

DC UPS vs AC UPS - Economy comparison – XiV

Description	Servers	Power	AC UPS			DC UPS		
			Efficiency	Total Power	Losses	Efficiency	Total Power	Losses
	Qty	W	%	kW	kW	%	kW	kW
Power consumption by servers (PSU on 5 o 12 V)=	15	350		5,3			5,3	
Input power to server PSU			74,0%	7,1	1,8	93,0%	5,6	0,4
Power to AC UPS vs DC UPS			91,0%	7,8	0,7	96,5%	5,8	0,2
Power for Cooling			35,0%	2,7		35,0%	2,0	
Power from transformer				10,5			7,9	
Price per kWh	EUR	0,15	Total kWh/y			Total kWh/y		
kWh per year	Hrs.	8760	92199			69181		
EUR			Savings			Savings:		
Energy cost per year AC UPS	13830		%			EUR/y	kWh/y	Tons CO2/y
Energy costs per year DC UPS	10377		25%			3453	23018	23

Excel spreadsheet available at: www.netpower.se

25% Energy Savings!

Solar installation Eskilstuna

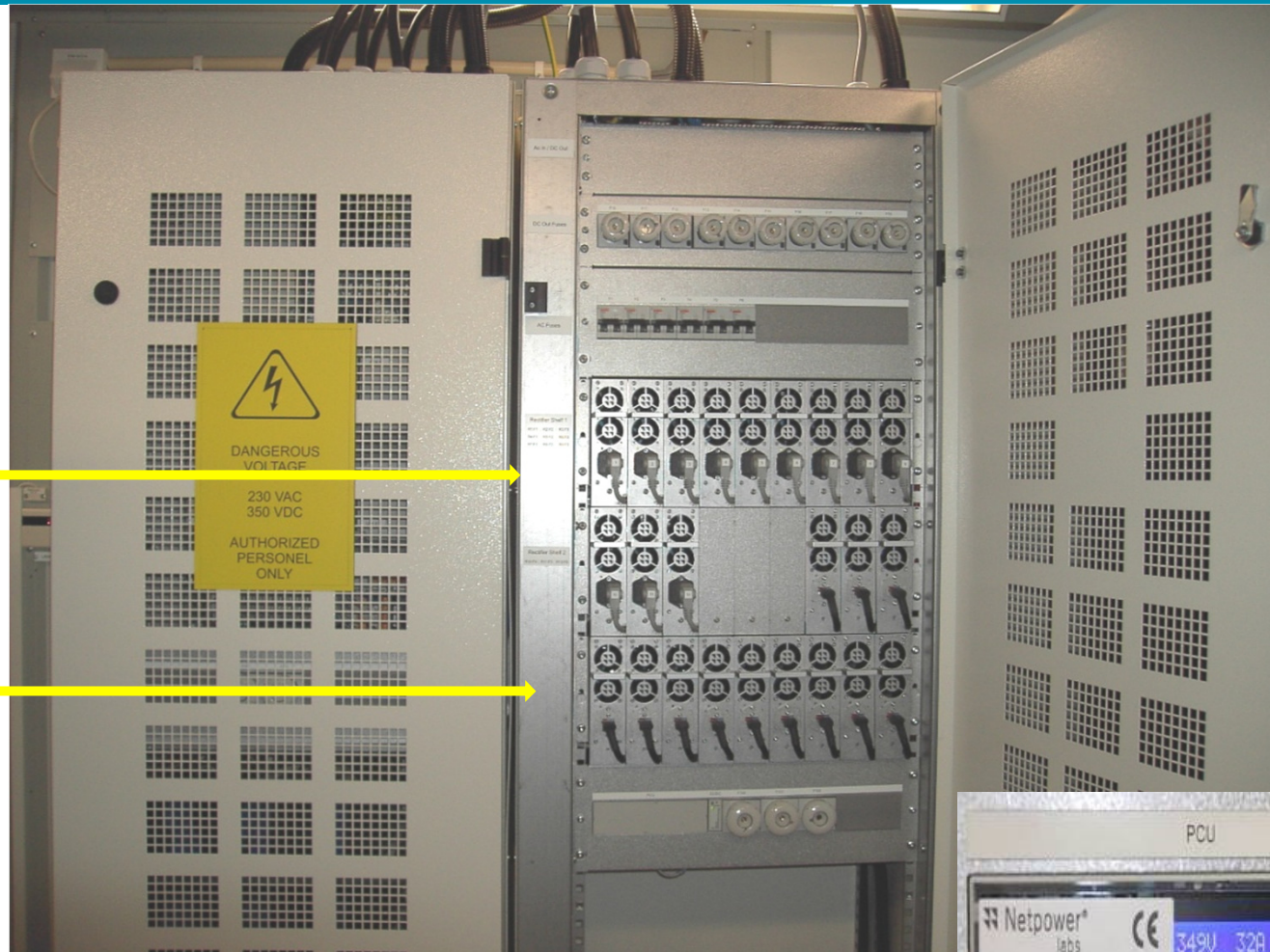


UPS DC + Solar

Rectifiers

Solar regulators

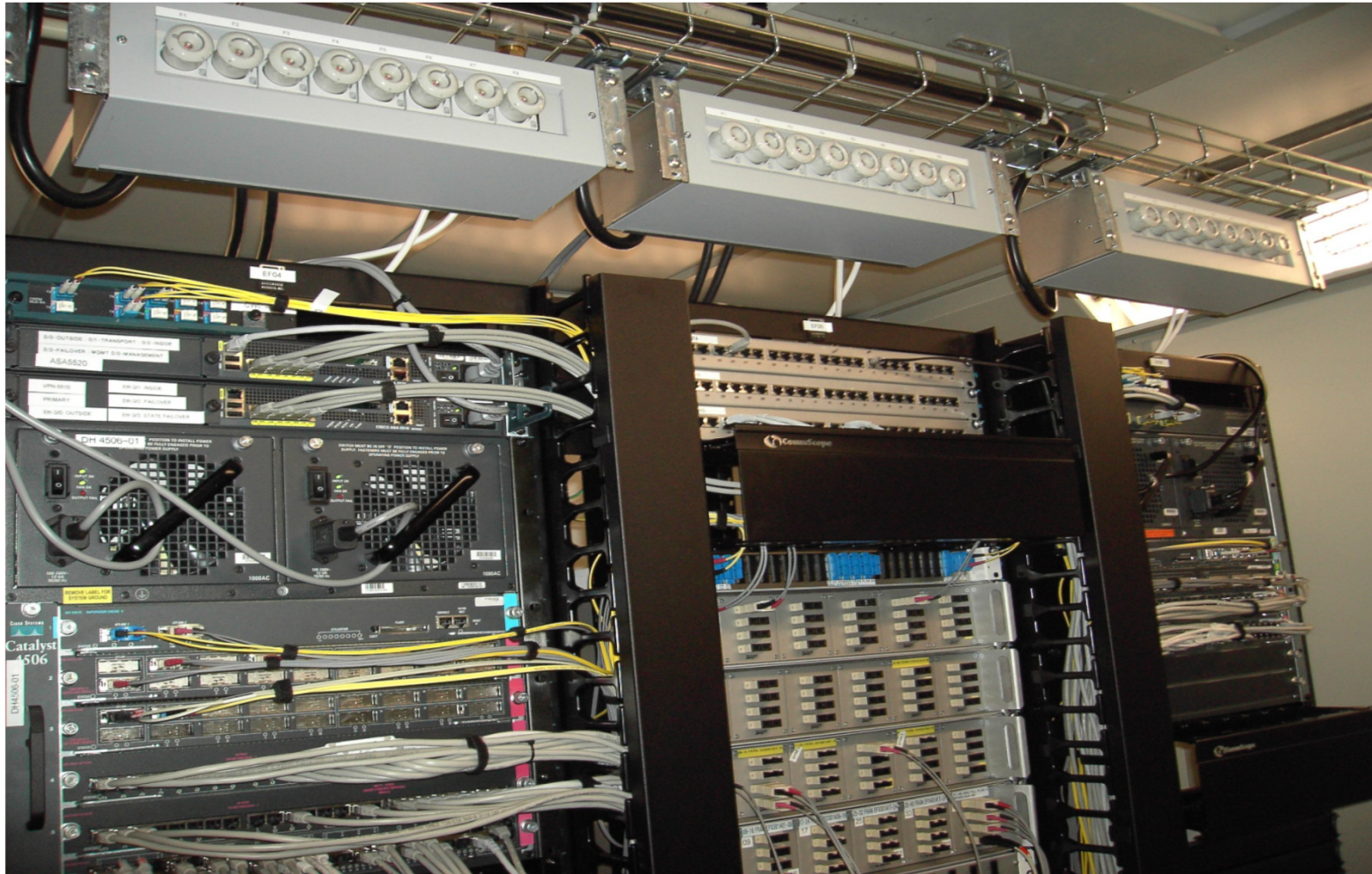
Total
Modularity!



