# 300W Power Supply
# efficiency 87% / 90% / 87%

## Contents

# 1. General

This power supply is intended for server systems. The PSU complies with Japanese legal regulations.

## 1.1 Related Documents

| Title | File | REV | Description |
|---|---|---|---|
| MPA | | | master purchasing agreement |
| FTS_03230-1 | http://filestore.fsc.net/Portal/PORTALC/Uploads/FTS_03230-1_SpecificationEnvironmentalConsciousProducts.pdf | history see file | This is the general specification of environmental conscious FTS products which includes the reference to the special documents for PSU development. |
| Banned substances | http://filestore.fsc.net/Portal/PORTALC/Uploads/Suppliers_Confirmation_List_of_prohibited_substances.doc | | The supplier has to confirm the "List of prohibited hazardous substances". |
| Declaration list | http://filestore.fsc.net/Portal/PORTALC/Uploads/Declaration_of_hazardous_substances.doc | | The supplier has to confirm the "List of hazardous substances to be avoided or declared". |
| RoHS | http://filestore.fsc.net/Portal/PORTALC/Uploads/Declaration_of_RoHS_compliance_FTS_(01).doc | | Confirmation to meet the RoHS requirements. |
| Plastic Materials | http://filestore.fsc.net/Portal/PORTALC/Uploads/Plastic_Declaration.doc | | Confirmation of requirements for plastic parts >25g. |
| AL-E-Cap | provided by FTS | Rev 18 | List of Japanese released Aluminium Electrolytic Capacitors |
| Fan list | provided by FTS | | List of released Fans |
| Feedback list | provided by FTS | | All issues concerning the PSU have to be listed and must be finished. |
| History list | provided by FTS | | The supplier has to maintain the list about the correlation of Rev-level, date code and serial number |
| Test Templates | provided by FTS | | The supplier has to test the PSU according to the test templates. |
| safety conformity | provided by FTS | | With DVT has to be done the safety approvals.<br>In this document has to be confirmed whether safety relevant points were changed for mass production.<br>When yes, they have to be listed. |
| SA-Checklist (ATP) | provided by FTS | | The SA-checklist will be defined with DVT-Sample and the PVTs have to be released according this list. |

# 2. Electrical Data

## 2.1 AC Input

The AC inlet must have an EMI improved PE connection (shield around socket).
The connector is according to IEC320 standard.

### 2.1.1 AC Input Values

| | |
|---|---|
| nominal input voltage range | 100V - 240V |
| min/max input voltage range | 90V - 264V |
| line frequency | 47Hz - 63Hz |
| total harmonic distortion of the input voltage | max. 5% |
| input voltage sag/drop | nominal voltage -20% ±1% (80) for 2 seconds repeated 10 times with a 10% duty cycle Loading 80% |
| Input current rating: @ 100Vac<br>@ 200Vac | 4A<br>2A |

### 2.1.2 Efficiency

All measurements are made with an AC-source with a total harmonic distortion <5% at an ambient temperature of 25°C ±3°C.

| % of Nom load \ Output Voltage | | +12V1 | +12V2 | $12V_{sb}$ |
|---|---|---|---|---|
| 10% load conditions | 10% | 1.21A | 1.21A | 0.08A |
| Light load conditions | 20% | 2.42A | 2.42A | 0.15A |
| Half load conditions | 50% | 6.06A | 6.06A | 0.38A |
| Nominal load conditions | 100% | 12.12A | 12.12A | 0.76A |

| | |
|---|---|
| efficiency at **10%** of nominal load<br>= 10% load condition | 100V: > 80%<br>115V: > 80%<br>230V: > 80% |
| efficiency at **20%** of nominal load<br>= Light load condition | 100V: > 87%<br>115V: > 87%<br>230V: > 87% |
| efficiency at **50%** of nominal load<br>= Half load condition | 100V: > 90%<br>115V: > 90%<br>230V: > 90% |
| efficiency at **100%** of nominal load<br>= Nominal load condition | 100V: > 87%<br>115V: > 87%<br>230V: > 87% |

### 2.1.3 Inrush Current

The inrush current must not cause any damage or excessive stress to any internal components. 10% of $I^2t$-rating of fuse is not allowed to be exceeded, measured with cold and warm power supply at an ambient temperature of 25°C.

The inrush current must not cause any damage or excessive stress to any internal components and must not exceed 50A, measured with cold power supply at an ambient temperature of 25°C at 100V AC and 230V AC.
The leading spike due to x-cap charging can be neglected.

For this test, the power supply is connected to an electrolytic capacitor (750µF/400V) which is charged to $325V_{DC}$ (this represents $230V_{AC}$). The impedance of the wire to the power supply is 50µH/500 mΩ. Repetitive on/off cycling of the input voltage must not cause any damage to the power supply.

### 2.1.4 Hold Up and repetitive AC Interruption Time

Additional to the requirements according to EN55024 (voltage dips and interruptions) the power supply provides the below required minimum hold up time and minimum repetitive AC interruption time while the interruption is applied at any time of the phase angle of the input voltage sine wave.
AC interruption means switching the AC input voltage down to 0V and on again after the minimum requested interruption time below.
All outputs shall remain within regulation and POWERGOOD shall remain at H level while the interruptions are applied.
No glitches on POWERGOOD allowed.

### 2.1.5 AC Input Current (PFC)

If the main converter is running and the output voltages are loaded within the nominal range (see section 2.2), the input current will not exceed the limits of EN61000-3-2 measured at 230VAC, and will not exceed the limits of class D of this regulation multiplied by the factor of 2.3 if the input voltage is 100V (Japanese standard).
The power supply will comply with the limits for class D from 75W input power (100V/50Hz and 230V/50Hz) to nominal input power (label rating).
To cover manufacturing tolerances min. 3% margin is required for bench test results of single units.

Active PFC circuits should provide the following power factor in the voltage range 100V - 240V.

Power Factor requirement

| Percentage of nominal load | **10%** | **20%** | **50%** | **100%** |
|---|---|---|---|---|
| Power Factor | — | 0.80 1) | 0.90 | 0.95 |

1) Power factor at 20% >0.80 only target value, as input power during this load condition is <75W.

### 2.1.6 AC Input Voltage Threshold Protection

PSU has threshold protections to guarantee proper operation of all converters (AUX, PFC, Main) in case of input voltage is not in specified range. PSU starts and stops without bouncing no matter if AC input voltage is switched on/off quickly or ramped up/down slowly (approx. 1V/second).

An AC turn on threshold guarantees that PSU will ramp up properly (no bouncing), PG will become H while all output rails are loaded within min to max load incl. cross loading.
Proposal for turn on threshold: 80V~88V.

An AC turn off threshold guarantees that PSU will switch off properly (no bouncing), PG will become L (no bouncing) while all output rails are loaded within min to max load incl. cross loading.
Proposal for turn off threshold: 70V~77V. We can discuss the threshold windows

Well designed hysteretic values guarantee that the PSU will always switch on and off without bouncing and PG is generated properly at any time.

If the AC input voltage is lower than the specified range, the power supply shall not be damaged and if POWERGOOD signal is bouncing, it must not violate the timing condition of POWERGOOD.

## 2.2 Main DC Outputs

| | |
|---|---|
| **continuous main output power incl. $12V_{sb}$ power** | **300W** |
| **Peak main output power incl. $12V_{sb}$ power (max. 10sec; duty cycle max. 10%)** | **350W** |

The power supply will turn on and remain on when all the outputs (main and aux) are at 0A load. This condition may last maximum 1 second after 12V output voltage has reached 90% of the nominal value.

