



## 1.0 INTRODUCTION

The purpose of this document is to specify the general requirements of a single-phase AC/DC, 50-Watt (50W across full temperature range) output power supply with the DC voltage output: 48V. The power supply shall operate between 90VAC and 264VAC.

## 2.0 AC INPUT REQUIREMENTS

### 2.1 INPUT VOLTAGE AND FREQUENCY

The power supply shall meet all specifications when powered from the following AC sources.

Parameter	Minimum	Nominal	Maximum
Voltage Range	90 VAC	100-240 VAC	264VAC
Line Frequency	47Hz	50-60Hz	63Hz
Input current	--	--	1.3A

Table 1: Input Voltage and Frequency

### 2.2 COLD STARTUP

The power supply shall be designed and tested to start up at all line voltages under nominal conditions per this specification, such as low temperature and full load.

### 2.3 AC INRUSH CURRENT

Under worst-case conditions, peak inrush current at cold turn-on shall not open line fuse/breaker, rectifier diode or cause permanent damage to the supply. The current spike caused by charging of EMI filter capacitor shall be ignored..

### 2.4 HOLD UP TIME

Output voltage will hold 10 ms at 100Vac/50Hz (cut off at 0° phase angle) and maximum load at room temperature. Hold up time is measured from when the line shut off to the drop of 48V below 45.6V

### 2.5 INPUT LEAKAGE CURRENT

The leakage current, measured per applicable safety standards, shall be 3.5mA maximum.



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ADP-50GR BDA

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## 2.6 BROWN OUT

The AC adapter shall not be damaged if the input voltage drops below the minimum low line voltage specified in Table 1.

## 2.7 LINE VOLTAGE SURGE AND SAG

AC line transient conditions are defined as ‘sag’ and ‘surge’ conditions. ‘Sag’ conditions also commonly referred to as ‘brownout’; these conditions are defined as the AC line voltage dropping below nominal voltage conditions. ‘Surge’ is defined to refer to conditions when the AC line voltage rises above nominal voltage. The power supply shall meet the requirements under the following AC line sag and surge conditions.

### AC Line Sag Transient Performance:

Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltage	50/60 Hz	No loss of function or performance
0 to ½ AC Cycle	100%	Nominal AC Voltages	50/60 Hz	No loss of function or performance
>1 AC cycles	>10%	Nominal AC Voltages	50/60 Hz	Loss of function acceptable, self recoverable

### AC Line Surge Transient Performance:

Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60 Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60 Hz	No loss of function or performance

Table 2 Line Voltage Surge and Sag


## 2.8 EFFICIENCY REQUIREMENT

The 115V & 230V efficiency should meet EU Lot-7 tire 4 request.  
(Eff > 89% / No load < 0.15W)

## 3.0 OUTPUT REQUIREMENTS

### 3.1 OUTPUT VOLTAGE AND CURRENT

The output shall remain within the tolerance defined in the table below under all combinations of line variation per Table 1, load variation per Table 3 below and environmental conditions. Total steady state system consumption per supply shall not exceed 50W

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Output	48V
Voltage (VDC)	+48.0
Tolerance (% & Vdc)	±5% (45.6~50.4)
Min. Current (A)	0
Max. Current (A) @ 0°C ambient	1.042
Max. Current (A) @ 25°C ambient	1.042
Max. Current (A) @ 45°C ambient	1.042

Table 3: Output Voltage and Load

### 3.2 RIPPLE AND NOISE

Ripple and Noise shall not exceed 250mVp-p as measured at the power supply output connector at minimum and maximum loads.

3.2.1 This measurement shall be taken at room temperature.

3.2.2 The ripple noise shall be within the limits from DC to 20MHz bandwidth.

3.2.3 Applied 47uF tantalum capacitor and 0.47uF ceramic capacitor at each output connector terminals.

3.2.4 Minimum load capacitance shall be zero and maximum load capacitance shall be 220uF for 48V output.

Common-mode noise coupled from AC side through the Y-cap from primary side return to secondary return shall be less than 50mVpp per IEEE 802.3 specification clause 40.8.3.3 for Gigabit Ethernet.


### 3.3 OVERSHOOT AND UNDERSHOOT

At turn on/off, the output voltages shall not overshoot 60V.

### 3.4 DYNAMIC RESPONSE

The output voltage shall stay within regulation band as specified in above for a 25% step load change at 1A/us from 25% load. The test frequency should be 20Hz/100Hz,50% duty. Load capacitance is defined below.

Minimum load capacitance shall be zero and maximum load capacitance shall be 220uF for 48V

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output.

### 3.5 TURN-ON DELAY and RISE TIME

The elapsed time between the application of input power and the attainment of output voltages to their nominal values shall not exceed 3 second. Rise time shall be 30ms maximum. Rising edge of the output shall be monotonic.

