Antenna Electronics
DC Power Supply Design Description

020.30.50.00.00-0002-DSN

Status: **RELEASED**

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Change Record

Version	Date	Author	Affected Section(s)	Reason
A	2018-10-24	P. Lopez	All	Reference Design
A.01	2021-05-26	P. Lopez	All	Added information for CoDR
A.02	2021-08-10	P. Lopez	All	Minor changes.
A.03	2022-01-31	P. Lopez	All	Changes for CoDR RIDs
A.04	2022-02-01	P. Lopez	3.2	Updated PBS in this section
B	2022-02-01	A. Lear	All	Formatting, copy edits; prepared PDF for signatures and release.

Table of Contents

1 Introduction

1.1 Purpose

This document provides a design description for the *Antenna Electronics* DC Power Supply subsystem. It covers the design approach, functions, description of key components, interfaces, and risks associated with the conceptual design. This document will form part of the Antenna Electronics Design documentation package.

1.2 Scope

The scope of this document covers the entire design of the DC Power Supply subsystem, as part of the Antenna Electronics design. It includes the subsystem's design, how it functions, and its interfaces with the necessary hardware and software systems. It does not include specific technical requirements or budgetary information.

2 Related Documents and Drawings

2.1 Applicable Documents

The following documents may not be directly referenced herein, but provide necessary context or supporting material.

Ref. No.	Document Title	Rev/Doc. No.
AD01	Systems Engineering Management Plan	020.10.00.00.00-0001-PLA
AD02	Requirements Management Plan	020.10.15.00.00-0001-PLA
AD03	System Requirements	020.10.15.10.00-0003-REQ
AD04	System Environmental Specifications	020.10.15.10.00-0001-SPE
AD05	System EMI/RFI Requirements	020.10.15.10.00-0002-REQ
AD06	System-Level Architecture Model	020.10.20.00.00-0002-DWG
AD07	Safety Specification	020.80.00.00.00-0001-REQ
AD08	Security Management Plan and Requirements	020.80.00.00.00-0003-REQ
AD09	System Electronics Specification	020.10.15.10.00-0008-REQ
AD10	System Technical Budgets	020.10.25.00.00-0002-DSN
AD11	Product Breakdown Structure	020.10.20.00.00-0004-DSN
AD12	Safety: Risk Analysis Procedures	020.80.00.00.00-0002-PRO

2.2 Applicable ICDs

The following ICDs define the external boundary of this subsystem and are applicable to its specification:

Ref. No.	Document Title	Rev./Doc. No.
AD20	Antenna Electronics to DC Power Supply Interface Control Document	020.10.40.05.00-0006-ICD
AD21	Antenna to Antenna Electronics Interface Control Document	020.10.40.05.00-0011-ICD
AD22	DC Power Supply System to Monitor and Control Interface Control Document	020.10.40.05.00-0054-ICD
AD23	Bins and Modules to Antenna Electronics Interface Control Document	020.10.40.05.00-0040-ICD

2.3 Reference Documents

The following documents are referenced within this text:

Ref. No.	Document Title	Rev/Doc. No.
RD01	Antenna Electronic Front End Enclosure Block Diagram	020.30.00.00.00-0002-BLK
RD02	Antenna Electronics Pedestal Enclosure Block Diagram	020.30.00.00.00-0003-BLK
RD03	Antenna time & Frequency Reference Requirements	020.35.20.00.00-0001-REQ
RD04	Digital Back End Requirements	020.30.25.00.00-0001-REQ
RD05	Front End Requirements	020.30.05.00.00-0003-REQ
RD06	Integrated Down Converter Requirements	020.30.15.00.00-0001-REQ
RD07	Monitor and Control Requirements	020.30.45.00.00-0002-REQ
RD08	Water Vapor Radiometer Requirements	020.45.00.00.00-0001-REQ
RD09	Cryogenics System Requirements	020.30.10.00.00-0001-REQ
RD10	DC Power Supply Requirements	020.30.10.00.00-0001-REQ

3 DC Power Supply Conceptual Design

Two observatories were looked at when choosing the ngVLA power supply design: the Atacama Large Millimeter Array (ALMA) and the Jansky Very Large Array (VLA). Both observatories bring in AC and use Commercial-Off-the-Shelf (COTS) parts to convert the AC power to DC power. Both supply DC power to the antenna electronics, where each module regulates the DC power to voltages that they can use inside the module.

The two observatories differ when it comes to backup power and the input to the module power supplies. ALMA uses an uninterruptible power source (UPS) and feeds the modular power supplies AC power. The VLA uses four 12V lead-acid in series to make up the 48V, which is then fed into the modular power supplies.

The ngVLA antenna electronics and environment are very similar to those of the VLA, which is one of the main reasons why the ngVLA DC Power Supply system follows the VLA design. One issue ALMA had with its design was the altitude of the operation site (over 5000 meters). ALMA also had some issues with the COTS AC to DC power supplies. They experienced failures with the module power supplies and the manufacturer was not very helpful pinpointing the reason for the failures. The VLA DC Power Supply modules have been really reliable and have not experienced many failures.

