FLEXI BTS OUTDOOR FCSA FAN DIAGONAL

Requirement Specification

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HISTORY

Date	Version	Author	Change Note No./Notes
29 Dec 05	1.0	Teemu Leskinen	First draft
16 Aug 06	1.1	Teemu Leskinen	Second draft
20 Sep 06	1.2	Teemu Leskinen	Reviewed. Inspection minutes can be found from IRMA database, minutes approved by Pasi Karjalainen. Inspection number is EMJA-6TYCJL
25 Sep 06	2.0	Teemu Leskinen	Approved by Hannu Koukkula
02 June 09	2.1	Raimo Takkinen	BE 33463 FCFA fan moved to its own specification. Previously FCSA was specified to +55C and now it is updated to +75C. Document is changed to NSN template
02 Aug 2009	3.0	Raimo Takkinen	Approved by Kimmo Lepisto

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Vocabulary

BTS	Base Transceiver Station
MTBF	Mean Time Between Failures
PWM	Pulse width modulation
RPM	Rotation per minute
EMC	Electromagnetic Compatibility
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
UL	Underwriter's Laboratories

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1 Introduction

The purpose of this document is to specify design requirements for the cooling fans used in Flexi BTS OD Site Support Module (FCSA 470145A). There are 4 pcs of FCSA fans to be used for FCSA.

2 General Description

FCSA fans are used to provide required cooling. The function of the fan is controlled by control card in FCSA and the control is based on internal temperatures of the units.

3 Functional Requirements

3.1 General

There shall be no limitations to the mounting position of the fan. I.e. the fan could be assembled either horizontal or vertical.

3.2 The operating point

The FCSA fan shall be minimum capable of providing 180 cubic meters per hour at a static pressure drop of 110 Pascal's at the nominal operating voltage at sea level pressure.

3.3 Fan Speed Control System

The fans are controlled with PWM-signal.

FANCTRL Frequency 1-5 kHz. FANCTRL control range from 0% to 100%.

0% FANCTRL = 100% (+/- 5%) max RPM

20% FANCTRL = 86% (+/- 5%) max RPM

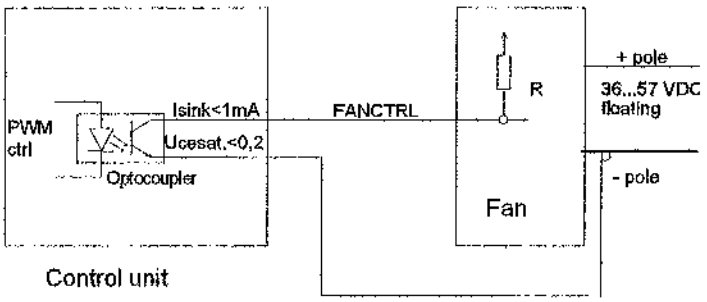
40% FANCTRL = 66% (+/- 5%) max RPM.

60% FANCTRL = 46% (+/- 5%) max RPM

80% FANCTRL = 26% (+/- 5%) max RPM

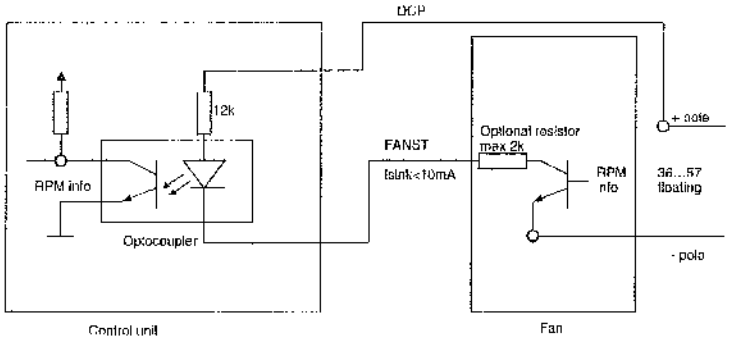
At FANCTRL >85% (+/- 5%) =fan will stop and remain stopped at all values higher than this value

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PWM control from control unit to fan

Figure 1. PWM connection



Rotation speed (radial fan 2 pulses/rov.) from fan to control unit, max Isink<10mA

Figure 2. RPM connection

Nominal speed for each fan with nominal voltage (48VDC) at operating point shall be following:

5000 rpm±5% =>

3.4 Current Consumption

FCSA fan nominal running current < 0.5 amps.