### 3.6 NOISE COUPLING EVALUATION

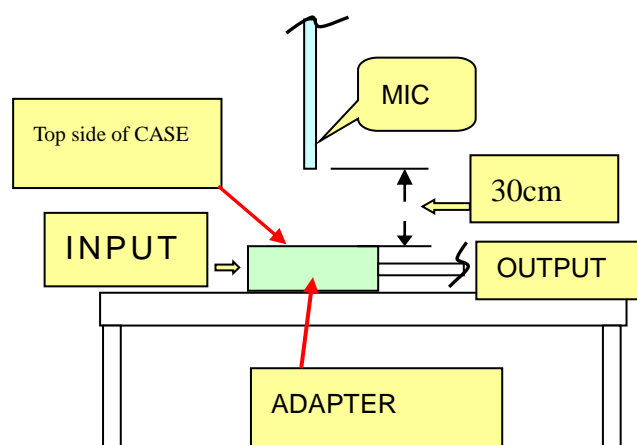
In a typical IP telephony installation, a call will be established. During the call, the handset cable will be tightly grasped by the user's hand. The remote station will evaluate power line noise injected into the call. This test will be performed in 110 VAC / 60 Hz installations and 240 VAC / 50 Hz installations with both handsets and approved IP phone headsets. This will be a subjective test in addition to the measurement stated below.

CM noise:

Output ripple voltage vs. earth ground to be 10.0Vpk-pk maximum, measured between the earth ground and either output without load at 264VAC / 50Hz

### 3.7 ACOUSTIC NOISE

The AC Adapter shall produce no human perceivable audible noise (less than 30dB at 30cm).



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### 3.8 PROTECTION FEATURES

#### 3.8.1 Shorted Output

The power supply shall withstand a continuous short circuit with no permanent damage. The power supply must not be damaged with the output shorted prior to power on at any line condition. A short is defined as impedance as less than 50mohms (0.050Ω). The power supply shall automatically restart when shorts to ground are removed.

#### 3.8.2 Over Current and Overpower Protection

The power supply shall be hiccupped when operating any output in overload condition. The maximum output current will limited to be less than 2A.

#### 3.8.3 No Load Protection


The power supply shall not suffer damage if the output has no load. The output shall remain < 105% of the maximum voltage rating in Table 3 under a no load condition.

#### 3.8.4 Over Voltage Protection (OVP)

The power supply shall not suffer damage and shall shut down in less than 2ms if any of its outputs reaches 125% of its nominal voltage. Upon removal of over voltage, it shall stay latched off until its input power is cycled.

#### 3.8.5 Over Thermal Protection

The power supply shall shut down to protect its components due to excessive internal temperature. The power supply shall either automatically restart if the internal temperature returns to a safe operating level.

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#### 4.0 ENVIRONMENTAL

##### 4.1 OPERATING

The power supply shall be capable of operating continuously in any mode without performance deterioration in the following environmental conditions.

4.1.1 Ambient Temperature: 0°C ~45°C

4.1.2 Relative Humidity: 10% ~ 90%

4.1.3 Altitude: -500 to 10,000 feet.

4.1.4 Cooling: The power supply will operate with convection cooling.

##### 4.2 NON - OPERATING

The power supply shall be capable of withstanding the following environmental conditions extended periods of time, without sustaining electrical or mechanical damage and subsequent operational deficiencies:

4.2.1 Ambient Temperature: -40 °C ~ 85 °C

4.2.2 Relative Humidity: 10% ~ 95%

4.2.3 -1000 to 30,000 feet

##### 4.3. PRODUCTION Hi-Pot

4.3.1 3000Vac or 4242Vdc Hi-Pot Test from primary to secondary for a minimum of one second.

The leakage current trip setting on the hi-pot tester must not be higher than 10mA.

#### 5.0 REGULATORY AND COMPLIANCE REQUIREMENTS

##### 5.1 SAFETY COMPLIANCE

###### General:

The supplier shall obtain the following regulatory approvals for the power supply as a stand-alone unit. The power supply shall not prevent the end product from passing all applicable safety requirements. The supplier shall demonstrate initial and continued compliance to the following standards, each based on the latest revision. All approvals must be obtained under worst-case environmental conditions detailed elsewhere in this specification. The power supply vendor shall



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10/22/'19	呂麗容	許家豪	潘懷哲	ES-50GR BDA	S00

obtain and maintain all approvals; approvals shall be in the name of the power supply vendor, but the only company name on the product shall be Cisco Systems.