Another reason the VLA design was chosen for ngVLA is its multiple stages of regulation. This improves isolation and performance for antenna electronics electromagnetic compatibility (EMC) requirements. The ALMA design only has two stages of regulation, one at the power supply module and another inside the antenna electronics. The VLA design has an extra stage of regulation at the AC to –48V DC sub-assembly. –48V systems are widely used in industry which allows COTS equipment to be used for ngVLA system. This will lower the overall cost of the DC Power Supply system.

3.1 DC Power Supply System Overview

Figure 1 (next page) shows a basic block diagram of the DC Power Supply system. The diagram shows the input and output voltages for each power supply module.

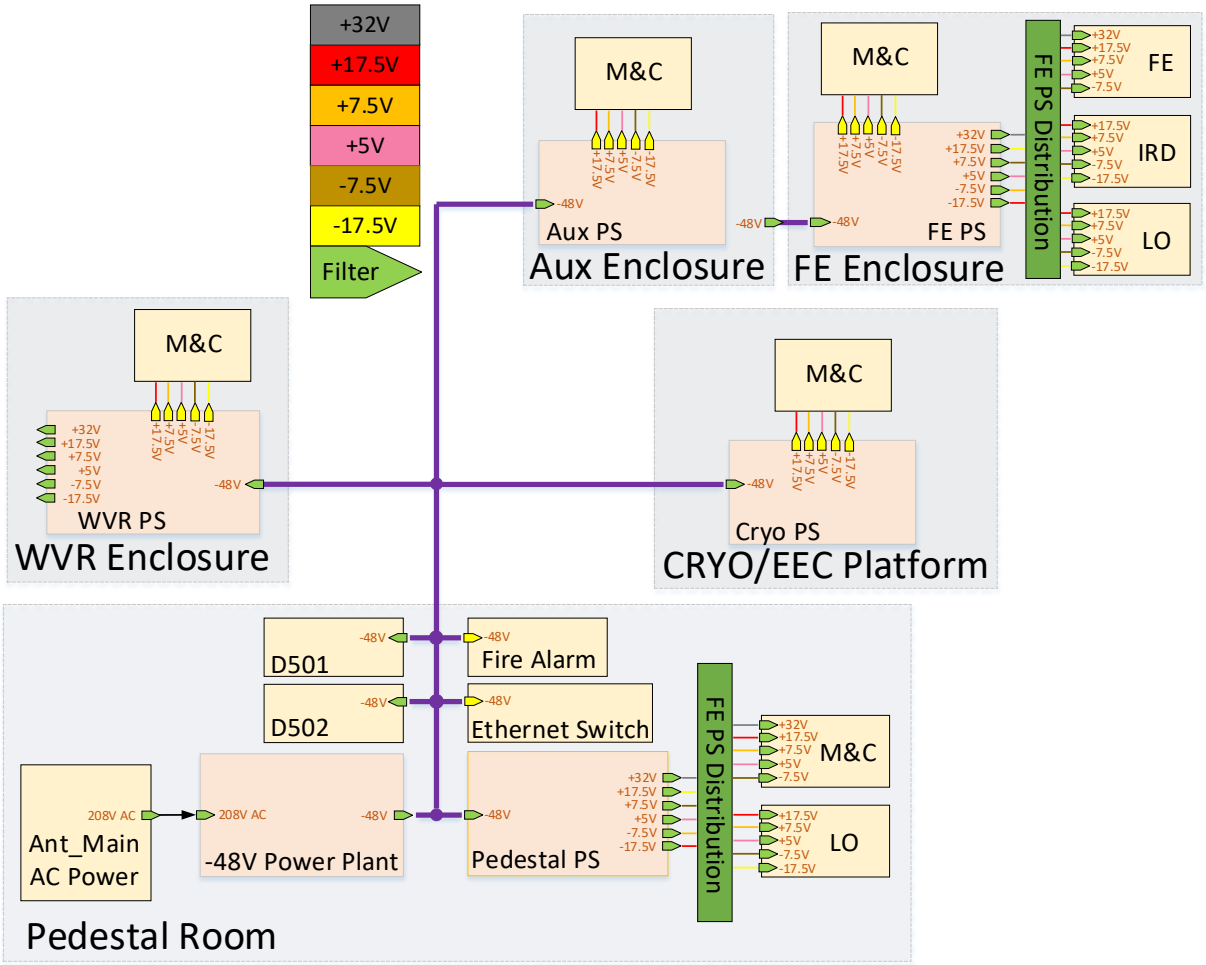

Figure 1: Block diagram of DC Power Supply subsystem.