 **Netpower®**
labs

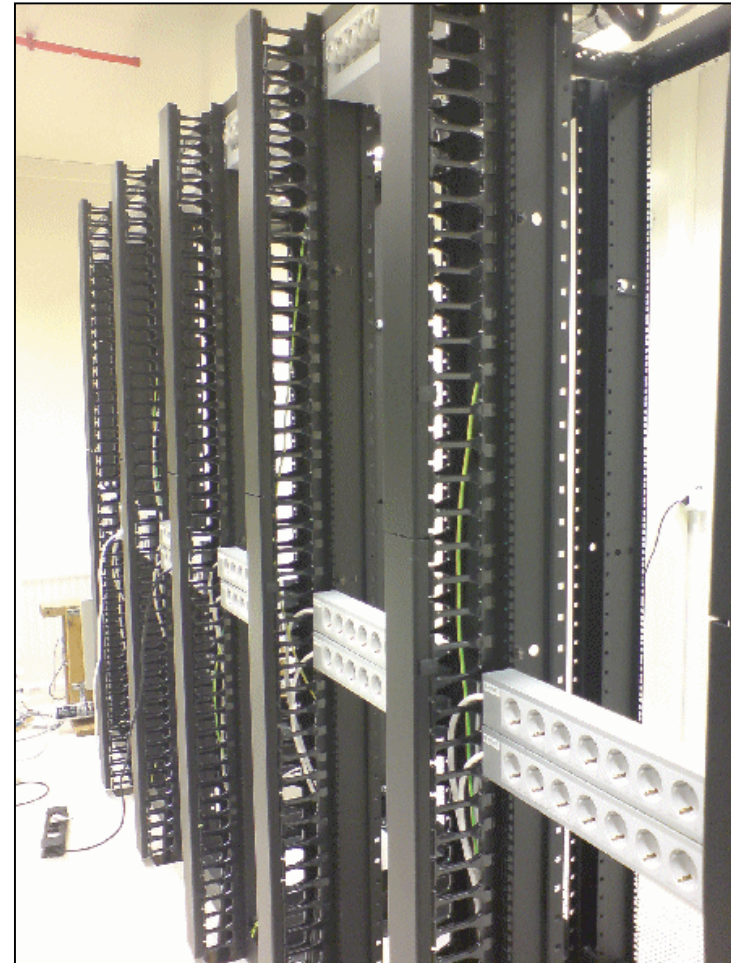


DC Distribution with AC PSU



References

- Gnesta Municipality, Sweden – Server Room
- EliCom, Sweden – Server Room, All Office PC
- NTT, Japan – Lab
- France Telecom, France – Lab
- Ericsson AB, Sweden – Lab
- Söderhamn Tech park, Sweden – TV/City net
- Compare Competence Area ICT, Sweden – Internal
- Swedish Energy Agency, – Data Centre
- Compare, Sweden – Data Centre
- Swedish Energy Agency, – Data Centre
- Fastighet AB Stubbsund, – Server cabinet
- IBM - DC in Storage XIV (Evaluation)
- Interpower , Korea – Lighting (LED), Monitors, Computers



Global Standard



ETSI EN 300 132-3-1 V2.1.1 (2012-02)



Draft ETSI EN 301 605 V1.1.1 (2013-01)



Environmental Engineering (EE);
Power supply interface at the input to telecommunications and
datacom (ICT) equipment;
Part 3: Operated by rectified current source, alternating
current source or direct current source up to 400 V;
Sub-part 1: Direct current source up to 400 V

Environmental Engineering (EE);
Earthing and bonding of 400 VDC data and telecom
(ICT) equipment

380V HVdc 全球規範

- ETSI (European Telecommunications Standards Institute;歐洲電信標準協會)
 - EN 3001320301 V2.1.1 2012-02 正式公布400V HVdc標準
“Direct current source up to 400V”
 - EN 301 605 V1.1.1 – ETSI於2013年一月份草擬 400V HVdc資料與通信設備的接地與保護標準 ” Environmental Engineering (EE); Earthing and bonding of 400VDC data and telecom (ICT) equipment” 並知會與詢問國際間各協會，2013年十月份已正式發布為正式的歐盟規範
- ITU (International Telecommunication Union;國際電訊聯盟) 2012-5月正式建議 400V HVdc標準
 - Recommendation ITU-T L.1200-” Direct current power feeding interface up to 400V at the input to telecommunication and ICT equipment”