POWERGOOD signal will go HIGH at no load condition with the defined timing according to section 3.3.

Single pulse step load may happen with a duty cycle < 5% with a maximum dI of 7A and a maximum pulse width of 100µs and a max slew rate of 0.5A/µs at load conditions below 0.1A.

No current flowing from System board into PSU allowed.

| | **+12V1** [1)] | **+12V2** [1)] |
|---|---|---|
| **nominal voltage** | 12.0V | 12.0V |
| **regulation tolerance** | +5%<br>-5% | +5%<br>-5% |
| **minimum current** | **0A** | **0A** |
| **continuous current** | **16A** | **16A** |
| **surge current for 10sec** | **18.5A** ~~(20msec)~~ | **18.5A** ~~(20msec)~~ |
| **Max step load** [3)] | 8A | 8A |
| **Slew rate during step load** | 0,5A/µS | 0.5A/µs |
| **ripple and noise** [2)] | 120mV [2)] | 120mV [2)] |

1) 12V1 and 12V2 must have separate current limit circuits to meet 240VA safety requirements.

2) Ripple and noise is measured from peak to peak with a bandwidth limit of 20MHz. (bypassed at the connector with a 10µF electrolytic and a 0.1µF ceramic disk capacitor).

3) Response time 5ms

### 2.2.1 Capacitors for Step Load Tests

For cross and step load testing please refer to the sections above to see the max step load and max slew rate.
During step load testing the output voltages will remain within their specified regulation tolerances.
Step load repetition rate: DC - 10kHz
Duty cycle: 0 - 100%

For step load tests connect below capacitors:

| Output Voltage | 12V1 | 12V2 | $12V_{sb}$ |
|---|---|---|---|
| Caps | 900µF | 900µF | 27µF |
| Impedance Z at 100KHz/25°C | 50mΩ | 50mΩ | N/A |

### 2.2.2 Maximum Capacitive Load

The power supply should be able to power up and operate normally with below capacitors simultaneously present on the DC outputs.

| Output Voltage | +12V1 | 12V2 | $12V_{sb}$ |
|---|---|---|---|
| capacitive load (µF) | 8000µF | 8000µF | 1000µF |

### 2.2.3 Residual Voltages

If the power supply is switched off by PSOFF, the residual voltage at any of the DC-outputs is less than 100mV steady state.

### 2.2.4 Audible Noise

No abnormal audible noise is allowed to be generated by the power supply. The power supply is designed to fulfil the thermal system and power supply requirements with the lowest possible fan speed.

When the power supply is stimulated with the step loads, defined in section 2.2, no audible noise is allowed to be generated by the power supply.
The repetition rate of the step load could be in the range between 10Hz .....10kHz.

## 2.3 Auxiliary Power Supply ($12V_{sb}$)

The auxiliary voltage (stand-by voltage) is available, when the power supply is connected to the AC input voltage and the mains switch (if requested) is switched on. The 12Vsb is not affected by PSOFF.

When AC input voltage is switched on the auxiliary voltage is the first voltage which will reach its tolerance range.
When AC input voltage is switched off the auxiliary voltage is the last voltage which leaves its tolerance range.
The ambient temperature in stand-by operation should not be higher than 40°C.

| | |
|---|---|
| **output voltage** | 12V |
| **regulation tolerance** | +5% / –5% |
| **adjustment (set point) in production** | **11.79V–12.37V** at 0A |
| **load range** | 0A – 1A; surge current for 10sec:2A |
| **ripple and noise** [2)] | 120mVpp |
| **hold up time** | see section “Signals Diagrams”.<br>Main converter is min load and caps connected as specified for step load testing.<br>$12V_{sb}$ is max load |
| **max step load**[1)] | **0.5A** |
| **Slew rate for step load**[1)] | 0.5A/µs repetition rate DC – 10kHz |

1) For this test the 12Vsb output should be bypassed with a capacitor as specified in section 2.2.1.
2) Ripple and noise is measured from peak to peak with a bandwidth limit of 20MHz.
(bypassed at the connector with a 10µF electrolytic and a 0.1uF ceramic disk capacitor).

## 2.4 Protections

The power supply is provided with protection circuits to prevent the power supply and the system from damage.

When main converter has latched off there is no automatic restart. The main converter can only be restarted by either cycling the AC input voltage or by cycling PSOFF signal.

**AC input voltage restart (PSOFF is Low state):**
After switching off the AC input voltage the user has to wait until 12Vsb has ramped down below 1V, then the AC input voltage can be switched on again.

**PSOFF restart:**
PSOFF has to be cycled to the H-state for at least 500ms before PSOFF returns to the L-state to guarantee restart.

### 2.4.1 Over Voltage Protection (OVP)

In case of main converter OVP the main converter shall latch off.

In case of 12Vsb OVP, the aux-converter may be hiccup-mode or latch off.

Components must not be over loaded during OVP condition.

| Output | 12V1 | 12V2 | $12V_{sb}$ |
|---|---|---|---|
| **min OVP** | 13.3V | 13.3V | 13.3V |
| **max OVP** | 15.6V | 15.6V | 15.6V |

### 2.4.2 Over Current Protection (OCP) and 240W Protection

No single output shall exceed 240W under any load condition.
All outputs should have OCP function; however safety must not be violated during OCP condition.
The main converter shall latch off.
The 12Vsb converter may enter into “HICCUP” mode. The 12Vsb converter can be limited dynamically.
When 12Vsb is overload, the 12Vsb converter and main converter must turn off at a defined overload trip point. Bouncing of the main converter and POWERGOOD is not allowed.

| Output | 12V1 | 12V2 | $12V_{sb}$ |
|---|---|---|---|
| **min OCP** | 18A | 18A | 2.2A |
| **max OCP** | 20A | 20A | 5A |

### 2.4.3 Short Circuit Protection (SCP)

A short circuit is defined as an impedance of max 0.03 Ohm.
A short circuit applied to any single output to GND during start-up or while running shall not cause any damage to the power supply. The main converter will latch off.
When 12Vsb is shorted the converter may enter “HICCUP” mode.

### 2.4.4 Over Temperature Protection (OTP) and Early Warning

The power supply is protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU shuts down and latch off. The standby outputs may also shut down or remain powered on. At an OTP condition the PowerGood signal goes LOW. One temperature sensor is sufficient if it indicates always the worst case temperature inside the power supply under all conditions.

The PSU need to provide an over temperature early warning information.

### 2.4.5 No Load Operation

Zero load operation will not cause any damage to the power supply.

### 2.4.6 Bulk Capacitor Over Voltage Protection

Power supplies with active PFC should have a 2nd independent over voltage protection circuit for the bulk capacitor.
This protection has to be implemented with an independent feedback divider.

A single failure (open or short) in PFC section is not allowed to cause any voltage above bulk cap rating!
A single failure (open or short) shall not cause overstress to any used Aluminum Electrolyte Capacitors.

### 2.4.7 Catastrophic Failure Protection

Should a component failure occur, the power supply should not exhibit any of the following.

- Flame
- Excessive smoke
- Charred PCB
- Fused PCB tracks
- Startling noise
- Emission of molten material

## 2.5 Mains recovery

When the AC input voltage comes up again after any mains failure the power supply has to start up automatically (if PSOFF is still LOW). Latch off is not allowed.