3.2 DC Power Supply System Components

This section discusses the major components that are part of the DC Power Supply subsystem. Below is the planned DC Power Supply system Product Tree breakdown:

DC Power Supply Subsystem	Configuration Item Number
DC Power Supply System General	020.30.50.00.00
FE Enclosure Power Supply Unit	020.30.50.01.00
Auxiliary Enclosure Power Supply Unit	020.30.50.02.00
CRYO/EEC Platform Power Supply Unit	020.30.50.03.00
Pedestal Room Power Supply Unit	020.30.50.04.00
Pedestal Battery	020.30.50.05.00
WVR Power Supply Unit	020.45.40.00.00
–48V Power Plant	020.30.50.07.00

3.2.1 –48V Power Plant System

This subsystem major components consists of a COTS AC to –48V DC Power Plant, configuration item number 020.30.50.07.01, and COTS Lithium Batteries, configuration item number 020.30.50.05.01. The –48V Power Plant System Block Diagram is shown in Figure 2.

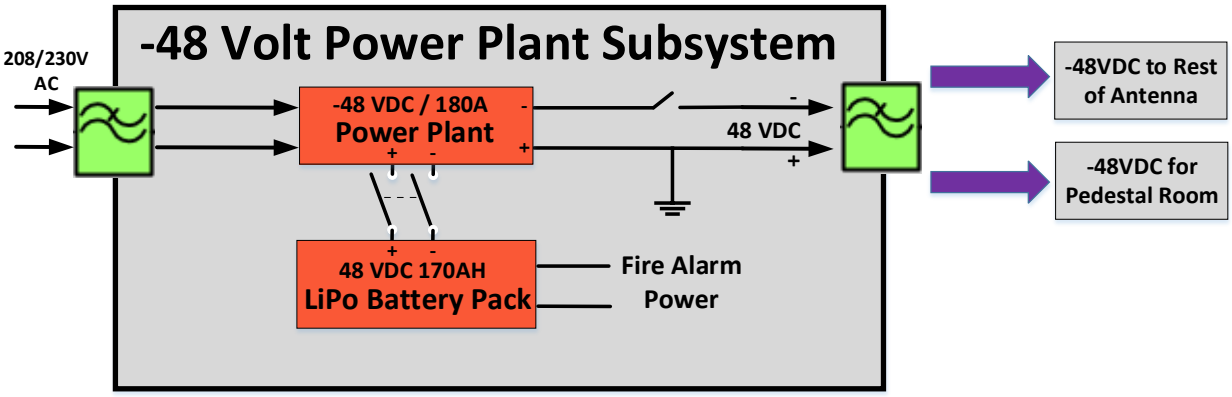

Figure 2: –48V Power Plant subsystem block diagram.

Table 1 shows the electronics that it supplies –48V to and the preliminary estimated power requirements. If the requirements shown in Table 1 differ from the DC Power Supply Requirement Specification [RD10], the latter shall take precedence.

Parameter	Preliminary Estimated Power Requirement
AC to Power Plant	The -48V Power Plant input shall require 208V 3 Phase AC @ ~36A.
Power Plant to Batteries	The -48V Power Plant shall include an Upper Voltage fail-safe limit of 53.5 VDC or lower and a fail-safe low voltage limit or Low Voltage Disconnect of 41.9VDC or higher to prevent over discharge.
Power Plant to Pedestal Power Supply Module	The -48V Power Plant shall deliver –48 VDC @ ~12A to the Pedestal Power Supply Module, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.
Power Plant to Auxiliary Power Supply Module	The -48V Power Plant shall deliver –48 VDC @ ~3A to the Auxiliary Power Supply Module, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.
Power Plant to Front End Power Supply Module	The -48V Power Plant shall deliver –48 VDC @ ~61A to the Front End Power Supply Module, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.
Power Plant to CRYO/EEC Power Supply Module	The -48V Power Plant shall deliver –48 VDC @ ~3A to the CRYO/EEC Power Supply Module, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.
Power Plant to Water Vapor Radiometer Power Supply Module	The -48V Power Plant shall deliver –48 VDC @ ~11A to the Water Vapor System, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.
Power Plant to Digital BE & Data Transmission System	The -48V Power Plant shall deliver –48 VDC @ ~10A to the Digital BE & Data Transmission System, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.
Power Plant to Fire Alarm	The -48V Power Plant shall deliver –48 VDC @ ~2A to the Fire Alarm, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.

Parameter	Preliminary Estimated Power Requirement
Power Plant to Ethernet Switch	The -48V Power Plant shall deliver –48 VDC @ ~2A to the Ethernet Switch, which shall tolerate voltages from –42.0 VDC to –60.0 VDC.

Table 1: Preliminary estimated power requirements for –48V power plant.