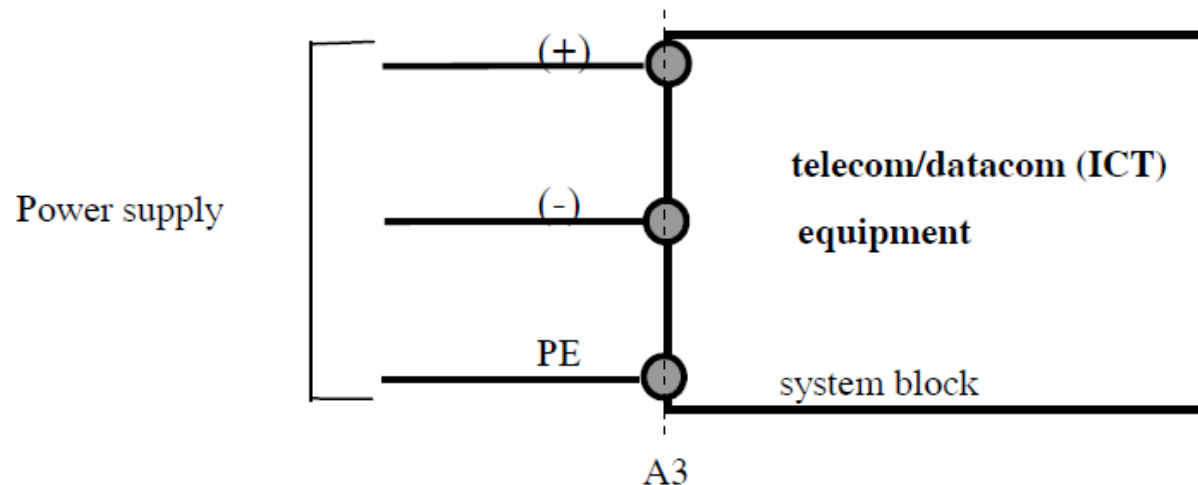
ETSI 與 ITU hvDC 標準

EN 3001320301 定義 hvDC 系統標準

- Minimum voltage : 260V DC
- Maximum voltage : 400V DC
- Normal operating voltage: 354V(156 cells) 與 380V DC(168 cells)

– A3介面最低電壓

– A3介面最高電壓



(+) Positive DC terminal.
(-) Negative DC terminal.
PE Protective Earth.

Figure 1: General identification of the interface A3

ETSI EN 301 605 接地與保護標準

EN 301 605 建議兩種接地系統

- TN-S 接地系統: Netpower 採用，可靠、安全與易於使用及維護
- IT 高阻抗中性點接地系統 - 伴隨接地錯誤警報

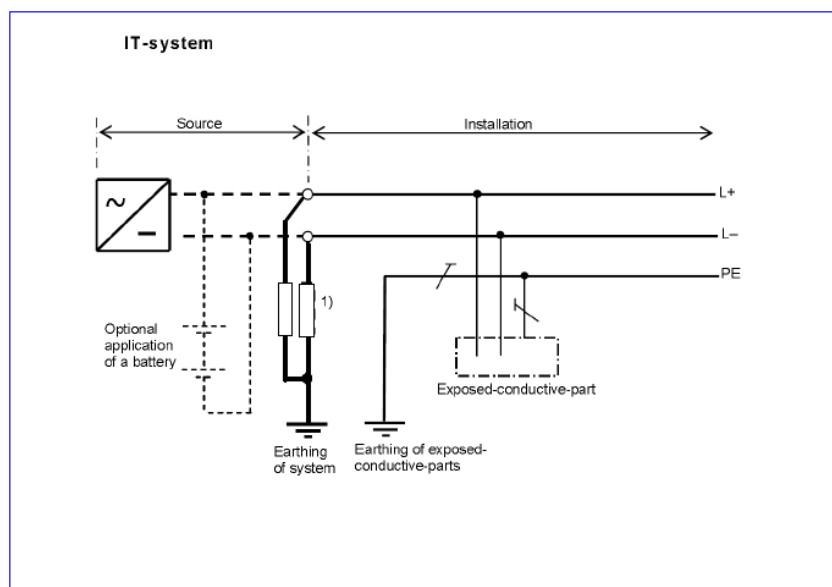


Figure 2: IT system with earthed high-ohmic mid-point terminal (MP)