The power supply will be sold all countries and needs to have world-wide approvals as below:

Product Safety	Type of Approval	Standards	Level/Class
Europe	CE	EN 60950-1 and EN 62368-1	
USA	UL or CSA NRTL	UL 60950-1, and UL 62368-1	
Canada	cUL or CSA	CSA 60950-1-07 and CSA 62368-1	
China	CCC	GB4943.1	
Taiwan	BSMI	CNS14336-1	
Japan	PSE		
South Korea	KC		
Singapore	PSB		
Australia/New Zealand	RCM/E134		
Russia, Belarus, Kazakhstan	EAC	CU-TR 004/2011 CU-TR 020/2011	
India	BIS	IS 13252(Part-1):2010	
Mexico	NOM		
Argentina	S-Mark		
South Africa	NRCS LoA		

## 5.2 ELECTROMAGNETIC COMPATIBILITY (EMC)

	<p><b>Emissions</b>  FCC Part 15 (CFR 47) Class B }  ICES-003 Class B }  EN55022 Class B } 4dB margin w/unshielded cables  CISPR22 Class B } (Without GND)  AS/NZS CISPR22 Class B }  VCCI Class B }  KN22 Class B * }  CNS13438 Class B }</p> <p><b>Immunity</b>  EN55022</p>
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	EN55024 ** EN61000-3-2 (Not needed for this project because input power < 75W) EN61000-3-3 EN61000-6-1 EN60601-1-2
<b>EN55024 Requirements</b>	<b>Quality levels</b>
EN61000-4-2 ESD	6kV contact, 8kV air
EN61000-4-3 RS	10V/m, 80MHz – 2.5GHz
EN61000-4-4 EFTB	2kV AC mains (w/100kHz rep freq)
EN61000-4-5 Surge	2kV(2ohm)diff, 4kV(12ohm)comm
EN61000-4-6 CS	10Vrms
EN61000-4-8 MS	30A/m at 50 and 60 Hz
EN61000-4-11 VDI	30% for 10ms, 60% for 100ms, >95% for 5s, >95% for 10ms, 30% for 500ms
EN61000-4-11 VDI *	>95% 0.5 Periods (8.3ms), 30% for 30 Periods (500ms), >95% for 300 Periods (5s)
	* Conducted emissions on the AC mains and VDI will also be done at 220VAC/60Hz.
<b>Additional Immunity Requirements</b>	FCC Part 68 (CFR 47) Sec 68.302

### 5.3 RoHS 6

The unit shall be RoHS 6(lead free) compliant to the requirements of European Union's Restriction on use of hazardous substances in Electrical and Electronics Equipments (RoHS 6) Directive 2002/95/EC.


## 6.0 RELIABILITY AND QUALITY

### 6.1 RELIABILITY

When the power supply is operating within the limits of this specification the MTBF shall be at least 300,000 hours at 25°C (Bellcore).

### 6.2 ELECTROLYTIC CAPACITOR LIFE

The predicted electrolytic capacitor life shall be a minimum of 3 years at 45°C ambient, half load and 24 power-on hours per day and 365 days per year. E-cap case temperature shall be used for

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the life calculation. Input voltage would be 100Vac / 240V.

### 6.3 HALT/ STRIFE

Supplier shall perform HALT test (based on Cisco's HALT/STRIFE test plan EDCS-617316) during the engineering evaluation stage. Any deviation from this document supplier should submit the HALT test plan to Cisco for approval prior to execution.

### 6.4 HTOB Test

This is a Reliability Grade B (consumer) product, Cisco require IPC-9592B 1000 Hours HTOB test on 3 samples. This is not to demonstrate the DMTBF, but just a small very small sample size for 1000 hours.

### 6.5 Failure Mode Effect Analysis (FMEA)

Supplier shall perform FMEA activity (both design and process FMEA) during the design development stage.

### 6.6 ON GOING RELIABILITY TEST


The supplier will test a sample of production units (typically 30) every month under full load, high temperature and power cycling. AC input shall be low line and high line.

### 6.7 BURN IN

Every supply shall be burned in for minimum of 24 hours before shipment to Cisco Systems per the requirements defined in following Table.

Total Duration:	24 hours
Load:	>80% on each output
Temp:	45°C +/- 5°C
Input voltage:	Nominal, 1/2 at low and 1/2 at high range
Power Cycling:	45 min on, 15 min off

Table 4: Burn In Requirements


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10/22/'19	呂麗容	許家豪	潘懷哲	<b>ES-50GR BDA</b>	S00

7.0 Mechanical test

Mechanical Test				
7.1	Ball Impact	For Safety	1. Test height : 130cm. 2. Test place : 1 sample 1 time. 3. Steel ball, weight 0.5kg. 4. Concrete floor.	1. If case has any crack. The golden finger can't touch inside components. 2. Hi- Pot pass. (AC 3000V/1min) 3. Refer to IEC60950 & DELTA document 10000-0173-7b.
		For Reliability	Refer to DELTA document 10000-0258 chapter.4	
7.2	Drop Test	For Safety	1. Drop height : 110cm. 2. Drop test place : 6 faces for each. 3. Concrete floor.	1. If case has any crack. The golden finger can't touch inside components. 2. Hi- Pot pass. (AC 3000V/1min) 3. Refer to IEC60950 & DELTA document 10000-0173-7a.
		For Reliability	Refer to DELTA document 10000-0258 chapter.2	

Product ingress protection (IP) rating : Not requirement

Product Application : Set Top Box

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10/22/'19	呂麗容	許家豪	潘懷哲	<b>ES-50GR BDA</b>	S00