3.2.2 Pedestal Room Power Supply Module

The Pedestal Power Supply module converts –48V DC to the required DC voltages needed for the electronics located in the Pedestal Room. The Pedestal Power Supply module consists of a Module Interface Board (MIB) for M&C purposes, configuration item number 020.30.50.04.01; a digital board that converts analog signals to digital signals needed for M&C purposes or could be used to carry out commands from the MIB, configuration item number 020.30.50.04.02; and a motherboard that contains the regulators that convert –48V to the appropriate voltages for the other electronic LRUs, configuration item number 020.30.50.04.03. The Pedestal Power Supply module will require a distribution board, configuration item number 020.30.50.04.04. Cabling from the Pedestal Room Power Supply module will be covered in the product breakdown structure configuration item number 020.30.50.04.05. The Pedestal Room Power Supply module block diagram is shown in Figure 3.

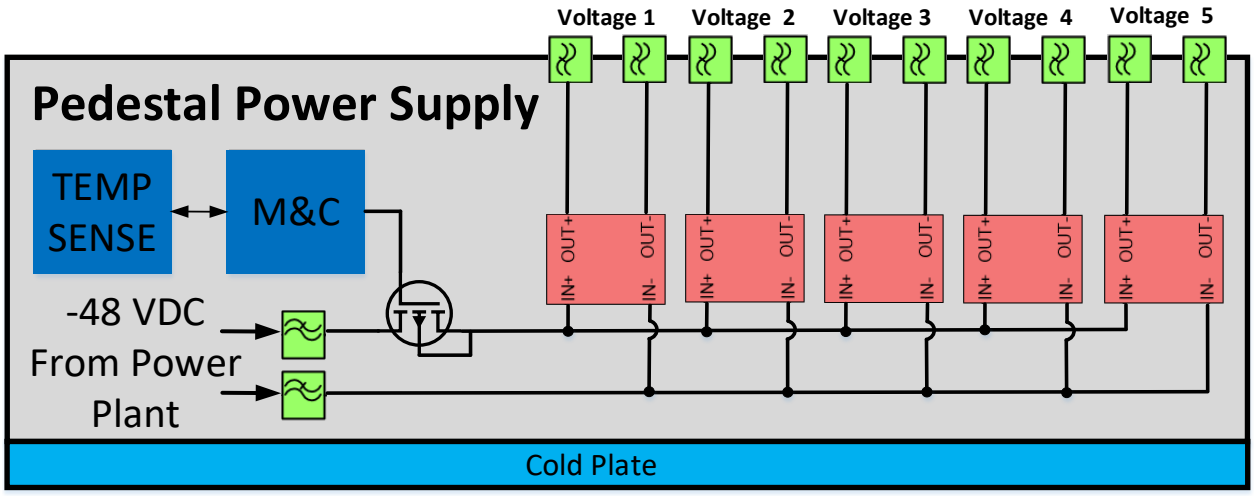

Figure 3: Pedestal power supply module block diagram.

Table 2 shows the electronics that the Pedestal Power Supply module supplies voltage to and the preliminary estimated power requirements. If the requirements shown in Table 2 differ from the DC Power Supply Requirements Specification [RD10], the latter shall take precedence.

Parameter	Preliminary Estimated Power Requirement
Pedestal Power Supply Module to M&C Modules	The –48V Pedestal Power Supply Module shall supply M&C Modules with +17.5V @ ~1A, +7.5V @ ~1A, +5V @ ~2A and –17.5V @ ~1A.
Pedestal Power Supply Module to LO Reference Receiver Generator and Distribution Module	The -48V Pedestal Power Supply Module shall supply the LO Reference Receiver Generator and Distributor module with +17.5V @ ~2.5A, +7.5V @ ~1.5A, +5V @ ~2A, -7.5V @ ~250 mA, and –17.5V @ ~250 mA.

Table 2: Preliminary estimated power requirements for pedestal power supply module.

3.2.3 Auxiliary Enclosure Power Supply Module

The Auxiliary Power Supply module converts –48V DC to the required DC voltages needed for the electronics located in the Auxiliary Enclosure. The Auxiliary Power Supply module consists of a MIB for M&C purposes, configuration item number 020.30.50.02.01; a digital board that converts analog signals to digital signals needed for M&C purposes or could be used to carry out commands from the MIB, configuration item number 020.30.50.02.02; and a motherboard that contains the regulators to convert –48V to the appropriate voltages for the other electronic LRUs, configuration item number 020.30.50.02.03. Cabling from the Auxiliary Power Supply module will be covered in the product breakdown structure configuration item number 020.30.50.02.04. The Pedestal Room Power Supply module block diagram is shown in Figure 4.

