CPS Industrial Power Supply

Power Supply Specification

Model Number: FSAK C Series

1U High, multiple output power supply

AC Input: full range, active PFC.

DC Output: 6 configurable, 360W~540W

Revision: A-01 & B-01

Revision History

Rev	Description	Owner	Date
X-01	Preliminary	Y.C. Shang	12/18/10
A/B-01	Initial Released	Y.C. Shang	04/18/11

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1. Scope

This document defines the industrial quality, 1U high, 360W~540W configurable outputs power supplies for the application of industrial grade system. The outputs of FSAK C series can be configured to meet the following buss structures:

a) Intel ATX12V platform
b) VME platform
c) CompactPCI platform

And the following key features:

1) Input: Full Range (90-264Vrms) with Active Power Factor Correction.
2) Output: Product is provided with a total of six outputs that can be configured with the combination of the following output voltages: +12V, +5V, +3.3V, +24V, -12V, -5V and +5Vsb.
3) Cooling: A 38mm or 40mm (Delta or Sanyo Denki) high reliable DC fan is used for cooling the power supply.

2. Electrical

The electrical specifications that follow are to be met over the environmental ranges specified in Section 3 unless otherwise noted.

2.1. AC Input

Table 1 lists AC input voltage and frequency range for continuous operation. The power supply is capable of supplying full-rated output power over the input voltage ranges specified.

Parameter	Min	Nominal Input	Max	Unit
V_{in} Voltage	90	100-240	264	Vrms
V_{in} Frequency	47	50/60	63	Hz
V_{in} Current /360W		6.0		A
V_{in} Current /420W		6.0		A
V_{in} Current /480W		8.0		A
V_{in} Current /540W		8.0		A

Table 1. AC input

- The inrush current is less than 50A under the conditions of 240Vrms input and 25^{o}C ambient cold start. The inrush current is limited to the extent that no damage will be done to the power supply under any specified line, load, and temperature conditions. The inrush current will not cause any external protection devices (i.e. fuses) to trip.
- The leakage current of the power supply module is less than 1.0mA measured at 240Vac input.
- The repetitive ON/OFF cycling of AC input voltage will not damage the power supply.
- The power supply can automatically recover from AC power loss.
- The primary fuse is installed for input over-current protection, and meet product safety requirement.

2.2. DC Output

2.2.1. DC Output Voltage Regulations

The DC output voltages remain within the regulation ranges shown in Table 2 when measured at the load end of the output connectors under all AC line, O/P loads, and environmental conditions. The voltage regulation will be maintained under continuous operation for a period of time equal to the MTBF specified in section 5.2 at any steady state temperature and operating conditions specified in section 3.

	+12V	+5V	+3.3V	+24V	-5V	-12V	+5Vsb	Unit
Range	±5%	±5%	±5%	±5%	±10%	±10%	±5%	Volt
Min	+11.40	+4.75	+3.14	+22.80	-4.50	-10.80	+4.75	Volt
Nom	+12.00	+5.00	+3.30	+24.00	-5.00	-12.00	+5.00	Volt
Max	+12.60	+5.25	+3.46	+25.20	-5.50	-13.20	+5.25	Volt

Table 2. DC Output Voltage Regulations

- The remote sense is provided to +12V, +5V, and +3.3V outputs to compensate for excessive cable drops.
- The voltage regulation of -12V output will be ±5% if -12V at V4 rail is applied.

2.2.2. DC Output Load Distributions

The Table 3 defines the power supply typical output load distribution.

Rev. A-01

Output Rail	Output Voltage	Minimum Current (A)	360W Max. (A)	420W Max (A)	480W Max. (A)	540W Max. (A)
V1	+12V	0.5	30.0	35.0	40.0	45.0
V2	+5V	0.0	15.0/30.0/35.0	15.0/30.0/35.0	19.0/35.0	24.0/35.0
	+3.3V	0.0	30.0/35.0	30.0/35.0	35.0	35.0
V3	+5V	0.0	30.0/35.0	30.0/35.0	35.0	35.0
	+3.3V	0.0	21.0/30.0/35.0	24.0/30.0/35.0	24.0/35.0	24.0/35.0
V4	+5V	0.0	35.0	35.0	35.0	35.0
	+3.3V	0.0	35.0	35.0	35.0	35.0
	+24V	0.0	4.0	4.0	5.0	5.0
	-12V	0.0	4.0	4.0	5.0	5.0
V5	-5V	0.0	1.0	1.0	1.0	1.0
	-12V	0.0	0.5/0.8	0.5/0.8	0.5/0.8	0.5/0.8
V6	+5Vsb	0.0	3.0/3.5/4.0	3.0/3.5/4.0	3.0/4.0	3.0/4.0
Max. combined O/P of V2 & V3			103W/---/---	120W/---/---	130W/---	150W/---

