



GS 112-17

Guidance for Specification 112-17

**POWER SUPPLIES FOR
ELECTRONIC EQUIPMENT**

August 1993

Copyright © The British Petroleum Company p.l.c.

All rights reserved. The information contained in this document is subject to the terms and conditions of the agreement or contract under which the document was supplied to the recipient's organisation. None of the information contained in this document shall be disclosed outside the recipient's own organisation without the prior written permission of Manager, Standards, BP International Limited, unless the terms of such agreement or contract expressly allow.

CONTENTS

Section	Page
FOREWORD	ii
1. GENERAL.....	1
2. STANDARD DESIGN CONDITIONS.....	1
3. NON STANDARD DESIGN CONDITIONS	5
4. DOCUMENTATION	5
4.1 Data Sheet	5
4.2 Disturbances	6
DATA SHEET - POWER SUPPLIES FOR ELECTRONIC EQUIPMENT	7
APPENDIX A.....	8
DEFINITIONS AND ABBREVIATIONS	8
APPENDIX B.....	9
LIST OF REFERENCED DOCUMENTS	9



FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

- (i) To ensure that all possible power supply variations are fully understood and detailed.
- (ii) To avoid electronic system operation instability or failure due to power supply conditions which were not declared at enquiry or purchase stage

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Specification Ready for Application

A Specification (BP Spec 112-17) is available which may be suitable for enquiry or purchasing without modification. It is derived from this BP Group Guidance for Specification by retaining the technical body unaltered but omitting all commentary, omitting the data page and inserting a modified Foreword.



Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. GENERAL

- 1.1 In order for this Specification to be effective it is vital that both the purchaser of the electronic equipment and the supplier of the equipment complete the Data Sheet which forms an integral part of this document. Any omission of information should be drawn to the attention of the offending party by the second party.
- 1.2 In the event that available power supplies are not suitable for the equipment to be supplied this must be drawn to the attention of the purchaser so that other arrangements can be considered.

2. STANDARD DESIGN CONDITIONS

- 2.1 Power supplies will be in accordance with [IEC 654-2 \(BS 5967: part 2\)](#)

It should be noted that characteristics additional to those given in IEC 654-2 are also included in this Specification. Should particular characteristics not apply then this must be clearly agreed between purchaser and supplier and such agreement noted on the Data Sheet.

- 2.2 The particular characteristics, selected from amongst the options given in [IEC 654-2](#), will be as defined on the Data Sheet.

IEC 654-2 supplies a number of options for each characteristic and the following notes are provided in order to assist the specifiers of electronic equipment.

- 2.2.1 AC Power Voltage Classes

Class a.c. 1 ($\pm 1\%$) is an extremely onerous condition which is normally only available at the output terminals of good class inverters. Further voltage drop along distribution cables is likely to lead to this tolerance being exceeded unless due care is exercised.

Class a.c. 2 ($\pm 10\%$) is the normal condition to specify since it covers the supplies from most sources of electrical power. However, even this does not cover some conditions where, for example, large motors are started on a relatively small capacity power system.

Class a.c. 3 ($+10\%$ to -15%) can normally include for the type of system which includes frequent large motor starting but it does not cover for voltage excursions following faults and fault clearance.

Class a.c. 4 ($+15\%$ to -20%) is the ideal class for electronic equipment suppliers to meet since it will cover all likely variations with the exception of short circuit or earth faults occurring electrically close to the point of supply and which may give rise to a transient ($<200\text{ms}$) voltage excursion outside the specified tolerance.



Special systems are uncommon but may be encountered. One such example might involve supply from an emergency generator which also feeds a large motor where severe voltage and frequency variations occur on starting and stopping the motor.

It should be noted that there is a long-standing CENELEC proposal that existing 415/240 voltage systems in Great Britain be harmonised at 400/230 V. The CENELEC proposals call for standardisation to be a three stage process:-

- (i) first stage to be achieved by 1995 requiring electricity supply authorities of 415/240 V systems to bring the voltage within the range 400/230 V $\pm 10\%$.
- (ii) an intermediate stage would require voltages to be brought within the range 400/230 V $+10\%$, -6% by the year 2003.
- (iii) the final stage would be likely to require achieving voltage in the range 400/230 V $\pm 6\%$ over a time period to be specified.