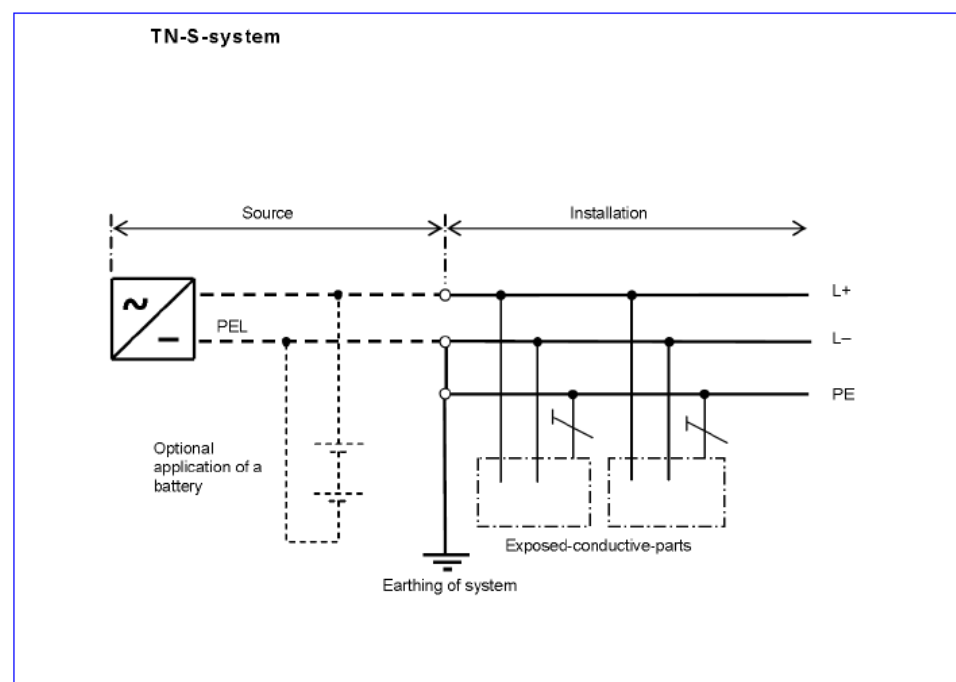


Figure 4: TN-S system with earthed negative line terminal (L-)

ICT hvDC Ready!!

NEC 發表第一台380VDC blade server

The industry's first blade servers that support high-voltage DC power supply systems "Express5800/SIGMABLADE-M (compatible DC380V)" ~ HVDC 380V power supply system in response to the sale, up to ~ 20% reduction of data center power consumption

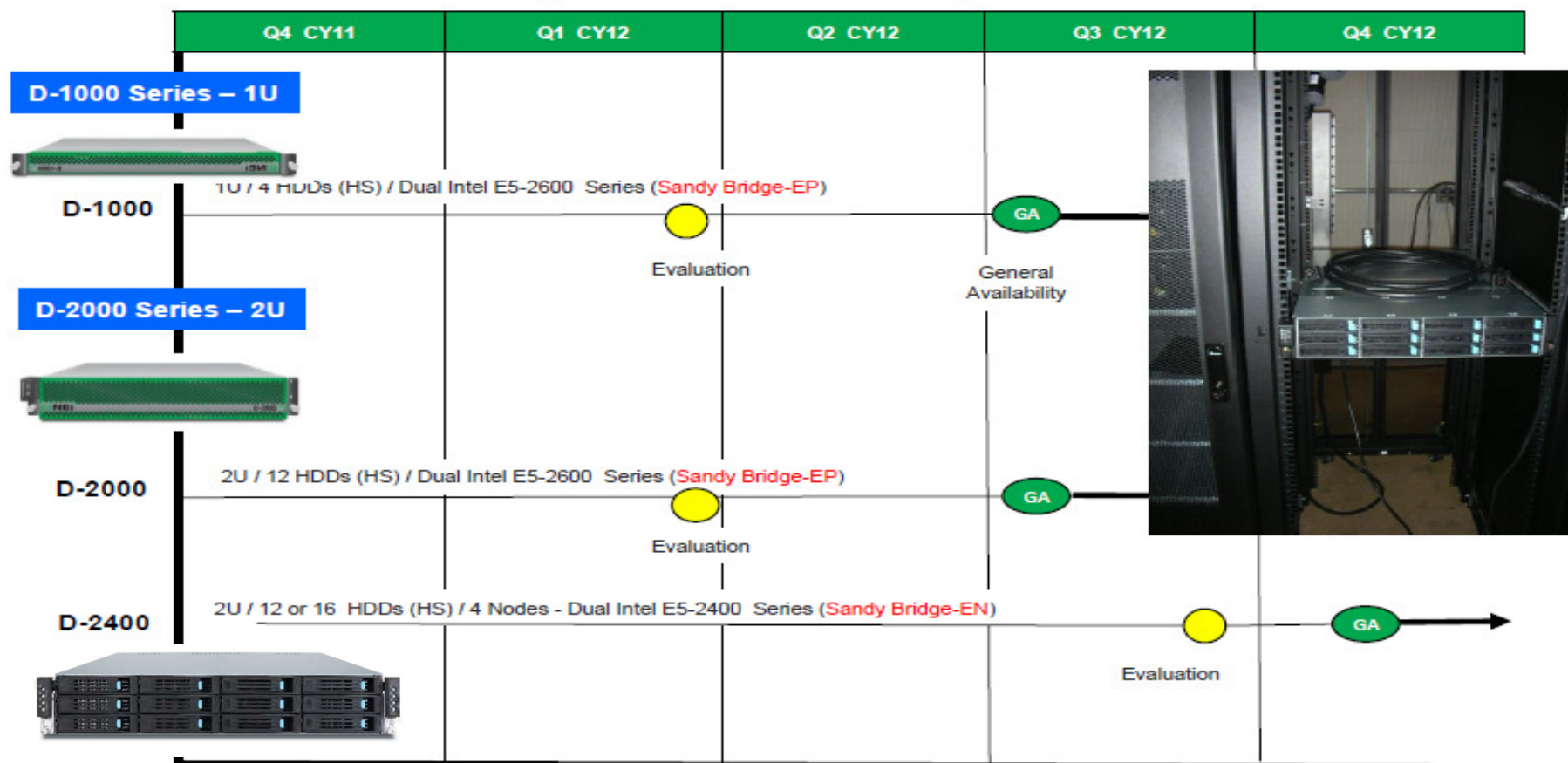
Nippon Electric Co., Ltd. December 15, 2011