Table 3. DC Output Load Distribution (360W – 540W)

Rev. B-01

Output Rail	Output Voltage	Minimum Current (A)	360W Max. (A)	420W Max (A)	480W Max. (A)	540W Max. (A)
V1	+12V	0.5	30.0	35.0	40.0	45.0
V2	+5V	0.0	15.0	15.0	19.0	24.0
V3	+3.3V	0.0	21.0	24.0	24.0	24.0
V4	+24V	0.0	4.0	4.0	5.0	5.0
	-12V	0.0	4.0	4.0	5.0	5.0
V5	-5V	0.0	1.0	1.0	1.0	1.0
	-12V	0.0	0.5/0.8	0.5/0.8	0.5/0.8	0.5/0.8
V6	+5Vsb	0.0	3.0/3.5/4.0	3.0/3.5/4.0	3.0/4.0	3.0/4.0
Max. combined O/P of V2 & V3			103W/---	120W/---	130W/---	150W/---

Table 3. DC Output Load Distribution (360W – 540W)

a) The total continuous output power is 360W to 540W max; The max. O/P is de-rated linearly to 50% of max. rated output when working temperature is increased from 50°C to 70°C.
b) The peak current of +12V output is 110% of max rated current and may last for 15 msec.
c) The following loads were used for the efficiency calculation defined by 80Plus: V1 (+12V), V2 (+5V w/smallest current listed), V3 (+3.3V w/smallest current listed), V4 (N/C), V5 (-12V w/ smallest current listed), V6 (+5Vsb w/ smallest current listed) and the max. combined output of V2 & V3 (wattage listed) is applied.
d) For 360W and 420W O/P, if Delta fan (40x40mm) is installed, the following conditions are applied: V2 and V3 are 30A max., V4 is not an option, and V6 is 3.5A max. with main output is ON (cooling fan is running).
e) When Sanyo fan (38x38mm) is installed, the following conditions are applied: V2 and V3 are 35A max., V4 can be any O/P voltage listed, and V6 is 4.0A max. with main output is ON (cooling fan is running).
f) When V2, V3, and V4 outputs are working in parallel, the output current is de-rated to 90% of their max. rated current. The active current share circuitry is built in for the best sharing performance. (for example, if V2/+5V and V3/+5V are working in parallel with Sanyo fan installed, the max. o/p current of V2 and V3 will be 31.5A each, with total 63A available for system application.)

2.2.3. DC Output Efficiency

The power supply efficiency is 80% minimum measured at 20%, 50%, full load and nominal line input, which is 115Vrms and 230Vrms conditions. The efficiency is measured in accordance with the definition released by the 80 Plus Organization (Plug Load Solutions). Please refer to the efficiency measurement table in details.

2.2.4. DC Output Ripple & Noise

The output ripple & noise specifications listed in Table 4 will be met throughout the load ranges as specified in section 2.2.2 and the nominal line input voltage conditions as specified in section 2.1. Ripple & noise is defined as periodic of random signals over a frequency band of 10Hz to 20MHz. Measurements should be made with an oscilloscope with 20MHz bandwidth. Add a 10uF electrolytic capacitor and a 0.1uF ceramic capacitor across output terminal during ripple & noise measurement.

	+12V	+5V	+3.3V	+24V	-5V	-12V	+5Vsb	Unit
Max. Ripple	120	50	50	240	100	120	50	mV P-P
Max Ripple & Noise	120	50	50	240	100	120	50	mV P-P

Table 4. DC Output Ripple & Noise

2.2.5. DC Output Transient Response

The output voltages will remain within the regulation limits specified in Table 2. The load-changing repetition rate is 50Hz to 10KHz, and the transient load slew rate 0.5A/us. The maximum step load size, and output capacitive loading are specified as followings in Table 5:

	+12V	+5V	+3.3V	+24V/-12V	-5V (V5)	-12V (V5)	+5Vsb
Step Load Size	60% of Max Load	30% of Max Load	30% of Max Load	30% of Max Load	0.1A	0.1A	0.5A
Capacitive Load	10000	10000	10000	2000	330	330	1000

Table 5. DC Output Ripple & Noise

2.2.6. DC Output Voltage Hold-up Time

The power supply will maintain outputs in regulation per section 2.2.1 despite a loss of input power at the nominal range of AC input and at 80% of maximum continuous output load as applicable for a minimum of 16 msec. except 540W model for a minimum of 15 msec.

