					0				
Cooling Capacity Control		Modulating					Modulating				
Compressors power input	kW	18,6	13,8	9,5	5,78	4,11	26,8	18,9	13	7,91	5,72

TECHNICAL DATA

VERSION (1)		U					U				
MODEL		120 M4 D					150 M4 D				
SIZE		E9					E9				
COOLING CAPACITY (2)		100%	80%	60%	40%	30%	100%	80%	60%	40%	30%
Total	kW	111	88,8	66,6	44,4	24,1	135	108	81	54	30,8
Sensible	kW	111	88,8	66,6	44,4	24,1	135	108	81	54	30,8
SHR (3)		1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Total power input (Comp. + Fans)	kW	31,6	22,4	15	9,46	4,42	41,4	28,6	19,4	11,8	6,04
"EC" SUPPLY FANS	n.	3					3				
Air flow	m^3/h	28000	23018	18037	13055	8500	32000	25911	19821	13732	8500
Nominal external static pressure	Pa	20	20	20	20	20	20	20	20	20	20
Maximum external static pressure	Pa	761	--	--	--	--	568	--	--	--	--
Power input (4)	kW	4,2	2,61	1,48	0,71	0,33	5,82	3,43	1,8	0,81	0,33
COMPRESSOR		Scroll					Scroll				
BLDC compressor	n.	2					2				
On/Off compressors	n.	2					2				
Cooling Capacity Control		Modulating					Modulating				
Compressors power input	kW	27,4	19,8	13,5	8,75	4,09	35,6	25,2	17,5	11	5,71

VERSION (1)		U / O	U / O	U / O	U / O	U / O
MODEL		012 M1 S	018 M1 S	022 M1 S	030 M1 S	047 M1 S
SIZE		E1	E2	E3	E4	E5
Power supply	V/ph/Hz	400/3+N/50	400/3+N/50	400/3+N/50	400/3+N/50	400/3+N/50
Maximum current input (FLA)	A	13,2	18,7	22,6	30,6	39,4

VERSION (1)		U / O	U / O	U / O	U	U
MODEL		042 M2 D	068 M2 D	094 M2 D	120 M4 D	150 M4 D
SIZE		E5	E7	E8	E9	E9
Power supply	V/ph/Hz	400/3+N/50	400/3+N/50	400/3+N/50	400/3+N/50	400/3+N/50
Maximum current input (FLA)	A	39,4	60,8	78,8	93,8	112

A431 – ELECTRIC HEATER

Electric heater consisting of finned aluminium elements, ensuring low surface temperature and deleting the air ionization problems. The optional is installed downstream the main cooling coil.
In electric heaters with three working steps the activation is binary type.
Components:

- Electric heater in aluminium armoured elements with integral fins
- Electrical control
- Safety thermostat.

The electric heater can be installed in combination with "P131 Hot water coil+2way valve". The operation is alternate with priority to the hot water heating coil.
The electric heater can be installed in combination with "P211 Hot gas heating+4way valve". The operation is alternate with priority to the hot gas re-heating system. In this configuration the electric heater groups the operating stages in a single step.
Temperature control on suction air.

TECHNICAL DATA

VERSION (1)		**U / O**	**U / O**	**U / O**	**U / O**	**U / O**
MODEL		**012 M1 S**	**018 M1 S**	**022 M1 S**	**030 M1 S**	**047 M1 S**
SIZE		**E1**	**E2**	**E3**	**E4**	**E5**
THERMAL CAPACITY	**kW**	**5,1**	**5,1**	**6,0**	**9,0**	**13,5**
Absorbed current (OA)	A	7,4	7,4	8,7	13,0	19,5
First working step	kW	5,1	5,1	3,0	3,0	4,5
Second working step	kW	-	-	3,0+3,0	6,0	9,0
Third working step	kW	-	-	-	3,0 + 6,0	4,5+9,0
NET WEIGHT (2)	**kg**	4	4	7	15	10

VERSION (1)		**U / O**	**U / O**	**U / O**	**U**	**U**
MODEL		**042 M2 D**	**068 M2 D**	**094 M2 D**	**120 M4 D**	**150 M4 D**
SIZE		**E5**	**E7**	**E8**	**E9**	**E9**
THERMAL CAPACITY	**kW**	**13,5**	**13,5**	**18,0**	**18,0**	**18,0**
Absorbed current (OA)	A	19,5	19,5	26,0	26,0	26,0
First working step	kW	4,5	4,5	4,5	4,5	4,5
Second working step	kW	9,0	9,0	13,5	13,5	13,5
Third working step	kW	4,5+9,0	4,5+9,0	4,5+13,5	4,5+13,5	4,5+13,5
NET WEIGHT (2)	**kg**	10	9,5	11	11	11

A432 - EXTRA POWER ELECTRIC HEATERS
The optional is not available for size E1, E2
The components are the same of the standard accessory
It is not possible to combine the extra power electric heaters with "P131 Hot water coil+2way valve" and "P211 Hot gas heating+4way valve".
Temperature control on suction air.