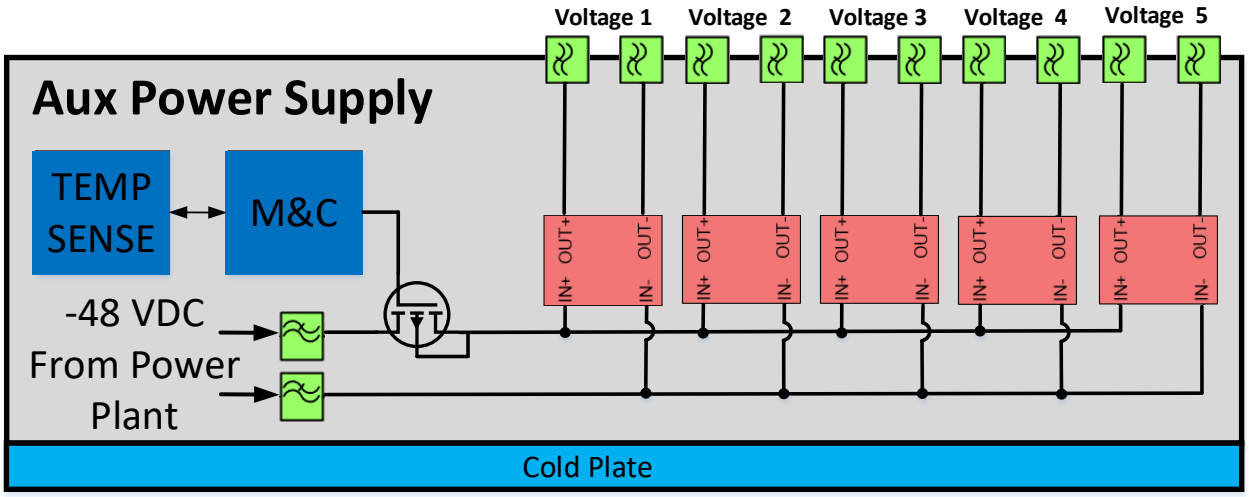

Figure 4: Auxiliary power supply module block diagram.

Table 3 shows the electronics that the Auxiliary Power Supply module supplies voltage to and the preliminary estimated power requirements. If the requirements shown in Table 3 differ from the DC Power Supply Requirements Specification [RD10], the latter shall take precedence.

Parameter	Value
Auxiliary Power Supply Module to VFD M&C Modules	The Auxiliary Power Supply module shall supply the VFD M&C Module with +17.5V @ ~1A, +7.5V @ ~1A, +5V @ 2A, and –17.5V @ ~1A.

Table 3: Preliminary estimated power requirements for the auxiliary power supply module.

3.2.4 Front End Power Supply Module

The Front End Power Supply module converts -48V DC to the required DC voltages needed for the electronics located in the Front End Enclosure. The Front End Power Supply module consists of a MIB for M&C purposes, configuration item number 020.30.50.01.01; a digital board that converts analog signals to digital signals needed for M&C purposes or could be used to carry out commands from the MIB, configuration item number 020.30.50.01.02; and a motherboard that contains the regulators to convert –48V to the appropriate voltages for the other electronic LRUs, configuration item number 020.30.50.01.03. The Front End Power Supply module will require a distribution board, configuration item number 020.30.50.01.04. Cabling from the Front End Power Supply module will be covered in the product

breakdown structure configuration item number 020.30.50.01.05. The Front End Power Supply module block diagram is shown in Figure 5.

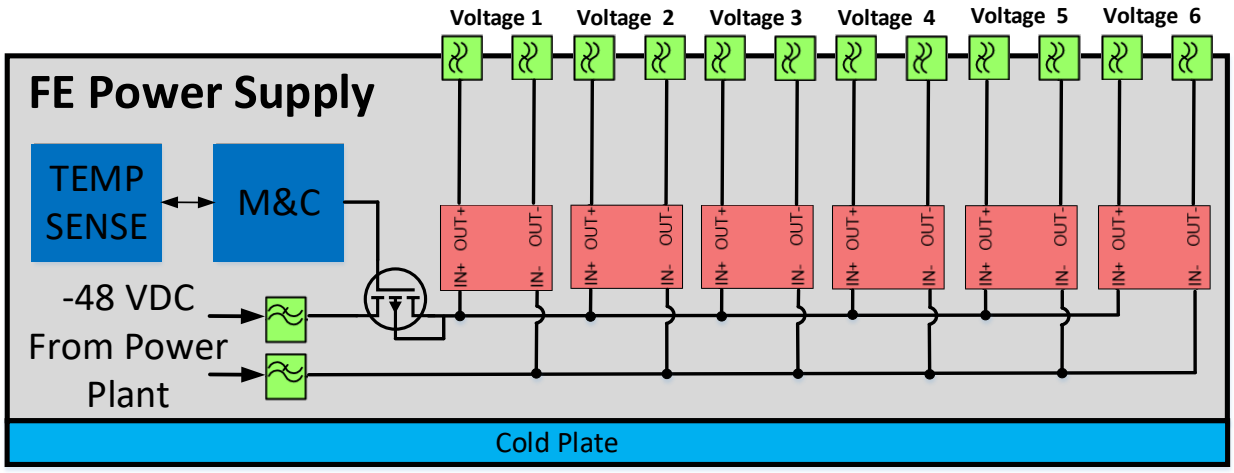

Figure 5: Front End power supply module block diagram.