2.3. Timing / Housekeeping / control

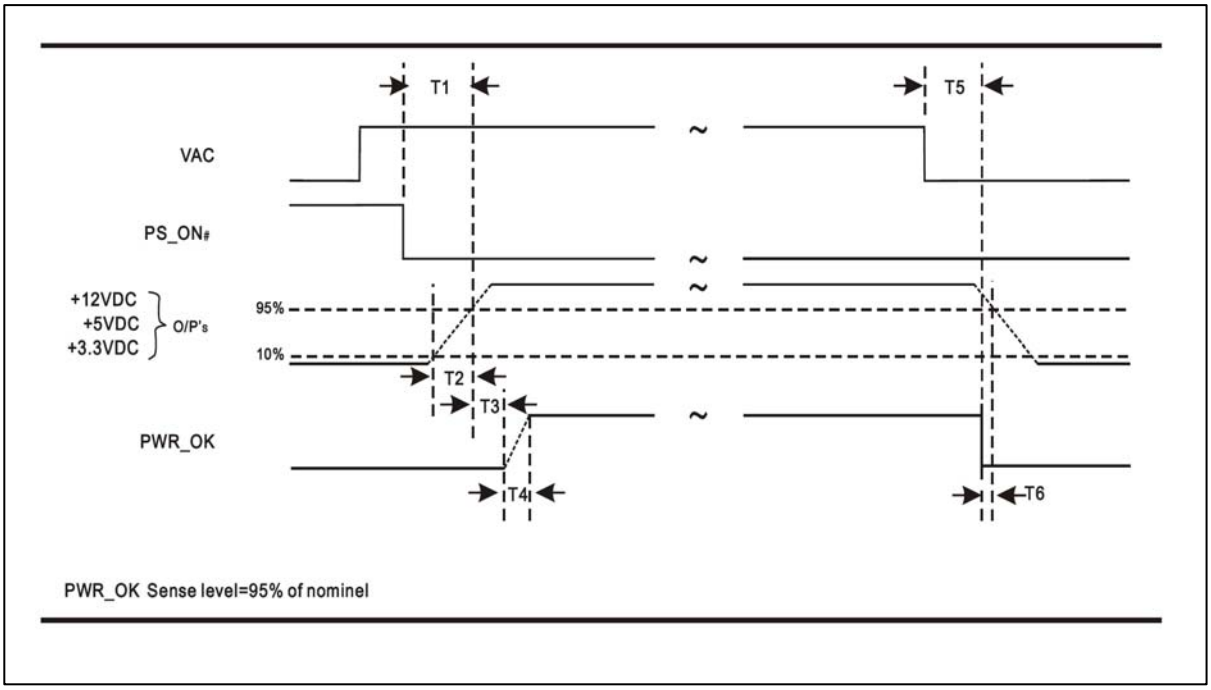


Figure 1. Power Supply Timing

Notes: T1 is defined is section 2.3.4
T2 is defined in section 2.3.5
T3, T4, T5 and T6 are defined in Table 6

2.3.1. PWR_OK (Power Good Signal)

PWR_OK is a "power good" signal. It will be asserted high by the power supply to indicate that the +5V output is above the under voltage threshold listed in Table 2 of Section 2.2. PWR_OK will be de-asserted to a low state when +5V output voltage falls below under voltage threshold, or when AC power has been removed for a time sufficiently such that power supply operation cannot work normally. The electrical and timing characteristics of the PWR_OK signal are given in Table 6 and in figure 1.

Signal type	+5V TTL compatible
Logic level low	Less than 0.4V while sinking 10mA
Logic level high	Greater than 4.75V while sourcing 200uA
High-state output impedance	1kΩ from output to common
PWR_OK delay	100ms < T_3 <500ms
PWR_OK rise time	$T_4 \leq$ 10ms
AC loss to PWR_OK hold-up Time	$T_5 \geq$ 16ms (at 80% of maximum rated output load)
Power-down warning	$T_6 \geq$ 1ms

Table 6. PWR_OK Signal Characteristics

2.3.2. PS_ON (DC Soft Start)

PS_ON is an active-low, TTL-compatible signal that allows a motherboard to remotely control the power supply in conjunction with features such as soft on/off, Wake on LAN, or wake-on modem. When PS_ON is pulled to low-level (1.5V max.), the power supply will turn on the main DC output rails: +12V, +5V, +3.3V, (+24V), (-5V) and –12V. When PS_ON is pulled to high-level (2.4V min.), the DC output rails will not deliver current and will be held at zero

potential with respect to ground. PS_ON has no effect to the +5Vsb output, which is always enabled whenever the AC power is present. Table 7 lists PS_ON signal characteristics.

	Min	Max
V_{IL}, Input Low Voltage	0.0V	1.5V
I_{IL}, Input Low Current (Vin = 0.4V)		-1.6mA
V_{IH}, Input high Voltage (Iin = -200uA)	2.4V	
V_{IH}, open circuit, Iin =0		5.25V

Table 7. PS_ON Signal Characteristics

2.3.3. +5Vsb (Standby Voltage Output)

+5Vsb is a standby voltage output that is active whenever the AC power is present. It provides a power source for circuits that must remain operational when the four main DC output rails are in a disabled state. Example uses include soft power control, Wake on LAN, wake on modem, intrusion detection, or suspend state activities. There is over current protection on the +5Vsb output to ensure the power supply will not be damaged if external circuits draw more current than the supply can provide.