TECHNICAL DATA

VERSION (1)		**U / O**	**U / O**	**U / O**	**U / O**	**U / O**
MODEL		**012 M1 S**	**018 M1 S**	**022 M1 S**	**030 M1 S**	**047 M1 S**
SIZE		**E1**	**E2**	**E3**	**E4**	**E5**
THERMAL CAPACITY	**kW**	**-**	**-**	**9,0**	**13,5**	**18,0**
Absorbed current (OA)	A	-	-	13,0	13,0	26,0
First working step	kW	-	-	4,5	4,5	4,5
Second working step	kW	-	-	4,5+4,5	9,0	13,5
Third working step	kW	-	-	-	4,5+9,0	4,5+13,5
NET WEIGHT (2)	**kg**	-	-	7	9,5	12

VERSION (1)		**U / O**	**U / O**	**U / O**	**U**	**U**
MODEL		**042 M2 D**	**068 M2 D**	**094 M2 D**	**120 M4 D**	**150 M4 D**
SIZE		**E5**	**E7**	**E8**	**E9**	**E9**
THERMAL CAPACITY	**kW**	**18,0**	**18,0**	**27,0**	**27,0**	**27,0**
Absorbed current (OA)	A	26,0	26,0	39,0	39,0	39,0
First working step	kW	4,5	4,5	9,0	9,0	9,0
Second working step	kW	13,5	13,5	18,0	18,0	18,0
Third working step	kW	4,5+13,5	4,5+13,5	9,0+18,0	9,0+18,0	9,0+18,0
NET WEIGHT (2)	**kg**	12	11,5	14,5	14,5	14,5

i-NEXT DX

OPTIONAL ACCESSORIES: 4301 – STEAM HUMIDIFIER 3KG/H
OPTIONAL ACCESSORIES: 4303 – STEAM HUMIDIFIER 8KG/H
OPTIONAL ACCESSORIES: 4305 – STEAM HUMIDIFIER 15KG/H

TECHNICAL DATA

VERSION (1)		**U / O**	**U / O**	**U / O**	**U / O**	**U / O**
MODEL		**012 M1 S**	**018 M1 S**	**022 M1 S**	**030 M1 S**	**047 M1 S**
SIZE		**E1**	**E2**	**E3**	**E4**	**E5**
VAPOUR PRODUCTION	**kg/h**	**3,0**	**3,0**	**3,0**	**8,0**	**8,0**
Power input	kW	2,3	2,3	2,3	6	6
Absorbed current (OA)	A	3,2	3,2	3,2	8,7	8,7
Max absorbed current (OA)	A	4,5	4,5	4,5	12,4	12,4
Water content	l	3,9	3,9	3,9	6,4	6,4
Max water supply pressure	Bar	1÷8	1÷8	1÷8	1÷8	1÷8
NET WEIGHT (2)	kg	4	4	4	10	10
HYDRAULIC CONNECTION						
WATER INLET - ISO 228/1 – G M	Ø	3/4"	3/4"	3/4"	3/4"	3/4"
WATER OUTLET – external diameter	Ø mm	19	19	19	19	19

TECHNICAL DATA

VERSION (1)		U / O	U / O	U / O	U	U
MODEL		042 M2 D	068 M2 D	094 M2 D	120 M4 D	150 M4 D
SIZE		E5	E7	E8	E9	E9
VAPOUR PRODUCTION	kg/h	8,0	8,0	8,0	8,0	8,0
Power input	kW	6,0	6,0	6,0	6,0	6,0
Absorbed current (OA)	A	8,7	8,7	8,7	8,7	8,7
Max absorbed current (OA)	A	12,4	12,4	12,4	12,4	12,4
Water content	l	6,4	6,4	6,4	6,4	6,4
Max water supply pressure	Bar	1÷8	1÷8	1÷8	1÷8	1÷8
NET WEIGHT (2)	kg	10	10	10	10	10
HYDRAULIC CONNECTION						
WATER INLET - ISO 228/1 – G M	Ø	3/4"	3/4"	3/4"	3/4"	3/4"
WATER OUTLET – external diameter	Ø mm	19	19	19	19	19

TECHNICAL DATA

VERSION (1)		U / O	U / O	U / O	U / O	U / O
MODEL		012 M1 S	018 M1 S	022 M1 S	030 M1 S	047 M1 S
SIZE		E1	E2	E3	E4	E5
VAPOUR PRODUCTION	kg/h	--	--	--	15,0	15,0
Power input	kW	--	--	--	11,3	11,3
Absorbed current (OA)	A	--	--	--	16,2	16,2
Max absorbed current (OA)	A	--	--	--	23	23
Water content	l	--	--	--	10,3	10,3
Max water supply pressure	Bar	--	--	--	1÷8	1÷8
NET WEIGHT (2)	kg	--	--	--	16	16
HYDRAULIC CONNECTION						
WATER INLET - ISO 228/1 – G M	Ø	--	--	--	3/4"	3/4"
WATER OUTLET – external diameter	Ø mm	--	--	--	19	19

TECHNICAL DATA

VERSION (1)		U / O	U / O	U / O	U	U
MODEL		042 M2 D	068 M2 D	094 M2 D	120 M4 D	150 M4 D
SIZE		E5	E7	E8	E9	E9
VAPOUR PRODUCTION	kg/h	15,0	15,0	15,0	15,0	15,0
Power input	kW	11,3	11,3	11,3	11,3	11,3
Absorbed current (OA)	A	16,2	16,2	16,2	16,2	16,2
Max absorbed current (OA)	A	23	23	23	23	23
Water content	l	10,3	10,3	10,3	10,3	10,3
Max water supply pressure	Bar	1÷8	1÷8	1÷8	1÷8	1÷8
NET WEIGHT (2)	kg	16	16	16	16	16
HYDRAULIC CONNECTION						
WATER INLET - ISO 228/1 – G M	Ø	3/4"	3/4"	3/4"	3/4"	3/4"
WATER OUTLET – external diameter	Ø mm	19	19	19	19	19

i-NEXT DX U 018 M1 S E2

Software version: ELCA World 1.5.3.0
Database version: 1.6.3.0
User: Juan Barrio
Print data: 16/04/2021 17:18