At startup and during change of speed the surge current shall not exceed three times nominal running current. Startup current is < 1250 mA

3.5 Motor Protection

Fan shall have an automatic restart function, locked rotor and reverse polarity protection.

If the speed is becoming < 500 rpm, the "locked rotor status" is activated. Fan is trying every 5 s to restart the fan. Each attempt lasts 0,5 s.

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4 MECHANICAL requirements

4.1 Materials & manufacturing technologies

All materials will be selected to adequately protect all components within the cooling fan. Chosen materials must not degrade the functional or electrical performance of the unit or BS.

All materials are to have a minimum corrosion-resistant lifetime of 15 years, and must comply with the relevant corrosion-resistance, environmental and safety standards as defined in Section 6.

4.2 FCSA fan Dimensions

127 x 127mm x 38mm diagonal fan, with four 4,3 mm screw holes. The fixing points are in the corner and dimension between holes is 113,3 mm.

Tolerances for dimensions are +/- 0.5 mm and for screw holes +/-0.2 mm.

5 Electrical requirements

5.1 Electrical Interfaces

5.1.1 FCSA Fan Lead Connector

The connector shall be 5-pin header with angle lock (AMP 770602-5 or METHODE 1300-105W) and 4 pins (AMP 770601-2 or METHODE 9408-610G) shall be nickel plated all over and there shall be gold in contact area. Fan connector could be also corresponding if it can mate male connector Molex 22-12-2054/7478, which is on the fan control card.

The pin configuration is listed in table 2.

Table 1. FCSA fan Pin configuration

Pin	Signal
1	+ Voltage input
2	- Voltage input
3	PWM input
4	RPM output
5	Not Connected

Figure 3 presents allowed dimensions of the fan cable and position of pin 1.

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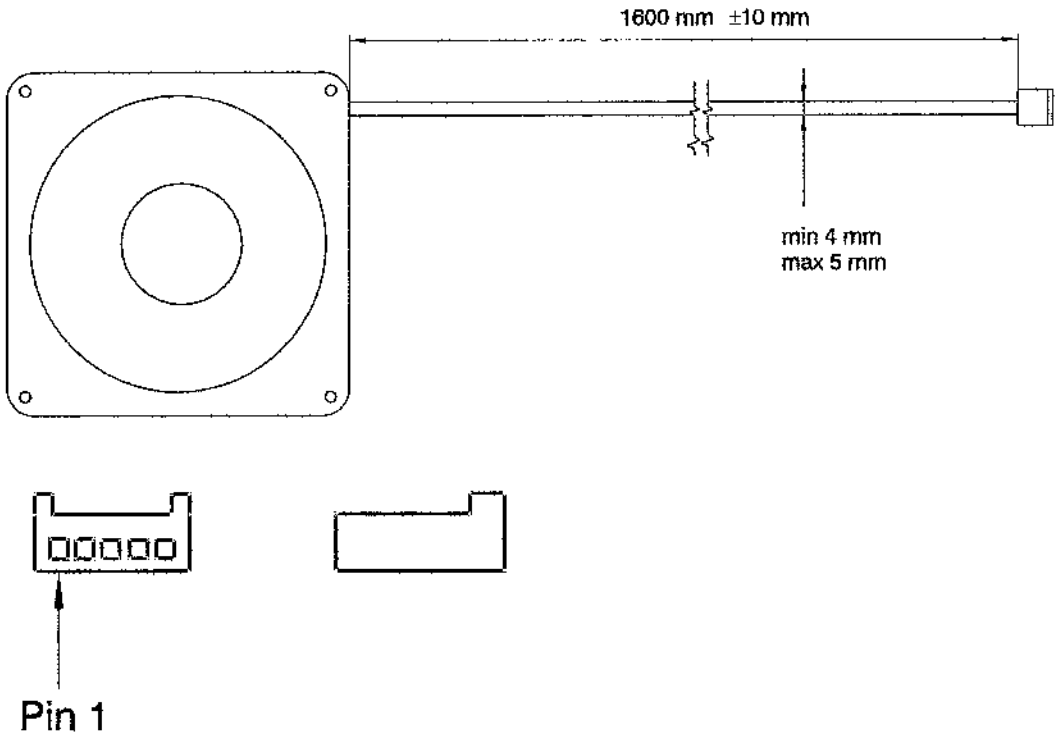


Figure 3. FCSA fan assembly

5.2 Input voltage

Fans are supplied with a nominal voltage of 48 VDC which may vary between 36...57 VDC however fan shall not be damaged if the voltage level is 0...36 VDC. Test report is required of that test. Power supply for fans meets [1] ETSI standard ETS 300 132-2.