2.3.4. Power-on Time

The power-on time is defined as the time from when PS_ON is pulled low to when the12V, +5V, and +3.3V output are within the regulation ranges specified in Section 2.2.1. The power-on time will be less than 200ms (T_1 <200 ms). +5Vsb has a power on time of one second max. after the valid AC Voltages applied.

2.3.5. Rise Time

The output voltage rise from ≤ 10% of nominal to within the regulation ranges specified in section 2.2.1 within 0.1 ms to 20 ms (0.1 ms ≤ T_2 ≤ 20 ms)

2.3.6. Power Sequencing

The +12V and +5V output levels are equal to or greater than the +3.3V output at all times during power-up and normal operation. The time between the +12V or +5V output reaching its minimum in-regulation level and +3.3V reaching its minimum in-regulation level is ≤ 20 msec.

2.3.7. Overshoot at Turn-on / Turn-off

The output voltage overshoot upon the application or removal of the input voltage, or the assertion / de-assertion of PS_ON will be less than 10% above the nominal voltage.

2.3.8. Reset after Shutdown

If the power supply latches into a shutdown state because of a fault condition on its outputs, the power supply can return to normal operation only after the fault condition has been removed and the PS_ON has been cycled OFF/ON with a minimum OFF time of 1 second.

2.3.9. +5Vsb at AC Power-down

After AC power is removed, the +5Vsb standby voltage output should remain at its steady state value for the minimum hold-up time specified in Section 2.2.6 until the output begins to decrease in voltage. The decrease can be monotonic in nature, dropping to 0.0V. There are no other perturbations of this voltage at or following removal of AC power.

2.4. Output Protection

2.4.1. Over Voltage Protection

The power supply can provide latch-mode over voltage protection as defined in Table 8.

Output	Min.	Nom.	Max.	Unit
+12VDC	13.6	14.6	15.6	Volts
+5VDC	5.5	6.25	7.0	Volts
+3.3VDC	3.7	4.1	4.5	Volts

Table 8. Over Voltage Protection

2.4.2. Over Current Protection

130% maximum for +12V (V1) output
150% maximum for +3.3V and +5V outputs

2.4.3. Short-circuit Protection

Output short circuit is defined as any output impedance of less than 0.1 ohms. The power supply can shut down and latch off for shorting the +12VDC, +5VDC, +3.3VDC, +24VDC, and -12VDC rails to return or any other rails. Shorts between main output rails and +5Vsb will not cause any damage to power supply. +5Vsb can be capable of being shorted indefinitely, but when the short is removed, the power supply will recover automatically or by cycling PS_ON. The power supply can be capable of withstanding a continuous short circuit to the output without damage or overstress to the unit (for example, to components, PCB traces, connectors) under the input conditions specified in section 2.1.

2.4.4. No-load Operation

No damage or hazardous condition will occur with all the DC output connectors disconnected from the load. The power supply may latch into the shutdown state.

2.4.5. Isolation (High Voltage Withstand)

Primary to Secondary 4242Vdc
Primary to Earth GND 2800Vdc

3. Environmental

The following subsections define recommended environmental specifications and test parameters. Based on the typical conditions to which an ATX power supply may be subjected during operation or shipment.

3.1. Temperature

Operating -10°C to +50°C
Non-operating -40°C to +85°C

3.2. Humidity

Operating 10% to 90% relative humidity (non-condensing)
Non-operating 5% to 95% relative humidity (non-condensing)

3.3. Altitude

Operating 0 to 16,000 feet (meet CCC 5000m requirement)
Storage 0 to 50,000 feet

4. Electromagnetic Compatibility

The following subsections outline applicable product regulatory specifications for this power supply.

4.1. Emissions

The power supply can comply with FCC Part 15 and EN55022: 2006 meeting Class B for both conducted and radiated emissions with a 3 dB margin.

4.2. Immunity

The power supply can comply with EN 55024: 1998+A1: 2001+A2: 2003.