REMOTE CONDENSER

MAIN CIRCUIT

REMOTE CONDENSER

Code		GR-Z A B 50 027
Quantity	N°	1
Version		B
Circuits	N°	1
Outdoor air temperature	°C	35,0
Condensing temperature	°C	50,6
Air flow	m³/h	8350
Rejection capacity	kW	26,8

FANS

Fans power input	kW	0,60
Quantity	N°	1
Project pressure	Pa	0

VRF zoning systems installed in 2004 at the University of Southern California.

Ten years ago, we introduced our Variable Refrigerant Flow (VRF) zoning systems as a solution for many HVAC needs. Soon after, the state-of-the-art technology was tapped as the HVAC solution in a University of Southern California sorority house. Sirius Mechanical, Moreno Valley, California, was so impressed by our system's efficiency and functionality at the sorority house that it decided to specialize in our systems for both its commercial and residential work. "There's just no better energy-efficient system," said Randy Scholnick, director of sales for Sirius Mechanical.

The features in our VRF zoning products have improved over the years. The systems have become even more efficient, better designed and quieter, while continuing to require less piping, fewer fittings and minimal routine maintenance. Today, VRF zoning systems are 25 percent more efficient than traditional systems with many users seeing energy bills at half of what is expected. What's more? The average life expectancy of our CITY MULTI® VRF zoning systems is 25 to 30 years, versus 15 to 20 years for a traditional commercial rooftop system, with a typical five- to seven-year payback period.

Part	Maintenance Checking step	Times/ month
Air filter	1 . Open the grill 2 . Take out the air filter 3 . Use brush to clean the air filter under 40℃ water	1
Front Panel	1 . Get rid of the dust and dirt by using cloth and detergent , clean the panel	1
Drain Pan and host	1 . Check the drain pan and host are clean or not, if it is dirty, clean it 2 . Check there is no barrier for the condensing water flow out	3
Evaporator	1 . Clean the dirt of fins 2 . Clean any barrier of indoor air flow	1
Electrical Part	1 . Check the running ampere and voltage is normal or not 2 . Check the electrical connection is fixed or loose	12

7. TUNNEL CONTROL & MANAGEMENT SYSTEM

7.1. SCADA

Company name: FCC INDUSTRIAL

- **Main Products**
  Tunnel & Motorway SCADA Software

- **Manufacturer's Warranty**
  Standard warranty is **12** months.

  We are able to offer an extended warranty of **60** months.

- **Manufacturers assessment of asset design life**
  The products have a design life of 15 years,

  when operated in accordance with regular maintenance carried out in accordance with the procedures detailed in the maintenance manuals.

- **Extended Life Cycle and Refurbishment**
  It will be possible to extent your product life cycle to 26 years? **Yes**

  and refurbishment to 13 years ? **Yes**

7.2. VISIBILITY NO AND CO MEASURING DEVICE IN TUNNELS

7.2.1. Modernizes measurement performance for tunnel air quality Sick VISIC100SF

VISIC100SF sensor unit

Description	Analyzer unit of the measuring system
Enclosure rating	IP 6K9K
Analog outputs	3 outputs: 4 ... 20 mA, 500 Ω Electrically isolated; short-circuit proof
Digital outputs	2 relay contacts: 48 V DC, 0.5 A, 24 W Preset for failure and maintenance request
Interfaces and bus protocols	
RS-485	Modbus RTU (not available when a TAD is used)
RS-485	PROFIBUS DP (option)
Indication	LC display, inside Status LEDs: "Operation", "Maintenance request" and "Failure"
Input	Functional keys
Operation	Via LC-display and function keys
Dimensions (W x H x D)	266 mm x 159 mm x 117 mm (for details see dimensional drawings)
Weight	≤ 2.8 kg
Material	Stainless steel 1.4571
Mounting	Wall-mounting, vertical, up to a wall inclination of 45°
Power supply	
Voltage	18 ... 28 V DC
	Other voltages with optional terminal box or Tunnel Adapter Device TAD
Current consumption	≤ 1 A
Power consumption	Without heating: ≤ 5 W With heating: ≤ 20 W

TAD tunnel adapter device

Description	Unit for displaying data, for operation and for connecting data cables
Enclosure rating	IP 66
Analog outputs	4 outputs (option): 4 ... 20 mA, 500 Ω Electrically isolated
Digital outputs	3 outputs (option): 125 V AC, 0.6 A / 30 V DC, 2 A
Digital inputs	1 input (option): 30 V DC
Indication	LC display and status LEDs
Input	Functional keys
Dimensions (W x H x D)	210 mm x 347 mm x 129 mm (for details see dimensional drawings)
Weight	5 kg
Material	Stainless steel 1.4571
Power supply	
Voltage	88 ... 264 V AC
Frequency	47 ... 63 Hz
Power consumption	15 W