2.2.2

AC Power Frequency

Power supplies obtained from public utilities such as the UK Regional Electricity Companies should be assumed to remain within $\pm 1\%$.

Supplies from sources such as high quality inverters can also be provided within a tolerance of $\pm 1\%$.

Supplies from sources such as independent factory or offshore platform main power systems should be assumed to give supplies within $\pm 5\%$.

Supplies from emergency generators or drilling platform generators will be Special and advice from the generator system designer should be sought.

Ideally the supplier of the electronic equipment should indicate that he can tolerate Special power frequency tolerance and should indicate the maximum permissible.

The slew rate, which is rate of change of frequency, can also be important. None is to be expected from public utilities but other supplies may give rise to rapid variation on occasion and should be identified.

Harmonic content of an a.c. power supply

It should be assumed that power obtained from public utilities will be within the limit given in Table 3 of document G5/3 'Limits For Harmonics In The United Kingdom Electricity Supply System' which is less than 5% Total Harmonic Distortion. It is good practice to also aim to meet this standard. Where this is of concern to the supplier of the electronic equipment then the plant operator should be consulted in order to ascertain whether such limits are exceeded at the point where the electronic equipment is to be installed and what levels arise across the total frequency spectrum.

If the source of supply is an inverter then particular care is required because whilst linear loading of the inverter is likely to result in harmonic distortion within 5% the effects of non-linear loading (e.g. switched mode power supplies) could result in harmonic distortion in the order of 10% and therefore high limits should be detailed. In this connection it should also be noted that all forms of converter can



give rise to ill effects due to commutation overlap. Adverse effects include 'ringing' which is a very high frequency oscillation caused by resonance. During this period a.c. supplies may swing from positive to negative several times in a period of some milliseconds. If this phenomena is known to exist then it should be identified as a disturbance condition.

2.2.3 Phase Angle of a Polyphase AC Power Supply

It should be assumed that the phase angle departure for power obtained from sources derived from synchronous generators (e.g. public utility supplies, factory or platform power generation, etc.) will be less than 1 degree. However, if power supplies are unbalanced across phases then some degree of phase shift will arise and will need to be quantified by the purchaser.

Supplies derived from inverters will depend upon how the total load is distributed across the phases. For balanced loads the phase angle departure should be within 1 degree but for 50% unbalanced loading can be up to 5 degrees.

In the event that phase angle is important to the supplier of the electronic equipment then the provider of the power supply must be consulted.

2.2.4 System Earthing

Care must be taken by the purchaser to give a clear description of the earthing systems employed. In particular, where single phase two wire systems are employed these will most likely be Single Pole and Neutral with the neutral earthed but could be Single Phase derived from across two phases of a three phase system which has it's neutral earthed or a Single Phase supply derived from a transformer having a secondary winding with a centre tapped earth.

2.2.5 Switching time for an a.c. auxiliary or back up power supply.

Main power supplies, where backed up by emergency generators, will normally be Special since the run up time of the diesel engine will be up to some 10 seconds.

Supplies which are derived from continuously running inverters equipped with bypass and a static switch will normally have a changeover time of less than 10 milliseconds although a shorter period can be achieved. However, if the inverter system should not include such an arrangement and supplies are changed over by means of contactors, operating in conjunction with voltage sensing devices, then clearly the sensing device and the contactor changeover time, typically up to 1 second, should be entered.

2.2.6 DC Power Voltage Classes

Class d.c. 1 ($\pm 1\%$) is possible from high quality regulated rectifier (charger) and battery systems.

Class d.c. 2 (+10% -15%) is the normal operational condition to specify since it covers most sources of regulated d.c. power. Care is needed however to ensure that all possible variations are covered including boost charging (whether automatic or manual) and voltage decline due to battery discharge (within the declared autonomy time) should the charger fail.



Class d.c. 3 (+15% to -20%) will cover a condition where varying loads are located at some distance from the source of supply and therefore additional distribution cable voltage drops may occur. This is particularly true for lower voltage systems.