Table 4 shows the electronics that the Auxiliary Power Supply module supplies voltage to and the preliminary estimated power requirements. If the requirements shown in Table 4 differ from the DC Power Supply Requirements Specification [RD10], the latter shall take precedence.

Parameter	Value
Front End Power Supply Module to Front End	The FE Power Supply Module shall supply the FE Module with +32V @ ~500 mA, +17.5V @ ~6A, +5V @ ~500 mA, and –7.5V @ ~500 mA.
Front End Power Supply Module to Integrated Downconvert /Digitizer	The FE Power Supply Module shall supply the IRD Modules with +17.5V @ ~10 mA, +7.5V @ ~1A, +5V @ ~1A, –7.5V @ ~100 mA, and –17.5V @ ~10 mA.
Front End Power Supply Module to LO Clock Receiver and LO Reference Sample Clock Generator	The FE Power Supply Module shall supply the LO Clock Modules with +17.5V @ ~2.5A, +7.5V @ ~1.5A, +5V @ ~2A, –7.5V @ ~250 mA, and –17.5V @ ~250 mA.
Front End Power Supply Module to M&C Module	The FE Power Supply Module shall supply M&C Modules with +17.5V @ ~1A, +7.5V @ ~1A, +5V @ ~2A, and –17.5V @ ~1A.

Table 4: – Preliminary estimated power requirements for the Front End power supply module.

3.2.5 CRYO/EEC Platform Power Supply Module

The CRYO/EEC Power Supply module converts –48V DC to the required DC voltages needed for the electronics located in the CRYO/EEC enclosure. The CRYO/EEC Power Supply module consists of a MIB for M&C purposes, configuration item number 020.30.50.03.01; a digital board that converts analog signals to digital signals needed for M&C purposes or could be used to carry out commands from the MIB, configuration item number 020.30.50.03.02; and a motherboard that contains the regulators to convert –48V to the appropriate voltages for the other electronic LRUs, configuration item number 020.30.50.03.03. Cabling from the CRYO/EEC Power Supply module will be covered in the product

breakdown structure configuration item number 020.30.50.03.04. The CRYO/EEC Power Supply module block diagram is shown in Figure 6.

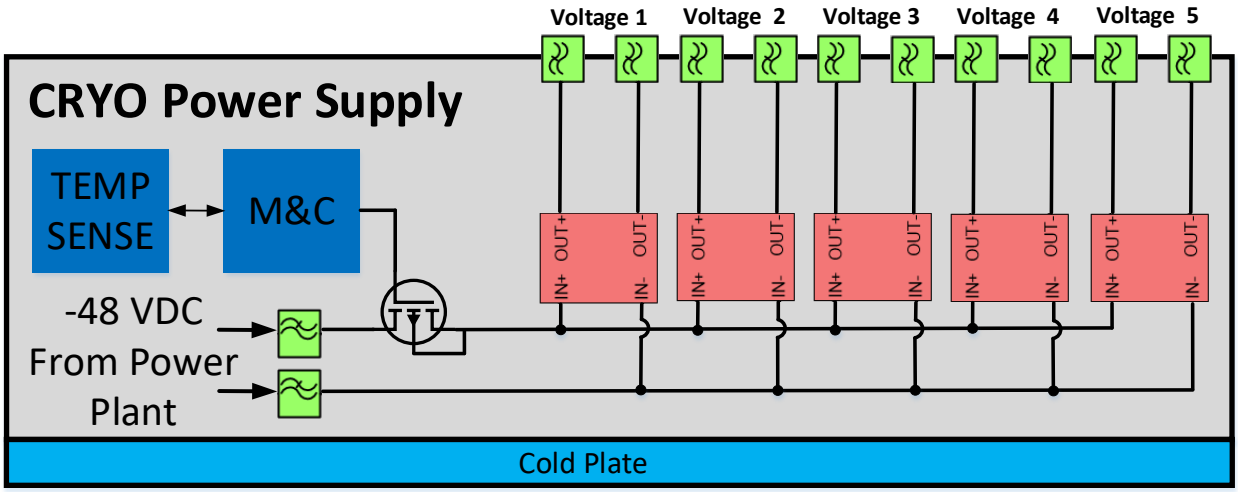

Figure 6: CRYO/EEC power supply module block diagram.

Table 5 shows the electronics that the Auxiliary Power Supply module supplies voltage to and the preliminary estimated power requirements. If the requirements shown in Table 5 differ from the DC Power Supply Requirements Specification [RD10], the latter shall take precedence.

Parameter	Value
Cryo Power Supply Module to M&C Module	The Cryo Power Supply Module shall supply M&C Module with +17.5V @ ~1A, +7.5V @ ~1A, +5V @ ~2A, and –17.5V @ ~1A.

Table 5: Preliminary estimated power requirements for the CRYO/EEC Power Supply module.