VISIC100SF terminal box

Description	Serves for connection of power supply, data and signal cabelling provided by the customer
Enclosure rating	IP 6K9K
Dimensions (W x H x D)	266 mm x 238 mm x 146 mm (for details see dimensional drawings)

TAD tunnel adapter device

Description	Unit for displaying data, for operation and for connecting data cables
Enclosure rating	IP 66
Analog outputs	4 outputs (option): 4 ... 20 mA, 500 Ω Electrically isolated
Digital outputs	3 outputs (option): 125 V AC, 0.6 A / 30 V DC, 2 A
Digital inputs	1 input (option): 30 V DC
Indication	LC display and status LEDs
Input	Functional keys
Dimensions (W x H x D)	210 mm x 347 mm x 129 mm (for details see dimensional drawings)
Weight	5 kg
Material	Stainless steel 1.4571
Power supply	
Voltage	88 ... 264 V AC
Frequency	47 ... 63 Hz
Power consumption	15 W

VISIC100SF terminal box

Description	Serves for connection of power supply, data and signal cabelling provided by the customer
Enclosure rating	IP 6K9K
Dimensions (W x H x D)	266 mm x 238 mm x 146 mm (for details see dimensional drawings)

6 VISIC100SF | SICK
8016499/2015-09
Subject to change without notice

7.2.2. Flow velocity monitor SICK FLOWSIC200

Power supply	
Operation voltage	90 ... 250 V AC; 50/60 Hz
Power consumption	approx. 20 W
Ambient conditions	
Temperature range	–40 ... +60°C
Storage temperature	–40 ... +70°C
Type of protection	FLSE200: IP66, MCU: IP65

1): The precision depends on calibration, installation conditions, flow profile, temperature and length of the measuring section

2) For operation with standard parameter settings (Factory settings).

7.3. LINEAR HEAT DETECTOR

Company name: SIEMENS

- **Main Products**
  Linear Heat Detector FIBROLASER OTS30XX (S)

  Sensor Cable SC-MFLTR-FRNC

- **Manufacturer's Warranty**
  Standard warranty is **12** months.

  We are able to offer an extended warranty of **60** months.

- **Manufacturers assessment of asset design life**
  The products have a design life of 15 years, when operated in accordance with regular maintenance carried out in accordance with the procedures detailed in the maintenance manuals.

- **Extended Life Cycle and Refurbishment**
  It will be possible to extent your product life cycle to 26 years ? **No**

  and refurbishment to 13 years ? **Yes**

Mechanical data

Controller	19" Rack / 3 units of height
dimensions (H x W x D)	13,1 x 48,3 x 33,8 cm
color	grey
weight	13 kg
Transportation box	wood
dimensions (H x W x D)	62 x 43 x 61 cm
weight (with Controller and Installation set)	35kg

Electrical data

operating voltage (24VDC Controller)	DC 12 ... 48 V
mains voltage (115/230VAC Controller)	AC 100 ... 240 V
power consumption (DC Controller)	<25W (max. 45 W/60°C)
programmable inputs	4 (optional 40)
programmable outputs (potential-free)	12 (optional 106)
communication interface	FibroNET (TCP/IP, Modbus TCP/RTU, RS485, RS232)

Optical data

laser wavelength	1064 nm
optical connector	E2000 / 8° bevel grinding
laser classification	class 1M according to EN60825-1: 2007
maximum measuring distance (OTS30xxS-SC: xx = 01, 02, 04)	2, 4, 8km (see project example)
laser wavelength	1550 nm
optical connector	E2000 / 8° bevel grinding
laser classification	class 1M according to EN60825-1: 2007
maximum measuring distance (OTS30xx-SC: xx = 06, 10)	12, 20 km (see project example)

Environmental conditions

storage temperature	-35 ... +75 °C
operating temperature	-10 ... +60 °C
humidity (no condensation permitted)	≤95 % rel.
protection category (IEC 60529)	IP51

Approvals

VdS (Pr EN 54-22)	G211076

SC-MFLT4-FRNC

FibroLaser™

Sensor Cable

- Detects hot gases and radiant heat using linear temperature measurement
- Flame Retardant and Non Corrosive sheath
- Consistent sensitivity throughout the entire sensor cable length
- Redundancy due to double optical fibers – for safety on the highest level
- Infrared absorbing cable insulation (FRNC)
- No electronic parts – immune to electromagnetic interferences
- Robust construction – resistant to environmental influences
- Easy installation
- No maintenance required
- High durability (up to 30 years)
- VdS approval (G211076)

7.4. DISTRIBUTED CONTROLLERS

SIEMENS ET-200 / ST-400H 7 ST-1500 / ST-1200

Voltages, currents, electrical potentials			
Rated voltage	DC 24 V (DC 20.4 to 28.8 V)		
Current consumption at 24 V	Max. 350 mA	Max. 550 mA max. 600 mA (for IM 153-2BAx2)	Max. 500 mA
Inrush current	2.5 A	2.5 A (for IM 153-2AA0x and IM 153-2BA00) 3.5 A (for IM 153-2BAx1) 3.0 A (for IM 153-2BAx2)	3.5 A
Power on the I/O bus (to supply the I/O modules)	—	max. 1.5 A	—
I^2t	0.1 A^2s		
Recommended external fusing for supply lines	In a configuration with grounded reference potential a fuse is required for redundant interface modules (recommendation: 2.5 A).		
Power dissipation, type	3 W	5 W (for IM 153-2AA0x and IM 153-2BA00) 4 W (for IM 153-2BAx1) 5.5 W (for IM 153-2BAx2)	4.5 W (for IM 153-2AB0x and IM 153-2BB00)

Scope of maintenance

The ET 200M is a maintenance-free DP slave.