Class d.c. 4 (+30% to - 25%) is the ideal class for electronic equipment suppliers to meet since it will cover all likely variations with the exception of short circuit or earth faults occurring electrically close to the point of supply and which may give rise to a transient (<200ms) voltage excursion outside the specified tolerance. Where no significant premium is incurred this class should be specified by the supplier.

Special systems are uncommon but may be encountered. One such example is the connection of an unregulated rectifier to an a.c. source which is itself subject to wide voltage variations.

2.2.7 DC Power Voltage Ripple

High quality regulated rectifier and battery systems are available which give ripple values within 0.2%.

Ripple values of up to 1% is a normal level to specify but it is to be preferred for the electronic equipment supplier to be able to accommodate up to 5% or even 15%.

Unregulated rectifiers, without filters, will give rise to Special levels.

2.2.8 Switching Times for DC Auxiliary or Back-up Power Supplies

Essential equipment needing two sources of supply should be fed from duplicate regulated power supplies arranged such that each one can provide the total power and both are continuously in service. Therefore, in the event of a single failure no time will elapse before the 'standby' unit takes the load.

The switching time for other units will depend upon the operating time of the voltage sensing device and the changeover device. The plant operator should be consulted for existing supplies and the intended supplier for new supplies.

2.2.9 Declaration of Non-Linear Loading

Non-linear loads always give rise to problems for a.c. supplies, this is particularly the case if a.c. supplies are derived from inverters. Since each a.c. supply is likely to be feeding a number of end users, it is important to know whether connected electronic equipment will be a source of disturbance. The electronic equipment supplier should therefore indicate on the data sheet (item 36) if their equipment is in a source of non-linear loading. If it is, then details should be provided on a separate sheet for the purchaser's information.

2.3 Supplies to telecommunication apparatus which is connected to the British Telecommunications network, all as defined in [BS 6484](#), shall conform to the requirements given in [BS 6484](#):

'Specification for electrical safety requirements for independent power supply units for indirect connection to certain telecommunication networks.'



Both the purchaser and the supplier should satisfy themselves that power supplies for the particular classes of apparatus do indeed meet the specified safety requirements. Early consultation with the responsible British Telecommunication authority is recommended.

3. NON STANDARD DESIGN CONDITIONS

- 3.1 Power supplies may, on occasion, be subjected to abnormal disturbance caused by over voltage or under voltage due to, for example, the starting of very large motors or major fault clearance. If such disturbances give rise to voltage excursion lying outside the power voltage classes specified then the magnitude and time of such departures from normal, which are expected to be very infrequent, should be known by the plant operator and the necessary data should be entered into the Data Sheet by the purchaser. Such disturbances may exceed the period of 200ms which [IEC 654-2](#) defines as a transient condition.

Alternating current conditions which should be covered here include 'brown outs' which are occasional severe voltage depressions, power system switching surges and ringing caused by converter commutation.

Such conditions should be known to the operator as a result of his past experience and as a result of various studies, such as power system load flow, fault, stability, harmonic and protection studies, which may have been undertaken.

A DC condition which could be included is the discharge characteristics of batteries following charger failure due to mains failure or component failure.

- 3.2 Suppliers of electronic equipment should be aware that abnormal disturbances can arise on power systems and may include suitable means for nullifying the effects of such disturbances on the performance of the equipment. Such means should be drawn to the attention of the purchaser, if available. In the event that disturbances of the type described will give rise to malfunction of the equipment then the supplier should indicate this to the purchaser on the Data Sheet.

4. DOCUMENTATION

4.1 Data Sheet

It is intended that as much information as possible be interchanged between the purchaser and the supplier of equipment as early as possible. However, it is recognised that some of the information may not be available at the time when enquiries are to be issued. The minimum data to be completed at the time of enquiry is indicated by an 'X' on the Data Sheet. All items should be entered at the time when a purchase order is placed or as soon as practicable thereafter.



No equipment should be put into commission until all entries, by both purchaser and supplier, have been entered into the Data Sheet or detailed as of no significance.