4.3. CE Testing

The following standards are applied during the CE testing

EN 55022:2006+A1:2007 Class B
EN 61000-3-2:20006+A1:2009+A2:2009 Class D
EN 61000-3-3:2008
EN 55024:1998+A1:2001+A2:2003, including

IEC 61000-4-2:2009 ESD Level 3: Air ±8KV; Level 2: Contact ±4KV	Criterion B
IEC 61000-4-3:2006+A1:2008+A2:2010 RF field susceptibility, Level 2 3V/m	Criterion A
IEC 61000-4-4:2004+A1:2010 EFT bursts, Level 2: 1KV, 0.5KV	Criterion B
IEC 61000-4-5:2006 Surge susceptibility, Level 3, 2kV L to PE / Level 2, 1kV L to N	Criterion B
IEC 61000-4-6:2009 Conducted susceptibility, EN61000-4-6, Level 2, 3V	Criterion A
IEC 61000-4-8:2010 Magnetic field immunity, Level 1, 1A/m, 50Hz for 5 min.	Criterion A
IEC 61000-4-11:2004 Voltage Dips & Short Interruptions $\%U_T$ 100/30/100 0.5P/25P/250P	Criterion B/C/C

5. Reliability

5.1. Component De-rating

The derating process promotes quality and high reliability. All electronic components are designed with conservative derating for use in commercial and industrial environments.

5.2. Mean Time between Failures (MTBF)

100K hours minimum at full load 25^{o}C per Bellcore_TR-332_ISSUE6

6. Safety

6.1. Safety

cUL	UL 60950-1 (substituted by cTUVus)
TUV	EN 60950-1:2006+A11+A1+A12
CB	IEC 60950-1:2005 (2nd Edition)+Am1:2009
CCC	(5000m altitude)
BSMI	

6.2. RoHS & REACH Compliance

The power supply meets the requirements of RoHS & REACH Compliance specified as followings:

- European Directive for Waste of electrical and electronic equipment (WEEE) 2012/19/EU
- European Directive for Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) 2011/65/EU
- ACPEIP, Administration on the Control of Pollution caused by Electronic Information Products (China RoHS), e.g. SJ/T 11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in EIP, SJ/T

11364-2006 Marking for Control of Pollution Caused by EIP

- Plastic and rubber parts are within the limits for 16 PAH and Benzopyrene polycyclic aromatic hydrocarbons
  - PAH (Polycyclic Aromatic Hydrocarbons):
    - 200mg/kg for components touched less than 30 seconds
    - 10mg/kg for components touched longer than 30 seconds
  - Benzopyrene are within the limits of:
    - 20mg/kg for components touched less than 30 seconds
    - 1mg/kg for components touched longer than 30 seconds

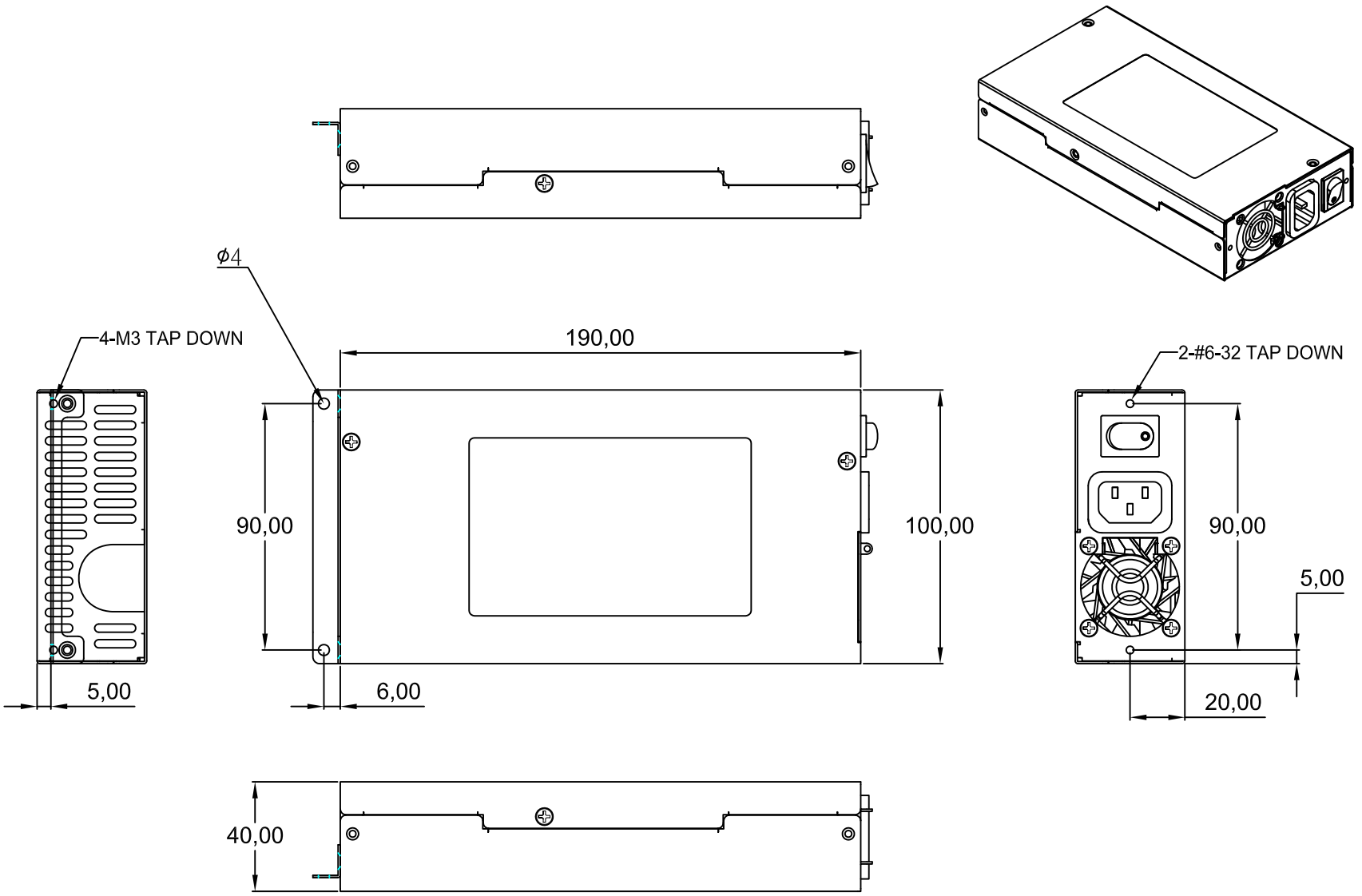
- Phthalate concentration is below 1mg/kg for:
  - Diisononyl phthalate
  - Diisodecyl phthalate
  - Bis(2-ethylhexyl)phthalate
  - Butyl benzyl phthalate
  - Di-n-octyl phthalate
  - Bis(n-butyl)phthalate