Maintenance is limited to the replacement or exchanging of modules or components.

8. VARIABLE MESSAGE SIGNS

8.1. SWARCO

Power consumptoin and maximum loads to components

MS2,MS3,MS4 = 3G6
AMI = 3G4

MS2_2x12_v3						
			Load			
Partname	Description	Quantity per Sign	Incident state [% of max load]	Congestion state [% of max load]	Quiescent state [% of max load]	
Board ECOFC..1 16x8x1 20 M05137-H.00	LED Module 16x8 RGB, 20mm	72	0,95	6,32	0	
Board ECOFC..1 8x8x1 25UK-Fla M06140-F.00	LED Flasher 8x8 RBG 25mm	4	10	20	0	Note: only active 50% of time when flasher are on
Illuminance sensor RS485 M08111-A.02	Illuminance sensor	2	N.A	N.A	N.A	Note: all "N.A." means that all components have a minimum of 30% reserve to speci
Indication Board 4xRGB HW UK M02390-A.00	Indication Module (status LEDs)	3	15	30	15	
Redundanzmodul MOSFET 5V/30A M02401-A.05	Redundancy Module	3	10	20	0	
Cont RAINBOW XTD TIV055731K..M08104-B.05	Controller	1	50	50	50	
SCHALTREGLER HWS150A-5/A 5V 30A	AC/DC PS Display	6				
SCHALTREGLER HWS50A-5/A 5V 10A	AC/DC PS Rainbowcontroller	1	20	20	20	
DSL to Ethernet Converter	DSL to Ethernet Converter	1	N.A	N.A	N.A	
						Maximum Power Consumption 100% LEDs on/100% Brightness
		Power consumption	53 W	94 W	43 W	400 W

MS3_2x16_v3						
			Load			
Partname	Description	Quantity per Sign	Incident state [% of max load]	Congestion state [% of max load]	Quiescent state [% of max load]	
Board ECOFC..1 16x8x1 20 M05137-H.00	LED Module 16x8 RGB, 20mm	176	0,95	6,32	0	
Board ECOFC..1 8x8x1 25UK-Fla M06140-F.00	LED Flasher 8x8 RBG 25mm	6	10	20	0	Note: only active 50% of time when flasher are on
Illuminance sensor RS485 M08111-A.02	Illuminance sensor	2	N.A	N.A	N.A	Note: all "N.A." means that all components have a minimum of 30% reserve to speci
Indication Board 4xRGB HW UK M02390-A.00	Indication Module (status LEDs)	1	15	30	15	
Redundanzmodul MOSFET 5V/30A M02401-A.05	Redundancy Module	8	10	20	0	
Cont RAINBOW XTD TIV055731K..M08104-B.05	Controller	1	50	50	50	
SCHALTREGLER HWS150A-5/A 5V 30A	AC/DC PS Display	1				
SCHALTREGLER HWS50A-5/A 5V 10A	AC/DC PS Rainbowcontroller	16	20	20	20	
RAINBOW EXTENSION TIV062400K M08109-A.04	Extension Board for Controller	1	N.A	N.A	N.A	
DSL to Ethernet Converter	DSL to Ethernet Converter	1	N.A	N.A	N.A	Maximum Power Consumption 100% LEDs on/100% Brightness
		Power consumption	134 W	232 W	107 W	940 W

MS3_3x18_v3						
			Load			
Partname	Description	Quantity per Sign	Incident state [% of max load]	Congestion state [% of max load]	Quiescent state [% of max load]	
Board ECOFC..1 16x8x1 20 M05137-H.00	LED Module 16x8 RGB, 20mm	300	0,95	6,32	0	
Board ECOFC..1 8x8x1 25UK-Fla M06140-F.00	LED Flasher 8x8 RBG 25mm	6	10	20	0	Note: only active 50% of time when flasher are on
Illuminance sensor RS485 M08111-A.02	Illuminance sensor	2	N.A	N.A	N.A	Note: all "N.A." means that all components have a minimum of 30% reserve to speci
Indication Board 4xRGB HW UK M02390-A.00	Indication Module (status LEDs)	1	15	30	15	
Redundanzmodul MOSFET 5V/30A M02401-A.05	Redundancy Module	13	10	20	0	
Cont RAINBOW XTD TIV055731K..M08104-B.05	Controller	1	50	50	50	
SCHALTREGLER HWS150A-5/A 5V 30A	AC/DC PS Display	26				
SCHALTREGLER HWS50A-5/A 5V 10A	AC/DC PS Rainbowcontroller	1				
RAINBOW EXTENSION TIV062400K M08109-A.04	Extension Board for Controller	1	N.A	N.A	N.A	
DSL to Ethernet Converter	DSL to Ethernet Converter	1	N.A	N.A	N.A	Maximum Power Consumption 100% LEDs on/100% Brightness
		Power consumption	221 W	388 W	175 W	1600 W