## 2.6 Ramp up, Tracking, Overshoot and Bouncing

There must be a smooth and continuous ramp up of each output from 10% to 95% of its final set point within the tolerance window.

No bouncing at any voltage (including 12Vsb) during ramp up and ramp down is allowed.

During ramp up or ramp down the overshoot will be less than 8% above the nominal voltage and will settle within 30ms into the regulation tolerance window.

## 2.7 DC Return and Frame Connection

All DC Returns are connected to a single point inside the power supply.
This point is connected via a short wide track to frame ground.

## 2.8 Fan and fan speed control

### 2.8.1 Fan

Fan size: 40 x 40 x 25mm or 40 x 40 x 28mm

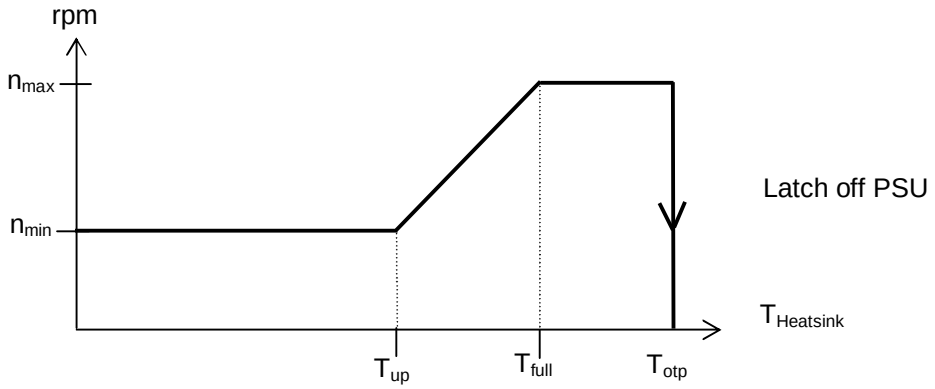
Bearing type: Ball

Currently released fans for this power supply: SUNON SG40281B3-0000-S99

The rated fan speed at 12V nominal voltage must be equal to or higher than **13000**rpm.

Every fan which is intended for the power supply must be released by FTS.

| **Sensor at heat sink – IC503** | | nominal values |
|---|---|---|
| minimum fan speed | $N_{min}$ | **2500**rpm |
| Maximum tolerance for Nmin | | **+/-15%** |
| temperature for speed up | $T_{up}$ | **70**°C ±2.5°C |
| temperature for fan full speed | $T_{full}$ | **90**°C |
| Maximum fan speed | $N_{max}$ | **13000**rpm |
| temperature for Early Warning | $T_{ew}$ | **85**°C |
| temperature for shut down (over temperature) | $T_{otp}$ | **95**°C ±4°C |




**Fan speed diagram**

| **Sensor for ambient air – IC21** | | nominal values |
|---|---|---|
| temperature for Early Warning | $T_{ew}$ | **65**°C |
| temperature for shut down (over temperature) | $T_{otp}$ | **75**°C ±4°C |

## 2.9 Air flow and air flow volume

### 2.9.1 Airflow direction

The power supply fan will suck air out of the system-housing. Air from system-motherboard area will flow into the power supply and will be emitted through the power supply air vents.

### 2.9.2 Airflow volume

For the airflow volume measurement mounting holes (e.g. for the fan duct) have to be covered with tape. See below table for requested minimum values.

To simulate the system housing for the airflow measurement, the power supply must work against a static sub pressure listed below.

| fan speed | min air flow volume | static sub pressure for airflow measurement |
|---|---|---|
| 2500rpm | $5.4*10^{-4}m^3/sec$ | 2.55Pa |
| 9600rpm | $270*10^{-3}m^3/sec$ | 53Pa |

## 2.10 Frequency-Modulation of main converter

FM (frequency modulation) of the main converter switching frequency is not allowed, due to audible noise and/or increasing output ripple.

# 3. Signals

## 3.1 PSOFF input signal

The PSOFF signal switches the main converter ON/OFF.
When PSOFF signal is open the main converter is OFF.
Signal is connected via a pull up to an internal AUX voltage.
PSOFF open circuit voltage is max. 12.6V.
Add a 100R current limiting resistor in series for protection.

| | | input voltage | input current |
|---|---|---|---|
| **PSOFF=H** | **main converter OFF** | PSOFF > 2V | |
| **PSOFF=L** | **main converter ON** | PSOFF < 0.8V | max –1.6mA@0V |

## 3.2 POWERGOOD output signal

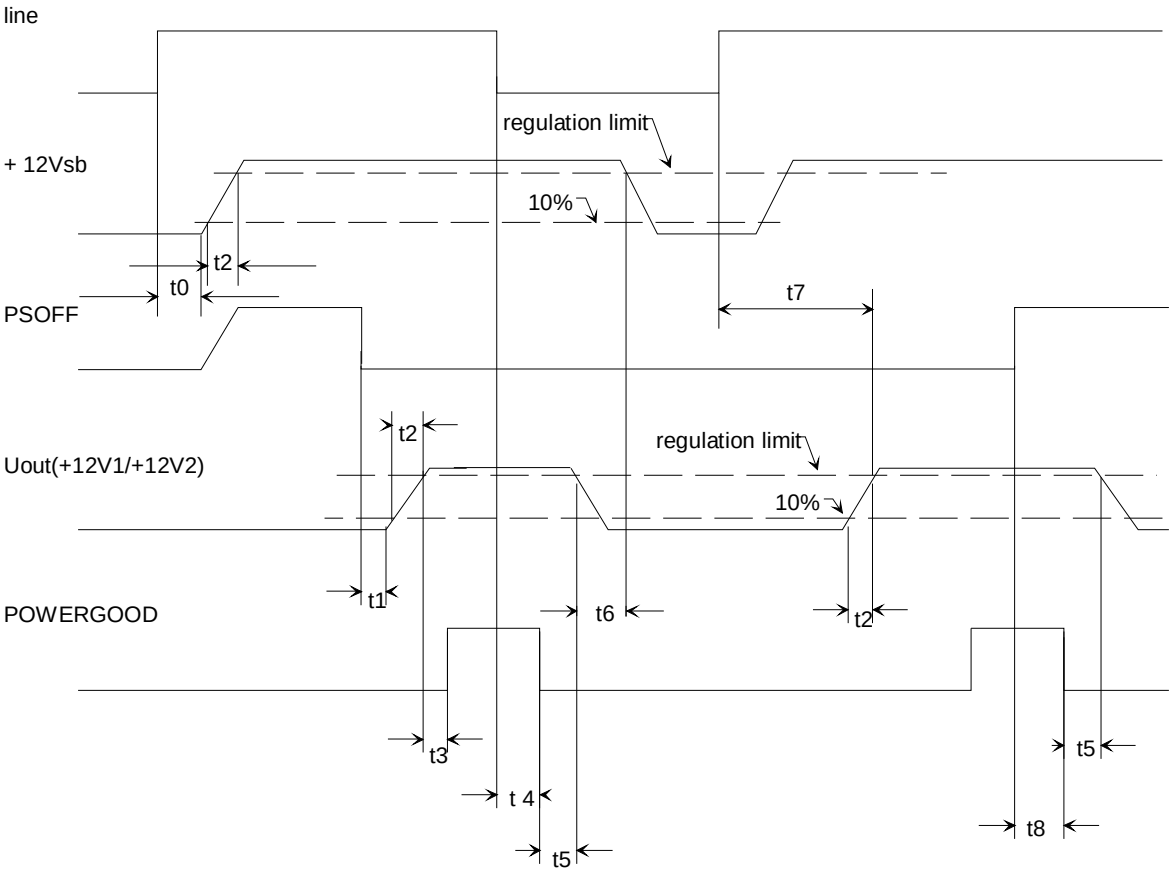
The POWERGOOD signal indicates that the output voltages are ok.
Signal will be generated via an open collector.
There is no pull up resistor inside PSU.
POWERGOOD open circuit voltage is max. 12.6V.
Add a 100R current limiting resistor in series for protection.

| | POWERGOOD | output voltage |
|---|---|---|
| **all output voltage are ok** | High | **2.7V** |
| **all output voltage are not ok** | Low | **0.6V** |

POWERGOOD has smooth rising and falling edges.
No glitches, bouncing or noise is allowed.
During start up in no load condition the PG signal must behave as defined in section 3.3.