"Express5800/SIGMABLADE-M (compatible DC380V)"
<Express5800Ni関Suru情報発信>

UNICOM 發表三系列 380VDC 伺服器

D-Series (380VDC) Platforms



StarLine 380VDC Busway

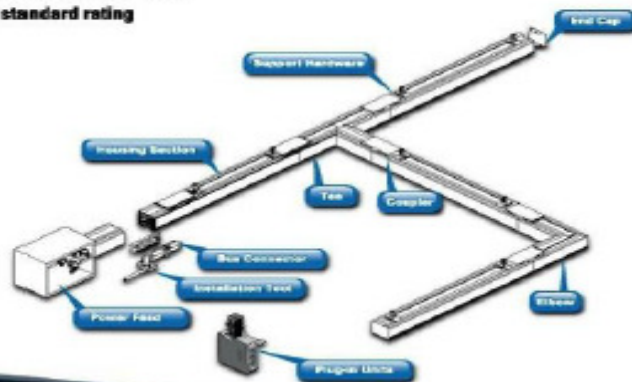
380V DC SAVES! & THE ADVANTAGE OF BUSWAY

STARLINE
TRACK BUSWAY



Technical Specifications

- 400 amps, 600 volts A.C. or D.C.
- 4 Poles with optional isolated ground
- 150% super-Neutral option
- UL and CUL Listed, CE Compliant
- Meets UL 857 and NEC Sec. 250
- Tin plated solid copper busbars
- Spring-pressure busbar and plug connection design (U.S. Patent #6,039,584)
- 10 ft, 5 ft and custom lengths
- 22kAIC standard rating



400A BUSWAY DISTRIBUTION COMPARISON

- 208V AC @ 400A = 144kVA/130kW (0.9pf)
- 415V AC @ 400A = 287kVA/258kW (0.9pf)
- 380V DC @ 400A = 152kVA X 2 = 304kVA/Kw (1.0pf)

AN OBSERVATION:

- 380V DC ALLOWS FOR MORE POWER DELIVERY THAN AC ON THE SAME AMOUNT OF COPPER!



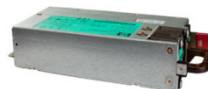
STARLINE
DC SOLUTIONS

HP HVDC 1200W 電源供應器已上市

Power Supply

HP 1200W Common Slot HVDC Power Supply

- **94% efficiency**
- Wide-ranging – 240V to 380V
- APP Saf-D-Grid Connector



HP 2400W HVDC Power Supply

- **94% efficiency**
- **Wide-ranging – 240V to 380V**



HP Platforms

HP Common Slot compatible platforms

- HP ProLiant DL, ML, SL
- HP BladeSystem c3000
- HP Storage (~20 platforms)
- HP Networking