- Polychlorinated biphenyl (PCB) concentration limits are less than two (2) parts per million (ppm).

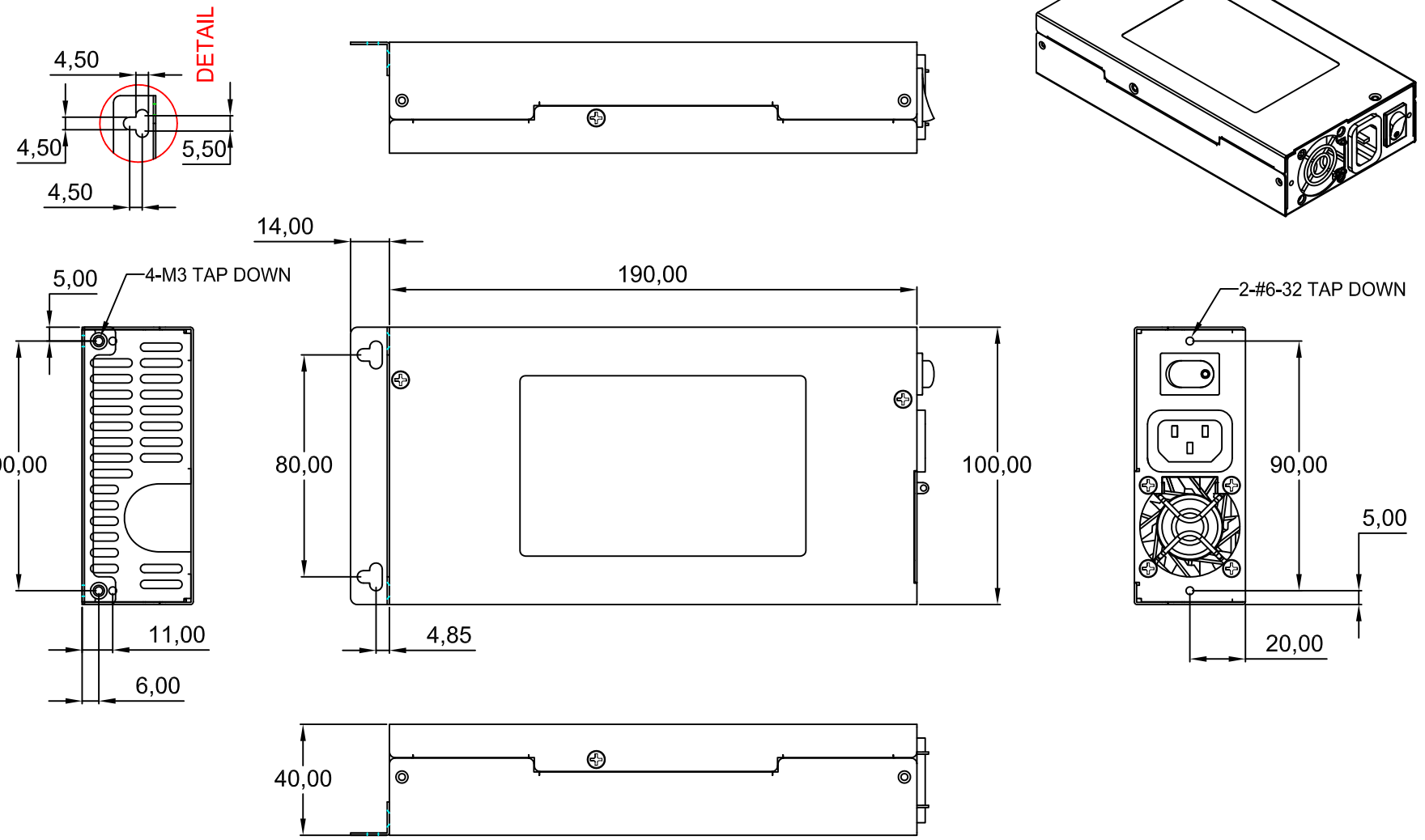
Regulation (EC) No 1907/2006 ... concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH): No substance of Very High Concern of the "Candidate List" exceeds more than 0,1 % of the global weight of the delivered item (without packaging of the item)