MS4_8x12_v3						
			Load			
Partname	Description	Quantity per Sign	Incident state [% of max load]	Congestion state [% of max load]	Quiescent state [% of max load]	
Board ECOFC..1 16x8x1 20 M05137-H.00	LED Module 16x8 RGB, 20mm	192	0,95	6,32	0	
Illuminance sensor RS485 M08111-A.02	Illuminance sensor	2	10	20	0	
Indication Board 4xRGB HW UK M02390-A.00	Indication Module (status LEDs)	1	15	30	15	
Redundanzmodul MOSFET 5V/30A M02401-A.05	Redundancy Module	8	10	20	0	
Cont RAINBOW XTD TIV055731K..M08104-B.05	Controller	1	50	50	50	
SCHALTREGLER HWS150A-5/A 5V 30A	AC/DC PS Display	16	30	30	30	
SCHALTREGLER HWS50A-5/A 5V 10A	AC/DC PS Rainbowcontroller	1	20	20	20	
RAINBOW EXTENSION TIV062400K M08109-A.04	Extension Board for Controller	1	N.A	N.A	N.A	
DSL to Ethernet Converter	DSL to Ethernet Converter	1	N.A	N.A	N.A	
						Maximum Power Consumption 100% LEDs on/100% Brightness
		Power consumption	140 W	246 W	110 W	1000 W

AMI_v3						
			Load			
Partname	Description	Quantity per Sign	Incident state [% of max load]	Congestion state [% of max load]	Quiescent state [% of max load]	
Board ECOFC..1 16x8x1 20 M05137-H.00	LED Module 16x8 RGB, 20mm	8	0,95	5,56	0	
Board ECOFC..1 8x8 RGB pp=16mm M04133-F.00	LED Module 16x8 RGB, 16mm	4	0,9	5,08	0	Note: only active 50% of time when flasher are on
LED-module AMI, red circle 1/2	LED Module Mono Red 1/2	4	0,95	5,56	0	
LED-module AMI, red circle 2/2	LED Module Mono Red 2/2	4	0,95	5,56	0	
Illuminance sensor RS485 M08111-A.02	Illuminance sensor	2	10	20	0	
I/O module V2 for Rainbow, RS485, 4DI/4DO	Digital Input Output Modul	1	30	30	30	
Indication Board 4xRGB HW UK M02390-A.00	Indication Module (status LEDs)	1	15	30	15	
Redundanzmodul MOSFET 5V/30A M02401-A.05	Redundancy Module	1	10	20	0	
Cont RAINBOW XTD TIV055731K..M08104-B.05	Controller	1	50	50	50	
SCHALTREGLER HWS150A-5/A 5V 30A	AC/DC PS Display	2	30	30	30	
RS485 / RS232 converter V4, 5-48VDC	RS485 / RS232 converter	1	30	30	30	
						Maximum Power Consumption 100% LEDs on/100% Brightness
		Power consumption	20 W	32 W	12 W	58 W

De: Dyer, Carl <carl.dyer@swarco.com>
Enviado el: martes, 1 de junio de 2021 12:33
Para: Gonzalez Gabarda, Carlos
CC: Auerböck, Stephan; Turner-Wilson, Mark
Asunto: FW: VM21021 Stonehenge Tunnel
Datos adjuntos: VMS Folder_en (2).pdf; MSxV3_PowerConsumption_and_Power_load_SWF_V3.0.xlsx

Importancia: Alta

Dear Carlos,

Please see attached product data sheet which is generic for all VMS Supplied by SWARCO. Please see answers to your questions below.:-

1. Electrical power (kW).
   Please see attached for Highways England V3 Signs.
2. Warranty.
   Standard Warranty 12Months. Extended Warranties available on request
3. Recommended maintenance intervals
   Annual safety check.
4. Life span
   15 – 20 years

Best regards

Carl Dyer
CTO – Chief Technology Officer

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The Better Way Every Day

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10.2 DMS

mi. 14/04/2021 12:26
António Carneiro <antoniocarneiro@dmsdisplays.com>
RE: A303 Stonehenge : Technical Datasheets

Para Gómez Lucena, Jose Ismael
CC Jaro Munoz, Pablo Jose; Ramirez Cascajero, Miguel Angel; Gonzalez Gabarda, Carlos

Respondió a este mensaje el 14/04/2021 12:31.
Haga clic aquí para descargar imágenes. Para ayudarle a proteger su confidencialidad, Outlook ha impedido la descarga automática de algunas imágenes en este mensaje.

Mensaje | DMS 2020 - Statement product MTBF.pdf | DMS 2020 - Stament Product Service and Maintenance.pdf | DMS 2020 - VMS Design Overview.pdf

- **Manufacturer / Provider**

Company name: DMS – Displays & Mobility Solutions, Lda

- **Main Products**

Short List of the main products:
VMS – Variable Messages Signs
LCS – Lane Control Signs
PID – Passenger Information Signs

- **Manufacturer's Warranty**

Standard warranty is **36** months.
We are able to offer an extended warranty of **60** months.

- **Manufacturers assessment of asset design life**

The products have a design life of **15** years,
when operated in accordance with regular maintenance carried out in accordance with the procedures detailed in the maintenance manuals.