After PSOFF signal transition from L-->H, and output load smaller than minimum current defined in section 2.2.
Timing t8 may be shorter than specified. Bouncing of PG is not allowed during this condition.

## 3.3 Signal diagrams




| t | time | value | | |
|---|---|---|---|---|
| t0 | power on delay aux converter | max 1500ms | | |
| t1 | PSOFF delay-time ON | 10ms ≤ t1 ≤ 250ms | | |
| t2 | rise time of the output voltages | 1.5ms<t2<20ms | | |
| t3 | POWERGOOD-delay-time | 100-500ms | | |
| t4 | min hold up time<br>min AC interruption time | Input voltage | 80% load | 20% load |
| | | $100V_{AC}$ | 16ms | 40ms |
| | | $115V_{AC}$ | 16ms | 40ms |
| | | $230V_{AC}$ | 16ms | 40ms |
| t5 | time between PG=L and main converter output voltages reach their minimum regulation tolerances | min 1ms | | |
| t6 | hold up time of the auxiliary converter | min 5ms | | |
| t7 | turn on delay | max 2000ms | | |
| t8 | PSOFF delay time OFF | 5ms ≤ t8 ≤ 50ms | | |
| | POWERGOOD rise and fall time | max 100us | | |

# 4. PM-Bus function

This interface fulfils the FTS's System-Monitoring-requirements.

| | |
|---|---|
| PM Bus address | 0xB0 |

## 4.1 P-meter: AC Input power measurement function

The p-meter function is intended to measure the AC input power consumption under stand by and normal operation mode.

Supplier is free to implement this function either by measuring the input or by measuring the secondary. If secondary power is measured, BMC will perform the estimation of input power.

12Vsb power measurement will be either implemented on the PSU or on the MB.

| | | |
|---|---|---|
| Operating AC voltage range | nominal PSU AC voltage range | output within specified tolerance |
| | below nominal AC voltage range | no damage shall occur |
| accuracy[1)] of p-meter @ AC input power **50**W-**100**W | | **±10%** |
| accuracy[1)] of p-meter @ AC input power >100W | | **±5%** of actual input power |
| FTS suggest to use IC | | Cirrus Logic CS5466 or CS5461<br>Also secondary power measurement is allow for RX100S7 |

1) Tolerance including thermal drift

## 4.2 EEPROM

- µC internal EEPROM will be used

| | |
|---|---|
| address | 0xA0 |
| size | 256bytes in single page |

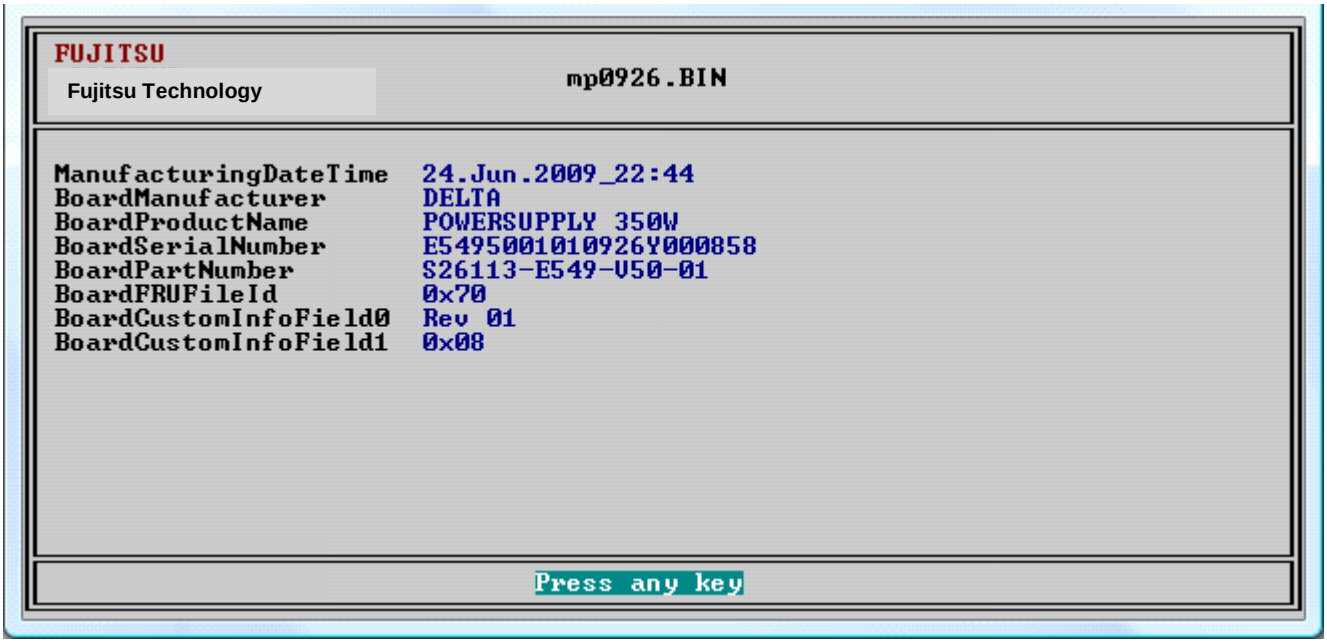
- GND (VSS) of EEPROM and System-Monitoring-Connector is connected close to GND-output-wires inside the PS.