Note! Fan shall tolerate continuous 36V...57 V power supply, independently of the status of the PWM control.

If supply voltage rises higher than 48V, rise of fan speed shall be limited. Purpose of this feature is to keep fan speed independent of various voltage supplies and so avoid unwanted acoustic noise effect.

6 Environmental Requirements

6.1 Water & Dust Ingress

For Outdoor use:

The FCSA fan shall comply with the water & dust ingress requirements of BS EN 60529 [2] to Class IP54 (for motor, electronics and connector).

6.2 Salt Fog and Moisture Tests

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Purpose:

The purpose of this is to evaluate degradation of the unit fans when exposed to moisture or salt fog conditions.

Requirement:

The unit cooling fans are required to undergo testing at the fan level according UL1950 3R classification for moisture.

Details about testing procedures can be found in the most recent edition of UL1950.

6.3 Operating Temperature Range

Operating temperature range for FCSA fan is -33 °C to +75 °C(Storage temperature is -45 °C to + 85 °C).

6.4 Safety

The equipment shall be designed and constructed in a way that under normal use or reasonably predictable conditions of misuse, it will not present any unacceptable risk to health and safety.

The equipment shall comply with standard EN60950 [3] and UL1950 [4]. The testing shall be carried out during type approval tests of the cabinet.

6.5 EMC

The cooling fan meets the following standards:

EN 55022 class B [5].

FCC part 15 Subpart C 15.209 (radiated)

FCC part 15 Subpart C 15.207 (conducted)

IEC 1000-4-2 thru 6

6.6 Acoustic noise

This figure should be measured in accordance with ISO 10302: Acoustics -Method for the measurement of airborne noise emitted by small air moving devices.

Following are the maximum allowed sound power levels for individual fans at the operating point for any RPM:

FCSA fan 62 dB(A)

Additionally FCSA fan is not allowed to exceed 65 dB(A).

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6.7 Climate, Mechanical Shock & Vibration

Storage and transportation test shall be tested with packed unit(s). In usage conditions shall be tested when fans are installed in application. Test classes are presented below.

STORAGE (ETS EN 300 019-2-1 V2.1.2 T1.3E):

TRANSPORTATION (ETS EN 300 019-2-2 V2.1.2 T2.3)

IN-USE (ETS EN 300 019-2-4 V2.1.2 T4.1) - IEC class 4M5 [11]

6.8 Recycling

All materials and processes used in the manufacture of the fan are to comply with ISO 14001 Environmental Management System [12].

6.9 Traceability

Tractability has to be at material batch level. The fan should contain week code (for example ww,yy or applicable).

Also module code label is required for fan. This must include also version controlling. Module code for fan is xxxxx and the first production version will be A.101. Marking in fan will be xxxxxA.101. It can be placed to fan product label and font size and type can be same as in other text in product label.

7 Operations Requirements

7.1 Assembly & Integration

Fan assembly and installation is to be possible without the use of special tools.

7.2 Testing

The cooling fan is to be designed such that minimal production testing is required, while ensuring that all shipped units are reliable and fault-free. Test procedures should ensure that all components and sub-assemblies are adequately tested before installation in application.

8 Quality and reliability

8.1 Reliability tests

The reliability requirements according to document [13]

8.2 ON-OFF testing for fans

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8.3 General

The purpose of the test is to ensure, that the fan motor can stand enough start-up situations, which will stress the fan motor more than continuous operation.

8.3.1 Test configuration

The test will be arranged for a series (10 pcs) of fans. The time will be set just that long that the fans have just stopped rotation. 50% of the fans have to be mounted shaft vertically and 50% shaft horizontally.

At least one fan must be tested with maximum back pressure with maximum current load.

RPM output signal must be controlled during test to make sure that there will not be any deviations to specification in all temperatures.

8.3.2 Test environment

The test will be performed in climate chamber/oven. Test conditions are required operational temperature range of the fan with minimum, maximum and a normal operating voltage.