HP blade-based platforms

- **HP BladeSystem c7000**
- HP Integrity Superdome 2



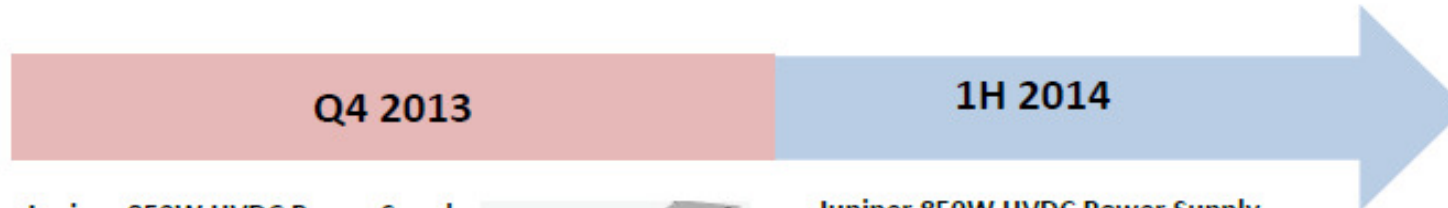
Power Infrastructure

1H 2013

2H 2013

HVDC Power Infrastructure

Juniper 380VDC Networking Product Plans



Power Supply

Juniper 850W HVDC Power Supply

- 94% efficiency
- Wide input range – 240V to 380V
- APP Saf-D-Grid Connector
- cTUVus listed



Juniper 850W HVDC Power Supply

- 94% efficiency
- Wide input range – 240V to 380VDC
- APP Saf-D-Grid Connector

Platforms

Juniper Data Center Platforms

- Top of Rack (TOR)
- EX4550 960 G-bits, 48 dual-speed GbE/10GbE ports with Virtual Chassis



- QFX3500 960M-bits, 48x10GbE, 4x40GbE, FCoE, iSCSI support
- QFX3600 1.28T-bits, 64x10GbE or 16x40GbE, FCoE, iSCSI support

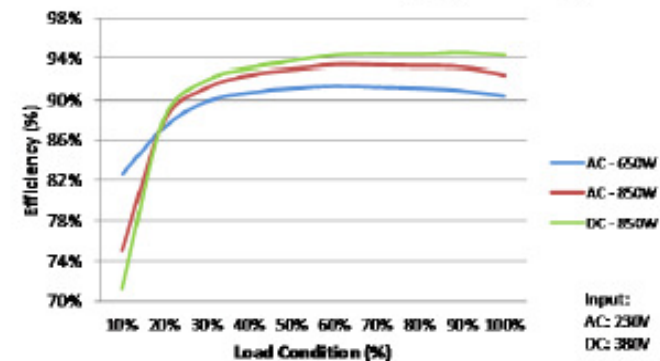


QFX3600-I micro-Fabric (5.12T-bits)

- Interconnects QFX3600s to support 16 racks of servers and storage
- QFX3600-I 1.28T-bits, 64x10GbE or 16x40GbE, FCoE, iSCSI support



Network Switch Power Supply Efficiency



INTELEC(r) 2013 • 13. - 17. October 2013, Hamburg - © VDE VERLAG GMBH • Berlin • Offenbach

最新hvDC供電 IDC – Zurich West

- May 30, 2012 發表
- 最新hvDC IDC座落在瑞士蘇黎世
- 1MW hvDC 配電 1,100 平方米機房擴充
- DC vs. AC 單電力配電效率提升 **10%**,從市電端到伺服器運算晶片耗能節省**20%以上**
- 佔地面積節省**25%**
- 節省設備、安裝與維護成本
- HP 提供hvDC DL385伺服器、HP X1800 G2網路儲存系統、BladeSystem c3000刀鋒伺服器, 所有ICT設備皆支援380V DC供電



HP 觀點 – 為何使用高壓直流電力 (hvDC) ?

CapEx Reductions	• Elimination of Inverters, PFC correction in PS • Reduced copper in distribution	Up to 15% Savings
OpEx Reductions	• Conversion efficiency gains of 5-10% • Lower operational and maintenance cost, 33% • Reduced distribution losses of 2% • Reduced heat dissipated on the data center floor • Increased reliability, 200% plus increase	Up to 35% Savings
Space Reductions	• Reduced power conversion volume at compute node by 50% • Reduced data center footprint, 25-33% savings	Up to 25% Savings
Power Quality Improvements	• Eliminates phase balance issues from single phase equipment • Harmonics controlled at the hvDC conversion • Ease of interconnect to alternative energy sources • Ease of connection to back up sources	

HP hvDC 電源供應器套件價格 \$449美元

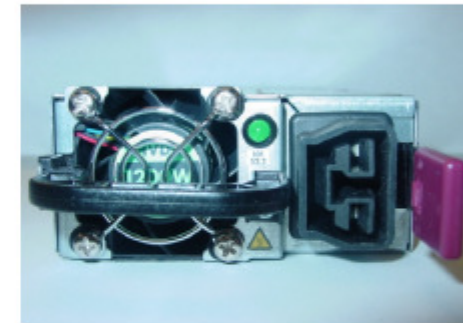
What's New: HP 1200W CS 380VDC Power Supply

Product overview:

Industry-first, mainstream power supply to support higher voltage (240V – 380V) DC power input.