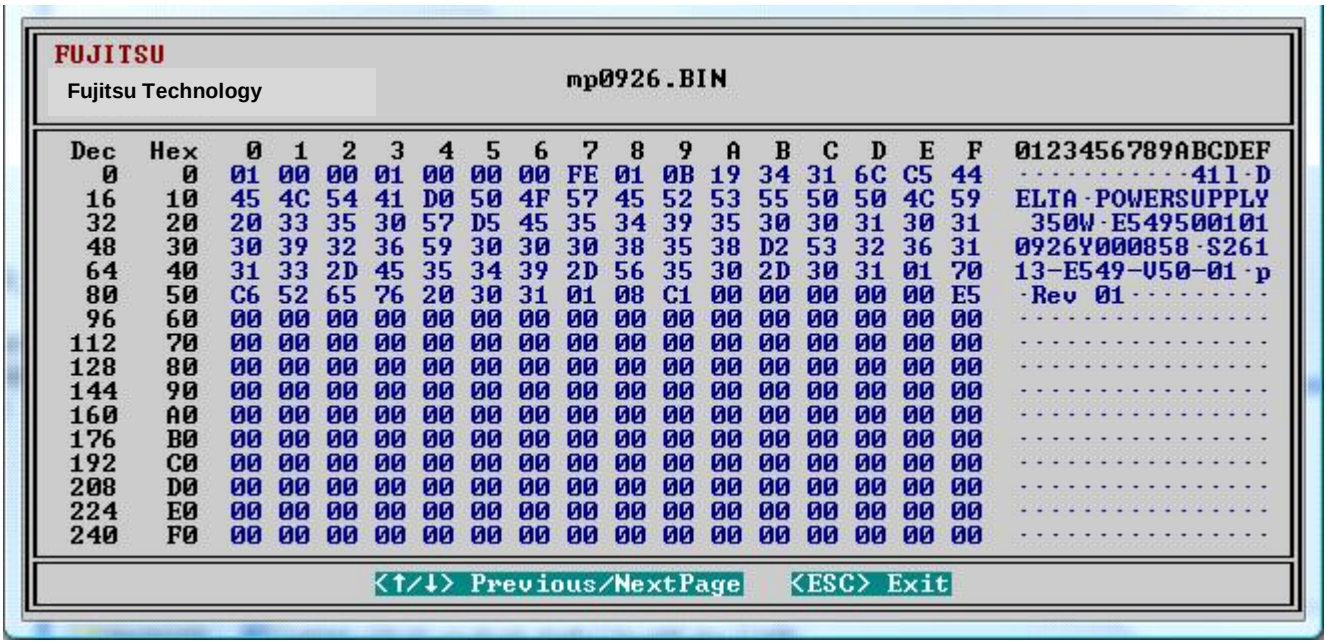
### 4.2.1 IPMI FRU ID PROM (EEPROM)

REV.06, 17. Februar 2011

| Address (hex) | Length | Content h:hex " ": ASCII | Comment |
|---|---|---|---|
| 00h - 07h | Fix: 8 Byte | 01h 00h 00h 01h 00h 00h 00h FEh | Common Header |
| 08h - 0Ah | Fix: 3 Byte | 01h 0Bh 19h | Board Area Format, Board Area Lenght, Language Code |
| 0Bh - 0Dh | Fix: 3 Byte | tth tth tth | **Mfg. Date/Time** in little endian code<br>Number of minutes from 0:00 hrs 1/1/1996, LeastSignificantByte first |
| 0Eh - 5Eh | Fix: 1 Byte<br>Variable: max. 8 Byte | uuh<br>"Board Manufacturer" | **Board Manufacturer** type/length byte ( uuh=C0h+length of Board Manufacturer (Hex))<br>**Board Manufacturer** = (DELTA, HIPRO, LITEON, ....) |
| | Fix: 1Byte<br>Variable: max. 17 Byte | kkh<br>"POWERSUPPLY wW" | **Board Product Name** type/length byte ( kkh=C0h+length of Board Product Name (Hex))<br>**Board Product Name** = "POWERSUPPLY+space+outputpower+W" (w=output power in W) |
| | Fix: 1 Byte<br>Fix: 21Byte | D5h<br>"E54470bbccyywwjdddddd" | **Board Serial Number** type/length byte ( =C0h+length Board Serial Number (Hex)=D5h)<br>**Board Serial Number =** 21digit barcode as on model label and peel off barcode |
| | Fix: 1 Byte<br>Fix: 18 Byte | D2h<br>"S26113-E544-V70-bb" | **Board Part Number** type/length byte ( =C0h+length Board Part Number (Hex)=D2h)<br>**Board Part Number =** FTS part number |
| | Fix: 1 Byte | 01h | **FRU-File-ID** type/lenght byte |
| | Fix: 1 Byte | E0h | **FRU-File-ID** Byte =E0h (encoded as OEM) |
| | Fix: 1 Byte<br>Fix: 6 Byte | C6h<br>"REV cc" | **Board Revision Level** type/length byte ( =C0h+length of Board Revision Level (Hex)=C6h)<br>**Board Revision Level** (cc = same REV number as on model label and barcodes) |
| | Fix: 1 Byte<br>Fix: 1 Byte | 01h<br>08h | **Asset Tag** type/lenght byte<br>**Asset Tag** =08h (encoded as powersupply) |
| | Fix: 1 Byte | C1h | type lenght byte encoded to indicate no more info fields |
| | Variable | 00h | empty space filled with 00h |
| 5Fh | Fix: 1 Byte | ssh | Zero check sum (start address = 08h - 5Eh) |
| 60h - FFh | Fix: 160 Byte | 00h | space filled with 00h |

Example:




## 4.3 Power Management

For Power management, PSU shall support PM-Bus. (Status monitoring over i²C-Bus).

Via the I²C-Bus, the computer system can communicate with the power supply to access currents, voltages, fan control, Fan speed, temperatures and Power. The communication follows the Power System Management Protocol Specification. Not all PM-Bus functions are supported.

## 4.4 PM Bus Commands

| | |
|---|---|
| 00h | PAGE |
| 03h | CLEAR_FAULTS |
| 19h | CAPABILITY |
| 3Ah | FAN_CONFIG_1_2 |
| 3Bh | FAN_COMMAND_1 |
| ~~3Ch~~ | ~~FAN_COMMAND_2~~ |
| 5Dh | IN_OC_WARN_LIMIT |
| 6Bh | PIN_OP_WARN_LIMIT |
| 78h | STATUS_BYTE |
| 79h | STATUS_WORD |
| 7Ah | STATUS_VOUT |
| 7Bh | STATUS_IOUT |
| 7Ch | STATUS_INPUT |
| 7Dh | STATUS_TEMPERATURE |
| 7Eh | STATUS_CML |
| 81h | STATUS_FANS_1_2 |
| 88h | READ_VIN |
| 89h | READ_IIN |
| 8Bh | READ_VOUT |
| 8Ch | READ_IOUT |
| 8Dh | READ_TEMPERATURE_1 |
| 8Eh | READ_TEMPERATURE_2 |
| 90h | READ_FAN_SPEED_1 |
| ~~91h~~ | ~~READ_FAN_SPEED_2~~ |
| 96h | READ_POUT |
| 97h | READ_PIN |
| 99h | MFR_ID |
| 9Ah | MFR_MODEL |
| 9Bh | MFR_REVISION |
| 9Ch | MFR_LOCATION |
| 9Dh | MFR_DATE |
| 9Eh | MFR_SERIAL |
| A0h | MFR_VIN_MIN |
| A1h | MFR_VIN_MAX |
| A2h | MFR_IIN_MAX |
| A3h | MFR_PIN_MAX |
| A4h | MFR_VOUT_MIN |
| A5h | MFR_VOUT_MAX |
| A6h | MFR_IOUT_MAX |
| A7h | MFR_POUT_MAX |
| A8h | MFR_TAMBIENT_MAX |
| A9h | MFR_TAMBIENT_MIN |
| AAh | MFR_EFFICIENCY_LL |
| ABh | MFR_EFFICIENCY_HL |

# 5. Safety / EMI / Environmental / Reliability Standards

## 5.1 Safety Standards

| | |
|---|---|
| **Protection class:** | I |
| **Leakage current:** | 254V/ 60Hz: <0.75mA<br>110V/ 60Hz: <0.50mA |
| **Safety requirements:** | IEC60950-1: 2005 / EN60950-1 : 2006 + ZB/ZC<br>UL 60950-1 / CAN-CSA-C22.2 60950-1 : 2007<br>For creapage and clearance distance calculations, 1st edition shall be applied.<br>BSMI: CNS14336<br>CCC: GB4943-2001 |
| **Test Reports** | CB-Certification and CB-Report including European deviation ZB/ZC, Japanese deviations, Australian deviations, Korean deviations, Singapore deviations and China deviations.<br>(Preferred test agency for CB-report is NEMKO.)<br>Test report from UL or CSA<br>(depends on agency which has done the North American safety tests)<br>BSMI-Certificate<br>CCC-Certificate |
| **Safety Marks (on the product)** | CE-Mark<br>$_{C}CSA_{US}$ or $_{C}UL_{US}$; Nemko; BSMI-Mark; CCC-Mark |
| **Safety Test in Mass Production** | According to safety agencies audit requirements, supplier must perform full safety tests in production line.<br>Also EN50116 must be fulfilled. |
| **HIPOT test condition during mass production** | Test voltage: 2200V DC<br>Trip current: 50µA<br>Arcing: tbd |