8.3.3 Test case

During the test fans are running at their normal operating voltages. The amount of starts has to be at least the same as estimated to happen in normal use during the operating period of 5 years; for fans 87 000 times. The time needed for the test can be calculated by the amount of starts and the time setting for on-off cycle. On-off test will be performed by "cutting" control line, not voltage.

8.3.4 Results

The fans have to stand the test without problems, with passing percentage of 100%. During the test the possible failures can be noticed for example by monitoring the starting current of fan groups.

Fans RPM and control line must be controlled during tests.

8.3.5 CpK Target

The CpK targets are as follows:

Prototype run 1 1,67

Production ramp up 1,33

Table 2. CpK characteristics

Characteristic	Specification	Key / Critical
PWM Response	According to Section **3.3**	Key
Nominal Running Current	< 0.5 Amps	Critical

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Peak Startup Current	< 1.5 Amps, < 3 Seconds	Critical
Tachometer Output	2 Pulses per Revolution	Key

8.4 MTBF and lifetime

Minimum acceptable level of reliability is expressed as a MTBF, which shall be more or equal than 5 800 000h. This MTBF requirement shall be met in the field through product lifetime.

Lifetime of the bearings > 10 years

The unit lifetime shall be 10 years

The unit life span shall be 15 years

The corrosion-free lifetime shall be 15 years

8.5 Workmanship and Inspection Requirements

The manufacturer shall perform all work and inspections in accordance with the company's documented Quality Procedures detailing the criteria for acceptance, rejection and rework of the manufactured product. The manufacturer's workmanship and inspection documentation is subjected to the approval of Nokia Quality Representatives prior to the performance of acceptance.

In addition to this, manufacturer shall comply with specific Nokia Quality Requirements:

-General requirements for printed circuit boards SAY0045 [14]

-Quality requirements for mounting and soldering plated through components, apply also additional instruction: Deviations and Clarifications on NTC-Level Quality Requirements Eau4513 in RAS/BS EAU 4513 [15]

-Quality requirements for mounting and soldering surface mounted components EAU 4000 [16]

-Quality requirements for repairs and modifications to component boards delivered to customers EAU 1943 [17]

-Quality requirements for the mechanical construction EAU 2197 [18]

9 Acceptance Criteria

The fan shall be accepted after a formal Nokia design review team has determined that:

- The fan meets all of the requirements in this specification,

- Can be consistently produced in mass quantities, which meet this specification,

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10 Documentation

The manufacturer shall provide documentation needed to verify the requirements set forth in this specification. This shall also include, but is not limited to the following:

- Characteristic curve of the fan, including noise level variation
- Circuit diagram
- Parts list
- Derating calculations
- Junction temperature calculations
- MTBF calculations
- Life time calculations
- Life time testing information
- R&D stress test information
- Production testing procedure
- Drawing of the fan, including dimensions, tolerance, holes, and materials
- Fan curves with nominal-, minimum- and maximum voltage
- Noise curves with nominal voltage and nominal pressure

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11 Reference Documents

[1] ETSI standard ETS 300 132-2.

[2] EN 60529 Classification of Degrees of Protection Provided by Enclosures (IP Code)

[3] EN 60950 Safety of Information Technology Equipment, Including Business Equipment

[4] UL 1950 (3rd edition) Safety of Information Technology Equipment

[5] EN 55022 Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment

[6] ISO 3743 Determination of Sound Power Levels of Noise Sources

[7] ISO 3744 Determination of Sound Power Levels of Noise Sources Using Sound Pressure

[8] ETS 300 019-1-1 Classification 1.3E - IEC class 1M4

[9] ETS 300 019-1-2 Classification 2.3

[10] ETS 300 019-1-3 Indoor BS: Classification 3.2

[11] ETS 300 019-1-4 Outdoor BS:Classification 4.1 - IEC class 4M3

[12] ISO 14001 Environmental Management Systems: Specification with Guidance for Use

[13] H6I 060594AE RAS/BS Reliability and Environmental Requirements, Supplier Plans and Procedures

[14] SAY0045 General requirements for printed circuit boards

[15] EAU 4513 Quality requirements for mounting and soldering plated through components, apply also additional instruction: Deviations and Clarifications on NTC-Level Quality Requirements Eau4513 in RAS/BS

[16] EAU 4000 Quality requirements for mounting and soldering surface mounted components

[17] EAU 1943 Quality requirements for repairs and modifications to component boards delivered to customers

[18] EAU 2197 Quality requirements for the mechanical construction

[19] Removed

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