Ideal for:

ProLiant Gen8 customers that require a higher voltage DC (direct current) power input in their data centers.



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100~240V AC PSU Kits **US\$379**
-48V DC PSU Kits **US\$699**

直流 VS. 交流供電分析

交流/直流供電分析 - 2

■ 建設成本(EMPx1，IN/OUTx1，PDU或PDFx2)

項 目	交流UPS 傳統並聯式	交流UPS 模組式	直流SMR 模組化	HVDC UPS 模組化
建設成本(含電池)	16,590,000元	10,525,000元	10,950,000元	13,040,000元
每kW費用(含電池)	38,402元	42,100元	47,608元	48,296元
設備佔用空間 (含輸出入盤)	6.4平方公尺	3.52平方公尺	5.12平方公尺	3.2平方公尺
電池佔用空間	7.7平方公尺	3.85平方公尺	6.24平方公尺	3.65平方公尺
管線器材費用	1,140,000	730,000	1,500,000	650,000

交流/直流供電分析 - 3

■ 用電比較(3.5元/度)

項 目	交流UPS 傳統式	交流UPS 模組式	直流SMR	HVDC UPS 模組化
設備效率 (一般模式)	≥ 90%	≥ 95%	≥ 91%	≥ 97%
系統效率 (含PSU/伺服器)	65%	68%	71%	78%
用電量/年	1, 497, 436度	1, 356, 037度	1, 355, 827度	1, 125, 512度
電費/年	\$5, 241, 026	\$4, 746, 130	\$4, 745, 395	\$3, 939, 292

PSU費用(HP)

10台/RACK

x20台xNT

\$2, 274, 000

\$2, 274, 000

\$4, 194, 000

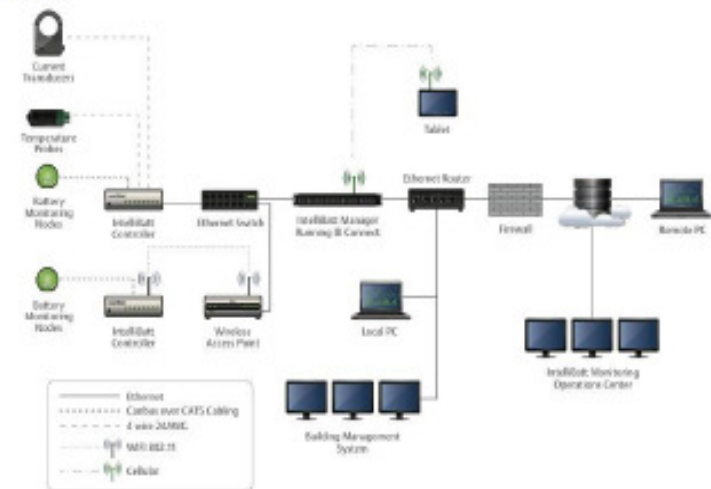
\$2, 694, 000

電池監控系統 BMS



Canara Product Features

- One node per battery
- Battery health visual LED light display
 - Green: Healthy
 - Yellow: Trending
 - Red: Critical
- Individual cell temperature monitoring at negative post
 - Recommended by IEEE-1491
- AC Ripple monitoring
 - AC Ripple can cause heating, gassing and high frequency cycling
- Data collection @ 4 times/day
- Float Voltage Balancing
- Wifi Networking
- Weekly battery assets report
- Remote monitoring service



Competitive Overview

Features	Canara	Alber	B-Tech	Cellwatch	Power Shield
Measurement frequency	4/day	1/month	1/week	1-2/day	1/day
Test load to battery ratio	1:1	1:10	1:24	1:4	1:2
System voltage	✓	✓	✓	✓	✓
Individual voltage during discharge	✓	✓	✓	✓	✓
Individual battery voltage	✓	✓	✓	✓	✓
Individual battery ohmic	✓	✓	✓	✓	✓
Ambient temperature	✓	✓	✓	✓	✓
Extend to Genset/substation/switchgear monitoring	✓	-	-	✓	-
Float current	✓	✓	-	-	-
Single point testing (avoids data skewing)	✓	-	-	-	-
Communication redundancy (Canbus)	✓	-	-	-	-
Individual battery temperature	✓	-	-	-	-
AC ripple (Capacitors/Rectifier issues)	✓	-	-	-	-
Visual state of health	✓	-	-	-	-
Cell/block voltage balancing	✓	-	-	-	-
Local Monitoring	✓	✓	✓	✓	✓
Cloud-based monitoring service	✓	-	-	-	-

Thank You.



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