7. Mechanical

Dimension W x L x H = 100 x 190 x 40mm. Please see attached outline drawing and output cable drawing in details.



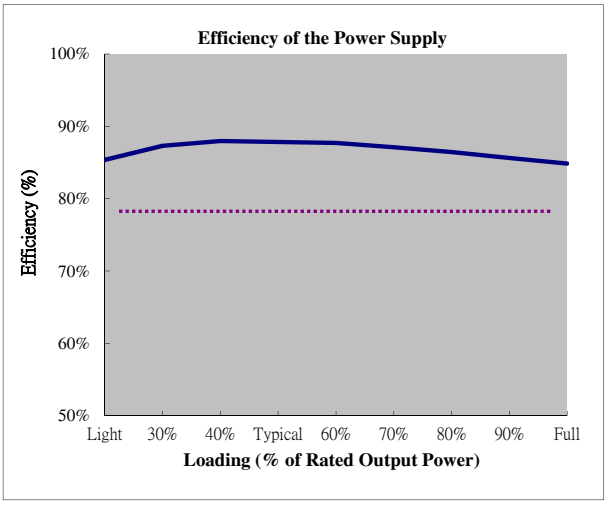
CPS	Drawing Number: C-1U-AC02-Z1				Dimension	Tolerance
	Model Number: FSAK C Series				0.0~10.0	±0.1
					10~100	±0.2
	Date	February 18, 2011	REV.	1.0	100~400	±0.25
	Design	C.Y. Chen	UNIT	mm	400~	±0.3

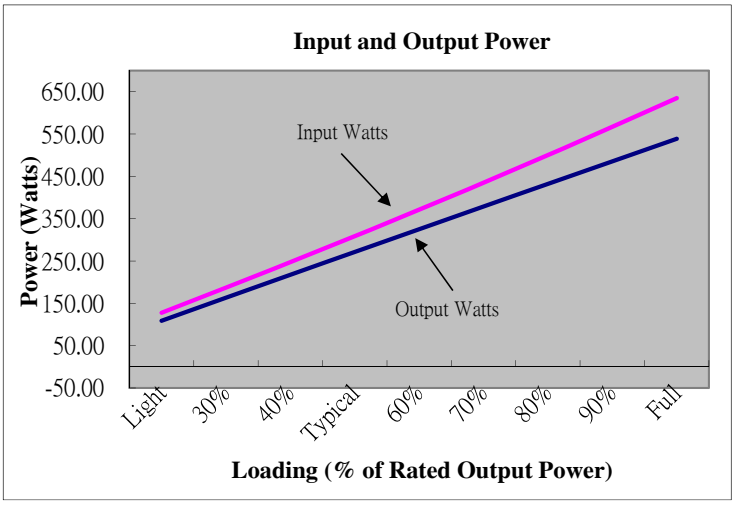


CPS	Drawing Number: C-1U-AC02-S1				Dimension	Tolerance
	Model Number: FSAK C Series				0.0~10.0	±0.1
					10~100	±0.2
	Date	February 18, 2011	REV.	1.0	100~400	±0.25
	Design	C.Y. Chen	UNIT	mm	400~	±0.3