4.2 Disturbances

Those system disturbances which cannot be adequately described in the Data Sheet may be represented by means such as oscillographs or system study graphs which demonstrate the types of infrequent disturbance which can be anticipated. Such documents should be clearly identified and referred to in the Data Sheet.



DATA SHEET - POWER SUPPLIES FOR ELECTRONIC EQUIPMENT

INDENT /PURCHASE ORDER NUMBER									
To be completed in BLOCK capitals									
1	Installation Site								
	MAIN AC VOLTAGE SUPPLIES				Available (From Purchaser)			Specified (By Supplier)	
					(a)	(b)	(c)		
2	3 phase 4 wire (660V 600V 440V 415V 380V Other								
3	1 phase 2 wire (380V 346V 254V 220V 120V other)								
4	Frequency 50 Hz 60 Hz Special)								
5	Voltage Class (a.c. 1 a.c. 2 a.c. 3 a.c. 4 Special)								
6	Frequency Variation (+0.2% + 1% + 5% Special)								
7	Slew Rate								
8	Harmonic Content (<2% <5% <10% <20% Special)								
9	Phase Angle (<1deg <2deg <3deg Special)								
10	System Earthing (Direct, Floating, Other)								
11	Possible Disturbances								
	STANDBY DC VOLTAGE SUPPLIES				Available			Not Available	
12	3 phase 4 wire (660V 600V 415V 380V Other)								
13	1 phase 2 wire (380V 120V 110V Special)								
14	Frequency (50 Hz 60 Hz Special)								
15	Voltage Class (ac1 a.c. 2 a.c. 3 a.c. 4 special)								
16	Frequency Variation (+0.2% +1% +5% Special)								
17	Slew Rate								
18	Harmonic Content (<2% <5% <10% <20% Special)								
19	Phase Angle (<1deg <2deg <3deg Special)								
20	System Earthing (Direct, Floating, Other)								
21	Possible Disturbance								
22	Switching Time (sec) (Main to Standby) (0ms <3ms <10ms <20ms <200ms <1s Special)								
23	Switching Time (sec) (Standby to Main) (0ms <3ms <10ms <20ms <200ms <1s Special)								
	MAIN DC VOLTAGE SUPPLIES				Available			Not Available	
24	Voltage (120V 110V 48V Other)								
25	Voltage Class (d.c. 1 d.c. 2 d.c. 3 d.c. 4 Special)								
26	Voltage Ripple (<0.2% <1% <5% <15% Special)								
27	Earthing (+ to earth, - to earth, Floating)								
28	Possible Disturbances								
	STANDBY DC VOLTAGE SUPPLIES				Available			Not Available	
29	Voltage (120V 110V 48V 24V Other)								
30	Voltage Class (d.c. 1 d.c. 2 d.c. 3 d.c. 4 Special)								
31	Voltage Ripple (<0.2% <1% <5% Special)								
32	Earthing (+ to earth, - to earth, Floating)								
33	Possible Disturbances								
34	Switching Time (sec) (Main to Standby) (0ms <1ms <5ms <20ms <200ms <1s Special)								
35	Switching Time (sec) (Standby to Main) (0ms <1ms <5ms <20ms <200ms <1s Special)								
36	Is Suppliers Equipment a Source of Non-Linear Loading?				Yes			No	
PURCHASERS COMMENTS					SUPPLIERS COMMENTS				
None		Attached			None			Attached	
PURCHASER REVISIONS					Name (Print)				
					Organisation				
Rev	Date	Remarks	By	App	Date				
					DATA SHEET NO:				



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

Abbreviations

BS British Standard

IEC International Electrotechnical Commission



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

IEC 654-2 (BS 5967: Part 2)	Operating conditions for industrial-process measurement and control equipment.
<i>Engineering Recommendation G5/3</i>	<i>System Design and Development Committee September 1976 Classification C. The Electricity Council Chief Engineers Conference. Limits for Harmonics in the United Kingdom Electricity Supply System.</i>
BS 6484	Specification for electrical safety requirements for independent power supply units for indirect connection to certain telecommunication networks.