## 5.2 EMC Requirements

### 5.2.1 General

| **Emission** | |
|---|---|
| RFI emission<br>Radiated: 30…1000 MHz<br>Conducted: 0.15…30 MHz | EN 55022:2006 (CISPR 22: 2005 ): Class A Limits<br>must comply @ 100V – 127V / 50Hz,60Hz<br>200V – 240V / 50Hz, 60Hz input voltage with 6dB margin in standard PC-unit<br>(requirement CISPR 22 covers also FCC, CSA, VCC, C-tick)<br>BSMI: CNS 13438<br>CCC. GB 9254: 2008 |
| Harmonic current | EN 61000-3-2: 2006 Class D Limits 2% margin 75W@230$V_{AC}$<br>JIS C61000-3-2: 2005 (Japanese Standard)<br>CCC: GB 17625 |
| Flicker | EN 61000-3-3: 1995 +A1: 2001 +A2: 2005 |
| **Immunity :** | EN 55024: 1998 +A1: 2001 +A2:2003<br>(CISPR 24:1997 +A1: 2001) |

| | |
|---|---|
| Electrostatic discharge: | EN 61000-4-2: 1995<br>8kV contact discharge (Global Products)<br>10kV air discharge (additional at all touchable conductive parts)<br>Performance criteria A or B |
| Immunity to radiated field | EN 61000-4-3: 1996<br>3V/m; 80…1000 MHz; 80% AM (1KHz);<br>Performance criteria A |
| Electrical fast transient (BURST) | EN 61000-4-4: 1995<br>2kV on power line<br>Performance criteria A or B |
| Surge immunity test | EN 61000-4-5: 1995<br>1.2kV differential mode<br>2.2kV common mode<br>Performance criteria A or B |
| Immunity to radio frequency common mode | EN 61000-4-6: 1996<br>3V; 0.15-80MHz; 80% AM (1KHz)<br>Performance criteria A |
| Immunity to power frequency magnetic field | EN 61000-4-8: 1993<br>50 Hz 1A/m<br>Performance criteria A |
| Power Line Voltage dips, short interruptions and voltage variations | EN 61000-4-11: 1994<br>>95% reduction, 0.5 cycles, performance criteria B<br>30% reduction, 25 cycles, performance criteria C<br>>95% reduction, 250 cycles, performance criteria C |

## 5.3 Reliability / Quality Requirements

| | |
|---|---|
| The reliability will be proven in different ways: **theoretical MTBF** | The power supply vendor has to provide a MTBF calculation according to Belcore RPP at 45°C ambient temperature, input voltage 230$V_{AC}$. The calculated value has to be >100.000h |

| | |
|---|---|
| **ongoing life test** | The supplier will continuously provide data on ongoing life tests for early life failures and long life failures |

| | |
|---|---|
| **shipped quality** | The shipped quality will be <1000ppm for the first 3 months after the start of volume production and will be improved to 500dpm |

| | |
|---|---|
| **field failure rate** | <0.2% per year after 3 months after start of PC-volume shipment. |

| | |
|---|---|
| **E-cap life time** | All used E-caps must have a useful life which exceeds 45k hours at 50°C power supply ambient and 60% output load<br>and 32k hours at 25°C at off mode.<br>For bulk cap only 2000 hours 105°C type. No local source allowed. (please use Jap. …-con vendors).<br>**Only capacitors from approved e-cap ok list must be use.** |

| | |
|---|---|
| **Fan life time** | The used fan must have a useful life (L10) which exceeds 45k hours<br>at 50°C power supply ambient at 60% load. |

| | |
|---|---|
| **Transformer saturation** | Is not allowed during regular operation and switch on and off transition |

| | |
|---|---|
| **Burn in** | Burn in at 45˚C ±5˚C is required 100% of the production units. A burn in reduction plan according to the industry standard may be applied. Minimum burn in time shall be defined FTS and supplier in PVT stage, but minimum burn in time is 2 hours.. |

| | |
|---|---|
| **AC cycles** | 2000 cycles on/off with 4sec on / 4sec off at 40°C ambient |

| | |
|---|---|
| **Resistors** | All resistors from vendor YAGEO >100kΩ have not to be used. |
| **Resistors for high voltage divider networks** | **SMD resistors:**<br>max. 2MOhm, size 1206; voltage per resistor below 135V<br>max. 1MOhm, size 0805; voltage per resistor below 80V<br>**THT resistors:**<br>max. 4.7MOhm, min. 0.25W; horizontal mounting preferred<br>**General for pcb layout:**<br>Network preferred to be arranged in straight line and has to have adequate clearance to solder pads or copper tracks.<br>Clearance of each individual solder pad to any other solder pad or copper track (!with or without solder resist!) depends on voltage and overall impedance. |

## 5.4 Environmental Requirements

| | |
|---|---|
| **Operating temperature for the P/S:** | $5^{o}$C - $50^{o}$C |
| **Operating height** | max 3000m |
| **Climate for system unit:** | IEC 60721-3-3 class 3K2 |
| **Mechanical environment (system unit):**<br>- Vibration (non-operating)<br>- Vibration (operating)<br>- Shock (non-operating)<br>- Shock (operating) | IEC 60721-3-3 class 3M2<br>The power supply will survive without any damage if the PC is submitted to the following test conditions:<br>10-500Hz, 1G<br>10-500Hz, 0.5G<br>50G/ 6ms/ half sinus/ 3 times each of the 6 directions<br>5G/6ms<br>For the PSU alone<br>SHOCK NON OPERATING 50G/6ms on each side 3 impacts (total impacts 18) |
| **Noise (system level):**<br>- sound power level ***LWAd* (B) :**<br>- sound pressure ***LpA* (dB) :** | tested according to ISO 7779 and ISO 9296<br>the power supply will be mounted in a PC chassis<br>idle mode: 3.6B office mode: 3.7B<br>idle mode: 24dB office mode: 25dB (at the operator position or if not available the mean value of the four bystander positions)<br>Tone content is not allowed according to ISO 7779 |
| **Air for system unit:** | IEC 721-3-3 class 3C2 / 3S2 |
| **Green power supply** | According to the FTS guideline FTS 03230-1, see MPA (master purchasing agreement). |
| **Ecological construction requirements** | The supplier shall use environmentally friendly materials state of the art. The power supply has to be designed in such a way that recycling/disassembly of the PCB and other components are easily possible. |
| **Hazardous substances** | FTS regulate the use of hazardous substances in two different ways.<br>It is not allowed to use any substances which are on the current valid list of prohibited hazardous substances.<br>Used substances of the avoiding list must be declared.<br>This has to be confirmed in the FTS Template<br>• Supplier's Confirmation "List of prohibited hazardous substances"<br>• Supplier's Confirmation of the "List of hazardous substances to be avoided or declared" |
| **RoHS conform (Restriction of hazardous substances)** | The power supply has to meet RoHS (EU Directive 2002/95/EC). This means, the following substances have to meet their threshold values in homogenous material (exemptions according to RoHS Directive are valid):<br>• lead, mercury, hexavalent chromium, PBB and PBDE ≤ 0.1% by weight<br>• cadmium ≤ 0.01% by weight<br>The "Declaration of RoHS compliance" must be signed. |