3.2.6 WVR Power Supply Module

The Water Vapor Radiometer Power Supply module converts –48V DC to the required DC voltages needed for the electronics located in the Water Vapor Radiometer Enclosure. The Water Vapor Radiometer Power Supply module consists of a MIB for M&C purposes, configuration item number 020.45.40.01.00; a digital board that converts analog signals to digital signals needed for M&C purposes or could be used to carry out commands from the MIB, configuration item number 020.45.40.02.00; and a motherboard that contains the regulators to convert –48V to the appropriate voltages for the other electronic LRUs, configuration item number 020.45.40.03.00. Cabling from the Water Vapor Radiometer Power Supply module will be covered in the product breakdown structure configuration item number 020.45.40.04.00. The Water Vapor Radiometer Power Supply module block diagram is shown in Figure 7 (next page).

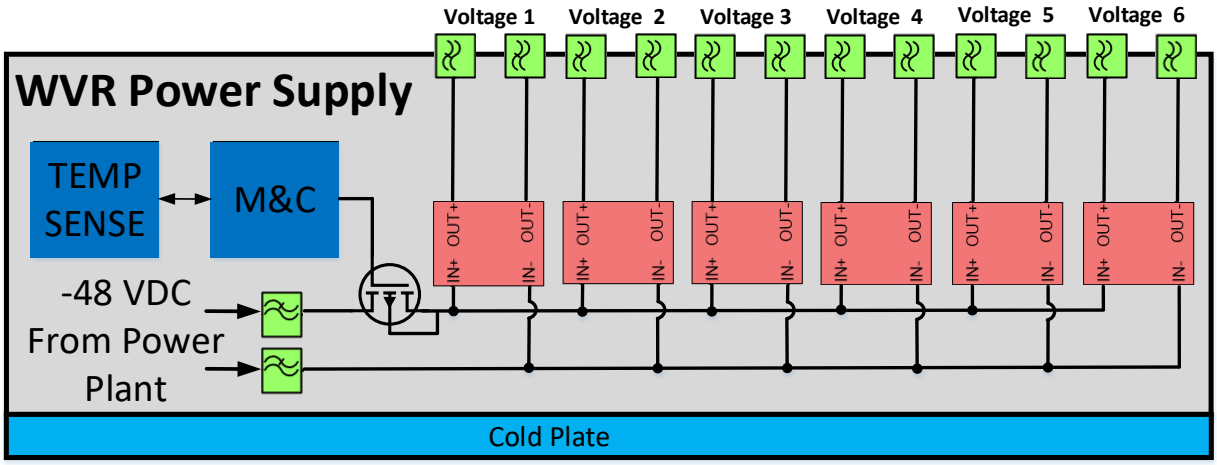

Figure 7: Water Vapor Radiometer Power Supply module block diagram.

Table 6 shows the electronics that the Water Vapor Radiometer Power Supply module supplies voltage to and the preliminary estimated power requirements. If the requirements shown in Table 6 differ from the DC Power Supply Requirements Specification [RD10], the latter shall take precedence.

Parameter	Value
WVR Power Supply Module to Front End	WVR Power Supply Module shall supply the FE Module with +32V @ ~500 mA, +17.5V @ ~6A, +5V @ ~500 mA, and –7.5V @ ~500 mA.
WVR Power Supply Module to Integrated Downconverter/Digitizer	WVR Power Supply Module shall supply the IRD Modules with +17.5V @ ~10 mA, +7.5V @ ~1A, +5V @ ~1A, –7.5V @ ~100 mA, and –17.5V @ ~10 mA.
WVR Power Supply Module to LO Clock Receiver and LO Reference Sample Clock Generator	WVR Power Supply Module shall supply the LO Clock Modules with +17.5V @ ~2.5A, +7.5V @ ~1.5A, –7.5V @ ~250 mA, and –17.5V @ ~250 mA.
WVR Power Supply Module to M&C Module	WVR Power Supply Module shall supply M&C Modules with +17.5V @ ~1A, +7.5V @ ~2A, and –17.5V @ ~1A.
WVR Power Supply Module to WVR Cooling System	WVR Power Supply Module shall supply the WVR cooling system with +17.5V @ ~2A.

Table 6: Preliminary estimated power requirements for the Water Vapor Radiometer Power Supply module.

3.3 DC Power Supply Interfaces with other Subsystems

Major interfaces exist between the DC Power Supply system and the following subsystems:

- Antenna 208VAC Transformer interfaces with the –48V Power Plant.
- Antenna Fire Alarm interfaces with the –48V Power Plant.
- Antenna Ethernet Switch interfaces with the –48V Power Plant.
- Digital Back End (DBE) and Data Transmission System (DTS) interfaces with the –48V Power Plant.
- Water Vapor Radiometer (WVR) interfaces with the Water Vapor Radiometer power supply module.
- Front End System (FE) interfaces with the Front End Power Supply module.