FSAK540C Efficiency Report @115V

	TOTAL 540W											
	TOTAL 540W				TOTAL 140W		6.00W	0.00W	15.00W	701.00		
O/P Voltage	12	12	12	12	3.3	5	-12	-5	5			
O/P Current	45.0A	0.0A	0.0A	0.0A	24.0A	24.0A	0.5A	0.0A	3.0A			
O/P Wattage	540W	0W	0W	0W	79.2W	120W	6.0W	0.0W	15W			
Ratio	+12V1	+12V2	+12V3	+12V4	+3.3V	+5V	-12V	-5V	+5VSB	Output power	Input power	Efficiency %
Light	6.93A	0.00A	0.00A	0.00A	2.60A	2.60A	0.08A	0.00A	0.46A	108.92	127.6	85.36%
	12.07V				3.38V	5.09V	-11.49V		5.06V			
30%	10.40A	0.00A	0.00A	0.00A	3.90A	3.90A	0.12A	0.00A	0.69A	163.18	186.9	87.31%
	12.06V				3.37V	5.08V	-11.49V		5.05V			
40%	13.87A	0.00A	0.00A	0.00A	5.20A	5.20A	0.15A	0.00A	0.92A	217.37	247.1	87.97%
	12.05V				3.37V	5.07V	-11.49V		5.03V			
Typical	17.33A	0.00A	0.00A	0.00A	6.50A	6.50A	0.19A	0.00A	1.16A	271.24	308.8	87.84%
	12.03V				3.36V	5.06V	-11.51V		5.03V			
60%	20.80A	0.00A	0.00A	0.00A	7.80A	7.80A	0.23A	0.00A	1.39A	325.11	370.7	87.70%
	12.02V				3.35V	5.05V	-11.52V		5.02V			
70%	24.27A	0.00A	0.00A	0.00A	9.10A	9.10A	0.27A	0.00A	1.62A	378.95	435	87.12%
	12.01V				3.35V	5.04V	-11.53V		5.01V			
80%	27.73A	0.00A	0.00A	0.00A	10.39A	10.39A	0.31A	0.00A	1.85A	432.32	500.1	86.45%
	11.99V				3.34V	5.03V	-11.53V		5.01V			
90%	31.20A	0.00A	0.00A	0.00A	11.69A	11.69A	0.35A	0.00A	2.08A	485.47	567	85.62%
	11.97V				3.33V	5.02V	-11.53V		4.99V			
Full	34.66A	0.00A	0.00A	0.00A	12.99A	12.99A	0.39A	0.00A	2.31A	538.69	634.9	84.85%
	11.95V				3.34V	5.01V	-11.54V		4.98V			





FSAK540C Efficiency Report @230V

	TOTAL 540W											
	TOTAL 540W				TOTAL 140W		6.00W	0.00W	15.00W	701.00		
O/P Voltage	12	12	12	12	3.3	5	-12	-5	5			
O/P Current	45.0A	0.0A	0.0A	0.0A	24.0A	24.0A	0.5A	0.0A	3.0A			
O/P Wattage	540W	0W	0W	0W	79.2W	120W	6.0W	0.0W	15W			
Ratio	+12V1	+12V2	+12V3	+12V4	+3.3V	+5V	-12V	-5V	+5VSB	Output power	Input power	Efficiency %
Light	6.93A	0.00A	0.00A	0.00A	2.60A	2.60A	0.08A	0.00A	0.46A	108.91	126.3	86.23%
	12.07V				3.38V	5.09V	-11.51V		5.05V			
30%	10.40A	0.00A	0.00A	0.00A	3.90A	3.90A	0.12A	0.00A	0.69A	163.22	184.1	88.66%
	12.06V				3.38V	5.08V	-11.50V		5.05V			
40%	13.87A	0.00A	0.00A	0.00A	5.20A	5.20A	0.15A	0.00A	0.92A	217.19	242.8	89.45%
	12.04V				3.36V	5.07V	-11.50V		5.04V			
Typical	17.33A	0.00A	0.00A	0.00A	6.50A	6.50A	0.19A	0.00A	1.16A	271.16	301.8	89.85%
	12.03V				3.35V	5.06V	-11.51V		5.02V			
60%	20.80A	0.00A	0.00A	0.00A	7.80A	7.80A	0.23A	0.00A	1.39A	325.02	361.7	89.86%
	12.02V				3.34V	5.05V	-11.52V		5.01V			
70%	24.27A	0.00A	0.00A	0.00A	9.10A	9.10A	0.27A	0.00A	1.62A	378.95	423.6	89.46%
	12.01V				3.35V	5.04V	-11.52V		5.01V			
80%	27.73A	0.00A	0.00A	0.00A	10.39A	10.39A	0.31A	0.00A	1.85A	432.31	485.3	89.08%
	11.99V				3.34V	5.03V	-11.53V		5.00V			
90%	31.20A	0.00A	0.00A	0.00A	11.69A	11.69A	0.35A	0.00A	2.08A	485.33	548.5	88.48%
	11.97V				3.32V	5.02V	-11.53V		4.98V			
Full	34.66A	0.00A	0.00A	0.00A	12.99A	12.99A	0.39A	0.00A	2.31A	538.78	611.9	88.05%
	11.96V				3.32V	5.01V	-11.55V		4.98V