| | |
|---|---|
| ~~**Halogen-free PCB**~~ | ~~The single PCB must be halogen-free according to IEC 61249-2-21,~~<br>~~this means Cl, Br ≤ 0.09% by weight; total (Cl + Br) ≤ 0.15% by weight~~ |
| **China RoHS** | According to SJ/T11364 - 2006;<br>The environmental protection use period must be “25” |
| ~~**PVC- and halogen free cable, plug and connector**~~ | ~~The cables, plugs and connectors must be PVC-free and halogen-free according to the IEC 61249-2-21, this means Cl, Br ≤ 0.09% by weight; total (Cl + Br) ≤ 0.15% by weight~~ |
| **Plastic parts > 25g (fan included)** | Plastic parts have to fulfil the requirements as specified in the “Manufacturer’s Statement of Plastic Materials” |
| **80 PLUS Certification** | The PSU has to be certified for the category “Gold” at 115V according to www.80plus.org |

## 5.5 Specific Quality requirements

| | |
|---|---|
| **Aluminum Electrolyte Capacitor (E-Cap)** | Aluminum Electrolyte Capacitors (E-caps) only according approved vendor list. |

| | |
|---|---|
| **Fan_Ok List** | Fans only according approved vendor list.<br>Any other fan has specially released by FTS |

| | |
|---|---|
| **Fan & E-cap life** | see section 5.3 |

| | |
|---|---|
| **Smoke & Fire** | see section 2.4.7 |

| | |
|---|---|
| **Forbidden parts** | |
| **Resistor** | see section 5.3 |

| | |
|---|---|
| ~~**YIYI connector**~~ | ~~For PATA connector has to be used only YIYI H 6680~~ |

| | |
|---|---|
| **AC On-Off Test** | The parameter has to take over from the vendor test report. |

## 6. Connector Pinning - recommended

| connector | manufacturer | pin # | signal | AWG |
|---|---|---|---|---|
| **P1** | Mini Fit Jr. | 1,2,3 | GND | 16 |
| **Systemboard** | Molex 39-01-2160 | 4,5,6 | 12V2 | 16 |
| | or equivalent | 7 | PSOFF | 22 |
| | | 8 | 12Vsb | 16 |
| | | 9,10,11 | 12V1 | 16 |
| | | 12,13,14 | GND | 16 |
| | | 15 | POWERGOOD | 22 |
| | | 16 | not connected | — |
| **P10** | AMP 171822-8 | 1 | not connected | — |
| **System-Monitoring** | or equivalent | 2 | FanC (optional) | — |
| | | 3 | not connected | — |
| | | 4 | FanM (optional) | — |
| | | 5 | SCL ($I^2$-C-Bus) | 22 |
| | | 6 | SDA ($I^2$-C-Bus) | 22 |
| | | 7 | not connected | — |
| | | 8 | GND | 22 |

All connectors have to be labeled.
No brass contacts are allowed for the HD drive connectors. Phosphor-bronze-tin-plated -contacts must be used only.

# 7. Mechanical dimensions

## 7.1 Housing

**TBD by ODM**

## 7.2 Housing Surface Resistance

For stable EMI performance all sides of PSU housing must have a conductive surface.
Surface resistance must be below 100mOhm according to LORESTA-EP MCP-T360 using ASP 4-pin probe.
Refer to FTS mechanic test report template for more detailed description.

## 7.3 Cable length

**TBD by ODM**

## 7.4 Label location

**TBD by ODM**

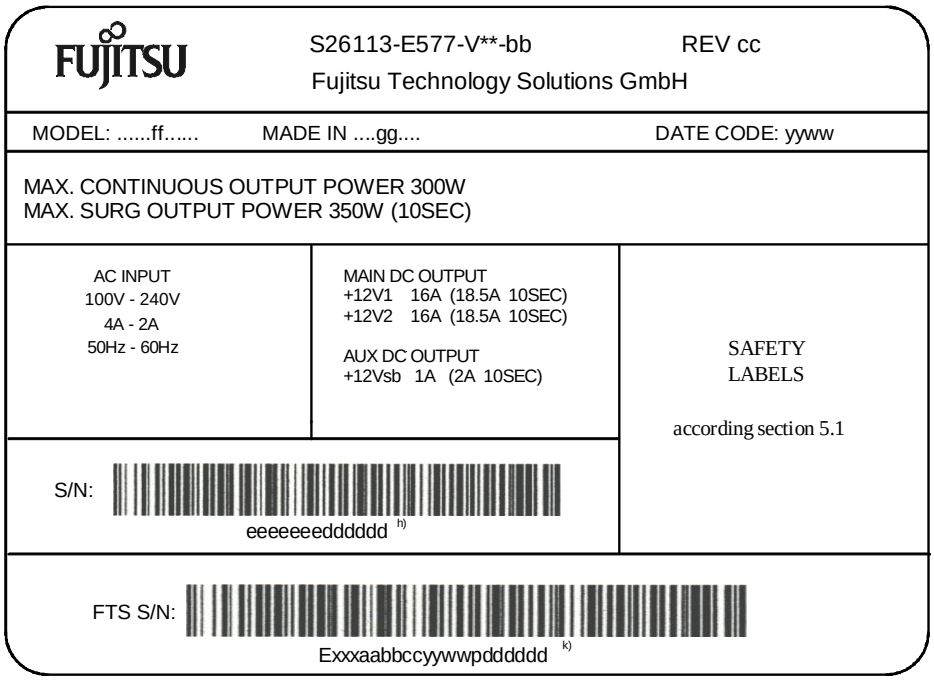
# 8. Labels

## 8.1 Caution label

Besides the main label of the manufacturer there is a special FTS label on the power supply:
CAUTION LABEL (several languages) must contain English, Japanese, German, Chinese.

## 8.2 Main label

The main label should contain the following information and should have this layout;
dimension approximately 70mm x 50mm.
This label also should contain the Chinese characters, necessary for BSMI.




**: Code for power supply vendor
bb: suffix of FTS part number, controlled by FTS through ECR
cc: revision level, controlled by vendor, approved by FTS through ECN/ECR
During design phase the units will be marked as follow on the label:
EVT: REV E1
DVT: REV D1
Pilot: REV 01
MP: according ECN/ECR procedures
ff: manufacturers model name
gg: manufacturers country
??: rating from safety submission
h): serial number of power supply, counted by power supply vendor
k): The same content like on the peel of label
The barcode structure has to be done according to standard code 128 (Code B).