- **Extended Life Cycle and Refurbishment**

It will be possible to extent your product life cycle to 26 years ? Yes/No: **No**
and refurbishment to 13 years ? Yes / No: **Yes**

- **Manufacturers recommended maintenance Regimes**

Maintenance Manual to be attached: "DMS 2020 – Statement Product Service and Maintenance"

DESIGN vs PERFORMANCE

▪ Product Lifetime:	> 15 years	**(high quality materials and finishing and resistance to environmental corrosion and pollution)**
▪ MTBF:	> 50.000 hours	
▪ MTTR:	< 1 hour	**(high modularity, plug and play design)**
▪ LED Lifetime:	> 100.000 hours	
▪ LED references:	NICHIA / CREE	
▪ Housing material:	AlMg3, V4A / AISI 316L	
▪ Enclosure protection:	IP55 / IP56 / IP65 / IP66	**(depending on sizes and installation)**
▪ External Temperature:	-40ºC … +70ºC	
▪ External Humidity:	Up to 98%	

DISPLAYS & MOBILITY SOLUTIONS

Assumptions, Analysis and Risk Mitigation on Product's MTBF

Statement and premises on DMS's products in LED technology

a) **Product application/type:**

- (VMS) Variable Message Traffic Signs, for road applications, certified under the EN 12966;
- (PID) Passenger Information Display, for railway applications, certified under the EN 50125.

b) **Product Life Time:**

- Product design and conception, own- and third-party components, construction and manufacture are to ensure and provide a lifetime of no less than **12 years.**
- Component repair or replacement with similar or compatible components, support, or technical assistance, is ensured for a period of no less than **15 years.**
- As a critical component of the functional performance the LEDs are of high quality and performance, ensuring a lifetime of no less than 100,000 hours of operation.
- The long operating lifetime is ensured by the quality of the LEDs, assembly according to the LED manufacturer's requirements, and operation with maximum currents below 50% of the maximum current allowed by the same manufacturer.
- If operated and maintained in accordance with the defined requirements and DMS's procedures, the 100,000 hours of operation are achieved with a degradation of the optical performance of less than 15% of the initial optical performance.
- The manufacturers of the LEDs used in DMS's products are: NICHIA, CREE and OSRAM.

c) **Product Warranty conditions and terms:**

- Basic warranty period from 30 up to 60 months.
- Warranty in regards to spare parts repair or replacement, in DMS's factory.
- Remote technical support included.
- Warranty extensions up to 12 years can be granted depending on the project conditions/agreements.

d) **Product MTBF**

- DMS's products are stated with a minimum **MTBF of 50.000 hours.**
- The critical components for the definition of MTBF are those whose failure implies the non-operation or availability of the product: Main and secondary controllers, power supplies and LED boards. Of these mentioned components, the ones with the lowest MTBF are the power supplies. Power supplies are from the manufacturer MeanWell with a declared minimum MTBF between 150,000 and 200,000 hours, 5 years warranty.

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- As product and component references are many and diverse, and since DMS technical assistance and maintenance service is basically a second line service, a parameter has been defined, within the scope of the quality management system (ISO 9001), which analyses the number of faults (repair or replacement of components) during the first 2 years of warranty.
- This analysis considers all requests for repair or replacement of any electrical or electronic component, after commissioning of products, under the terms and during the first 2 years of the warranty.
- The first 2 years are the most sensitive and they give us the most restrictive situation.
- Over the past 5 years we have consistently obtained an indicator = (number of faults) / (number of products under warranty) below 0,15 that allows us to upkeep an MTBF better than 50,000 hours.

e) MTBF risk mitigation

- Based on experience there are 3 main aspects - stressful phases - that can have a strong negative impact on the MTBF:
  i. Stress in the manufacturing process and FAT (short delivery time).
  ii. Transport stress (logistical handling).
  iii. Stress in installation and commissioning (insufficient and inadequate training and installation procedures and check-up);
- The product manufacture should be followed by a period of intensive test (burn-in) never less than 1 week, preferably 2 weeks, after which the FAT can be performed.
- The whole phase of transport logistics, loading, transport, unloading and unpacking, can be the source of some technical issues that may be revealed only after commissioning.
- Whenever possible a new test phase should be considered after transportation and before the installation. This would make it possible to detect any situations arising at this stage. Also, it can be seen as a complement or alternative to the FAT phase.
- Training of installation and commissioning teams should be provided, preferably within a pilot installation.
- An installation and basic test procedure should be defined for the installation team, including a checklist with steps or tasks to be followed.
- The commissioning should be done by a team different from the team that does the installation, following a check-up procedure. Even better would be if the commissioning team was also the maintenance team.
- A complete and minimum stock of spare parts must be available during the commissioning phase to ensure that all components are in full performance.
- Each component (part) should only be subject to a single repair action. A second anomaly should always imply the definitive rejection of that component.

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DISPLAYS & MOBILITY SOLUTIONS

Service and maintenance on VMS products (EN 12966)

General Assumptions and Principles

1. Maintenance-Free

a) According to the design and manufacture, and considering the functions of self-diagnosis, monitoring and communication, it is not necessary to program a maintenance plan for our VMS. A simple annual inspection is recommended, only to check external incidents that may be compromising the integrity of the equipment.

b) The housing ventilation is done by passive air compensating devices. Those devices are IP66 and mounted on the rear side in number and location to mitigate condensation. Nevertheless, distributed at the bottom of the housing there are protected outlets (small holes) for the eventual flow of liquids to the outside. These outlets do not compromise the ingress protection level of the housing (typically IP56 or IP66). Ventilation fans, internal or external, are not used. There are no moving mechanical devices or filters, avoiding the need for internal cleaning or replacement of any consumables.

c) The electronic components are based on automotive industry standards and the electronic boards are varnished with a high-performance acrylic-based product that provides a long-term protection (lifetime). This varnish is specifically made for LED boards as it has a high transparency and high resistance to UVs. Application reference link: https://electrolube.com/product/afa-aromatic-free-acrylic-conformal-coating/ .

d) Internal cleaning is not necessary. External cleaning under normal and usual environmental conditions at the installation site is not necessary. Normal rain should be sufficient to maintain an exterior cleaning process. Nevertheless, the VMS design withstand recurrent cleaning with high pressure water.