## 8.3 Additional Peel Off Barcode Label

The following barcode must be on the main label and additional on a peel off label as shown below.
Material: Polyester; type: 5770; manufacturer: 3M

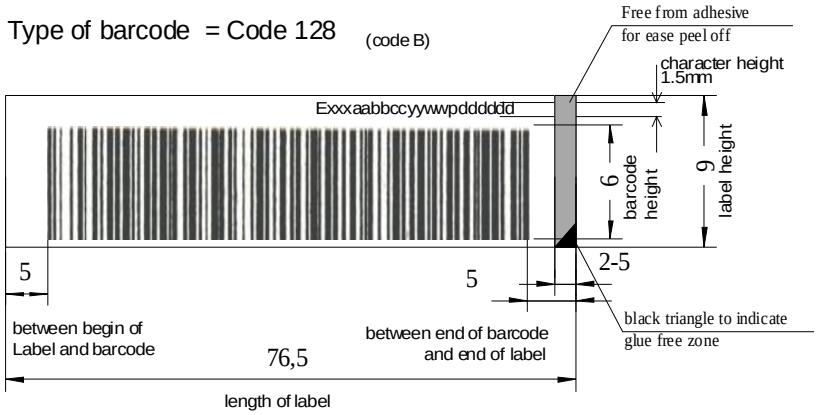
**The system of PSU bar code** (21digits)

# Exxxaabbccyywwpddddddd

for example

| E | 577 | 70 | 01 | 01 | 1026 | V | 123456 | = | S26113-E577-V70-01 | |
|---|---|---|---|---|---|---|---|---|---|---|
| is standing for S26113- | discription of the PSU E577- | manufacturer code V70- | suffix is starting always with 01, 01 can only changed by ECR issued by FTS | Revision level Rev 01 | date code year 10 week 26 | power of the PSU in Watt 300W acc. to the power code table, see 8.3.1 | serial number, six digits | | **Rev** | **01** |
| | | | | | | | | | **date code** | **year 10 week 26** |
| | | | | | | | | | **power of PSU** | **300W** |
| | | | | | | | | | **serial number** | **123456** |

Type of barcode = Code 128 (code B)




We want to pull the labels from the PSU housing and stick them on the PC housing.
For more easy pull off, we also need a second foil between the label and the underground.

### 8.3.1 Code table for power supply output power

Code table: Byte for power supply-output power

Used characters from barcode 128(Code B): Numbers 0-9 + uppercase and lowercase letters

| Character | Power(W) |
|---|---|
| 0 | 20 |
| 1 | 25 |
| 2 | 30 |
| 3 | 35 |
| 4 | 40 |
| 5 | 45 |
| 6 | 50 |
| 7 | 55 |
| 8 | 60 |
| 9 | 65 |
| A | 70 |
| B | 75 |
| C | 80 |
| D | 85 |
| E | 90 |
| F | 95 |
| G | 100 |
| H | 110 |
| I | 120 |
| J | 130 |
| K | 140 |
| L | 150 |
| M | 160 |
| N | 170 |
| O | 180 |
| P | 190 |
| Q | 200 |
| R | 220 |
| S | 240 |
| T | 260 |
| U | 280 |
| V | 300 |
| W | 320 |
| X | 340 |
| Y | 360 |
| Z | 380 |

| Character | Power(W) |
|---|---|
| a | 400 |
| b | 420 |
| c | 440 |
| d | 460 |
| e | 480 |
| f | 500 |
| g | 550 |
| h | 600 |
| i | 650 |
| j | 700 |
| k | 750 |
| l | 800 |
| m | 850 |
| n | 900 |
| o | 950 |
| p | 1000 |
| q | 1100 |
| r | 1200 |
| s | 1300 |
| t | 1400 |
| u | 1500 |
| v | 1600 |
| w | 1700 |
| x | 1800 |
| y | 1900 |
| z | 2000 |

| Invalid | |
|---|---|
| + | overflow |
| - | underflow |

## 8.4 Documentation

Any sample shipment of power supplies must be accompanied by the following documentation:

| | |
|---|---|
| DVT, mass production | • Schematic including component values 1 week before sample shipment<br>• BOM<br>• Component placement and layout as a black-and-white PDF file<br>• All layout layers in one page in a colored PDF file<br>• One set of blank PCB<br>• FTS test-report for EVT and DVT<br>If for DVT is required again depends on performance of EVT units<br>• Clear deviation lists from EVT to DVT, DVT to PVT, PVT to mass production |
| Pilots (PVT) | • As for EVT, DVT<br>• Safety certificates and<br>letter of compliance<br>• Environmental conformity<br>o Supplier's Confirmation "List of prohibited hazardous substances"<br>o Supplier's Confirmation of the "List of hazardous substances to be avoided or declared"<br>o Declaration of RoHS compliance<br>o Manufacturer's Statement of Plastic Materials |

DVT sample have to be shipped to FTS. It is used for safety submission.

# 9. Package

Defined by ODM.

# 10. Revision History

### Changes from Rev 01 to Rev 02

**Section 4.1** P-Meter requirements updated.

### Changes from Rev 02 to Rev 03

**Section 1.1** Were added.

**Section 2.2** updated

**Section 4** Updated, also with sub items.

**Section 5.2.1** At RFI emission the CCC standard was updated to the valid version.

**Section 5.3** Updated at MTBF, burn in and Resistor requirements.

**Section 5.4** Updated

**Section 5.5** Was added.

**Section 6** Updated at P10.

**Section 8.2** Main label updated.

**Section 8.3** Updated.

**Section 8.4** Updated.

### Changes from Rev 03 to Rev 04

**Section 2.1.3** The leading spike of the x-cap can be neglected.

**Section 2.1.5** The voltage range 100V – 240V in which the power factor has to be fulfilled was added.

**Section 2.1.6** Turn on and turn off thresholds were changed.

**Section 2.2** Surge current deleted, step load added.

**Section 2.2.1 and 2.2.2** Values were defined.

**Section 2.2.3** "steady state" was added.

**Section 2.4.2** The current values were defined for 12Vsb.

**Section 3.1** The definition of PSOFF input signal was updated.

**Section 3.2** The definition of POWERGOOD output signal was updated.

**Section 4.1** IC CS5461 for p-meter function was added.

**Section 4.4** PM commands were added.

**Section 5.2.1** The upper value of the voltage was corrected from 230V to 240V at RFI emission.

### Changes from Rev 04 to Rev 05

**Section 2.1.1** The headline was changed to AC Input values.
The table was enlarged with the input current ratings.

**Section 2.1.5** Power factor at 20% load only set as target.

**Section 2.2** Values added for surge current.

**Section 2.3** Values for adjustment in production and max step load added.

**Section2.8.1** The current released fan was listed
The minimal rated fan speed was defined.
The values of the fan were filled in the table.

**Section 2.9.2** The airflow volume was defined.

**Section 3.2** POWERGOOD output voltages were defined.

**Section 8.2** At the company name "GmbH" was added to "Fujitsu Technology Solutions GmbH".
At AC Input and Main DC Output the values were added.

### Changes from Rev 05 to Rev 06

**Section 2.8.1** Updated with IC503 and IC21.

**Section 8.2** At AUX DC OUTPUT was 12V changed to 12Vsb.

### Changes from Rev 06 to Rev 07

**Section 4.2.1** FRU-File-ID changed from 70h to E0h, from Factory Augsburg to OEM

**Section 6** Wire gauge for most cables for P1 was changed based on ODM's request from AWG 18 to AWG 16, to gain margin for efficiency

### Changes from Rev 07 to Rev 08

**Section 2.1.2** The current values in the table were corrected.

### Changes from Rev 08 to Rev 09

**Section 2.4.1** Typo for 12Vsb OVP was corrected

**Section 2.8.1** Line added for maximum tolerance for Nmin +/-15%.

**Section 5.4** The requirement “80 PLUS Certification” was added.

**Section 7.2** The requirement of housing surface resistance was implemented.

### Changes from Rev 09 to Rev 10

**Section 2.9.2** Table was updated.