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9. COMMUNICATIONS SYSTEMS, INCLUDING EMERGENCY AND MAINTENANCE TELEPHONES

9.1. High-power band selective TETRA booster

COBHAM : BSR 3604

BSR 3604 Datasheet

COBHAM

Technical specification

Frequency bands available (MHz)	Uplink	Downlink
	380-385 385-390 410-415 415-420 450-455 455-460	390-395 395-400 420-425 425-430 460-465 465-470
Operator bandwidth	5 MHz	
Duplex distance (in one band)	10 MHz	
Impedance	50 Ω	
Composite output power (UL)	-2dBm	
Output power/carrier (DL) per band	1 carrier: +36 dBm, 2 carriers: +33 dBm, 3-4 carriers: +30 dBm 8 carriers: +27 dBm	
Gain	45 - 55 dB in 1 dB steps	45 - 60 dB in 1 dB steps
IP3	> +68dBm	
Noise figure	<5dB typical at maximum gain	
Group delay	2µs max	
ALC	Implemented	
Spurious emissions from RF port	< -36dBm	
Intermodulation products	< -36dBm	
Remote control and alarm supervision	Via modem GSM, GSM-R or PSTN modem or Ethernet	
Power Requirements	230 VAC 50Hz, 115 VAC 60 Hz, -48 VDC	
Power Consumption	< 150W	

9.2. Channel Selective repeater Axell D-CSR3604

Appendix A - Specifications

RF Characteristics	U/L	D/L
INTERFACES		
AC/DC Input	Plinth	
Local RS232 terminal connection	9-pin internal	
Ethernet port	Internal	
RF Ports	7/16 Female	
External Alarms	4 external alarm dry-contact inputs (N/C or N/O configurable)	
Repeater status relay	1 Relay normally open (N/O)	
POWER		
Power Input	230VAC 50Hz or 110VAC 60Hz or -48 VDC	
Power consumption	180W, typical	
MECHANICAL SPECIFICATION		
Dimensions (h x W x D)	540 x 382 x 198 mm	
Enclosure	Aluminum (IP65)	
Weight	22 Kg	
Cooling	convection	
Mounting	Wallmount/Rackmount	
ENVIRONMENTAL SPECIFICATION		
Operating Temperature	-25°C to + 55°C	
Storage	-30°C to 70 °C	
MTBF	> 100 000 hrs	
Complies with	R&TT E Directive including, EN 301 489-18 ETSI TS 101 789-1, EN 60 950	

* The squelch is set to -108 dBm, which ensures correct operation for most repeater system scenarios. It will open approximately 3dB below the static sensitivity in the repeater cell thus it will be open to any mobile on the cell border.

9.3. Digital channel selective repeater for VHF
AXELL D-CSR 2502 for EMEA/APAC-RM

axell WIRELESS

Product Specification Sheet

D-CSR 2502 for EMEA/APAC - RM

Technical specifications

Electrical specifications	Uplink (UL)	Downlink (DL)
Standard operational frequency ranges (*1)	148 - 174MHz	148 - 174MHz
Number of Passbands (Band selective)	2 in both Uplink and Downlink	
Number of channels (Channel selective)	up to 8	
Filter Pass bandwidth (Band selective)	100 kHz to 5 MHz in steps of 25 kHz	
Filter Pass bandwidth (Channel selective)	12.5 kHz or 25 kHz	
Duplex frequency spacing	10MHz typical with options down to 3MHz	
Impedance	50 Ω	
Noise figure	<4 dB typical at maximum gain	
Group delay	Channel filter dependant	
ALC (Channel selective) (*2)	Time-slot based	
ALC (Band selective)	Fitted to prevent Composite power overload	
Selectivity	Dependent on filter selected	
Downlink Output – (20W HPA)(*3)	+25 dBm Composite – ETSI Compliant	
Uplink Output	+21 dBm Composite – ETSI Compliant	
Gain	65 to 95 dB in 1 dB steps	
Third order intercept	+54 dBm, typical	
Remote control and alarm supervision	Via modem GSM, P-25, PSTN, via Ethernet and SNMP	
Power requirements	110VAC 60Hz or 230VAC 50Hz or -48 VDC	
Power consumption	170 W, typical	

About Axell Wireless

Axell Wireless is one of the top global providers of wireless coverage solutions and the market leader in the provision of solutions for the public safety market worldwide. Our equipment has been deployed in some of the most technologically challenging environments in the world, providing coverage for tunnels, metros, buildings, stadiums and transportation systems all over the world. With its headquarters in the UK, Axell Wireless has been operating for over 40 years and has an international footprint. A proven track record combined with a reputation for providing innovative and high-quality products has made Axell Wireless a truly global player in the wireless coverage industry.