- Integrated Downconverter/Digitizers System (IRD) interfaces with the Front End Power Supply module.
- LO Reference Receiver Generator and Distribution System interfaces with the Front End Power Supply module and the Pedestal Power Supply module.
- Antenna Electronics M&C interfaces with all of the DC Power Supply systems.
- Antenna Cooling System interfaces with all of the DC Power Supply systems.

4 Design Assumptions and Drivers

The following assumptions are made in the definition of the DC Power Supply system requirements:

- Hardware requirements assume that all system parts that would normally be in place during observations are working within their respective specifications (e.g., HVAC, RTP systems) unless explicitly stated otherwise.
- Most COTS –48V DC Power Plant units our size do not come in 480V inputs. If one is found, the options would be limited to that one unit. To have more COTS options, the ability to change the size of antenna 208V transformer will be assumed.
- Pedestal Power Supply module requirements assume the Fire Alarm will be powered by –48V @ ~2A.
- Pedestal Power Supply module requirements assume the Ethernet switch will be powered by –48V @ ~2A.
- FE Power Supply module requirements assume all LO reference modules needed for each IRD module will be located in the FE Enclosure.
- All Power Supply modules assume all LOIF modules will be powered by +17.5V @ ~2.5A, +7.5V @ ~1A, +5V @ ~2A, –7.5V @ ~250mA, and –17.5V @ ~250mA.

5 DC Power Supply System Key Requirements

5.1 Key Requirements

A subset of the requirements that most directly drive the design is shown in Table 7.

Parameter	Summary of Requirement	Reference
AC to DC Conversion	Input AC voltage shall be converted to -48V DC via Power Plant subsystem.	[RD10]
DC Power Supply Module Input Voltage	Each DC Power Supply module shall require -48V DC input.	[RD10]
LRU Power Input	Input power to all LRUs shall be considered raw power. Internal regulation and filtering are required.	[RD10]
RFI Emission Threshold	The DC Power Supply system RFI suppression will eliminate certain supply architectures.	[RD10]
Number of Batteries needed	The time needed to safely place the antenna electronics into a safe standby mode will determine the number of backup batteries needed for the DC Power Supply system.	[RD10]

Table 7: Critical requirements for DC Power Supply.

5.2 Key –48V Power Plant Requirements

The key Power Plant requirements are shown in Table 8.

Parameter	Summary of Requirement	Reference
AC input	–48V Power Plant requires 208VAC 3 Phase @ ~34A input	[RD10]
Battery Use	Batteries shall not be used in the ngVLA system except in the case of the antenna –48 VDC power system and a commercial UPS device for critical AC line powered equipment.	[RD10]

Table 8: Critical requirements for –48V power plant.

5.3 Key DC Power Supply Module Requirements

The key DC Power Supply Module requirements are shown in the Table 9.

Parameter	Summary of Requirement	Reference
DC input	–48V is required as an input from the -48V Power Plant.	[RD10]

Table 9 – Critical requirements for DC Power Supply module.

6 RFI and Emissions

The DC Power Supply system will use RFI quite design practices. The DC Power Supply system plans to use shielded enclosures to reduce RFI. The fully sealed enclosures with conductive gaskets will utilize filtered connectors for all input/output ports. The –48V Power Plant will be housed in an RFI-shielded rack while the DC Power Supply modules will be housed in NRAO's Advanced RFI Containment System (ARCS) modules. The DC Power Supply system will incorporate AC surge protection in accordance with IEC 60364-4-44 and lightning protection in accordance with IEC 62305.

7 Bins and Modules

The DC Power Supply system takes advantage of COTS equipment and also uses custom modules to distribute voltages to electronics in an enclosure or platform. The –48V Power Plant and backup batteries will be COTS equipment that comes in a 19" rack mount enclosure. The modular power supplies will be custom and will be housed inside NRAOs ARCS modules. To cut down on weight across the antenna, the M&C modules and the DC Power Supply modules will be combined into one housing. Table 10 (next page) shows the estimated dimensions for the DC Power Supply system only. If the information shown in Table 10 differs from the DC Power Supply Requirements Specification [RD10], the latter shall take precedence.

DC Power Supply System	Equipment Location	Estimated Size	Estimated Weight	Estimated Heat Dissipation	Cooling Method
–48V Power Plant	Electronics Rack in Pedestal Room	2U or 3U (depending on final overall power requirements) 48,26 cm (19") rack mount	20 kg (45 lbs)	250 Watts	Air Cooled
Battery	Backup Battery Enclosure in Pedestal Room	56.4 cm (22.2") x 17.2 cm (6.8") x 56.4 cm (22.2")	72.6 kg (160 lbs)	TBD	Air Cooled
Pedestal Power Supply Module	Electronics Rack in Pedestal Room	ARCS 2U module	6.8 kg (15 lbs)	120 Watts	Liquid Cooled
Auxiliary Power Supply Module	Auxiliary Enclosure	ARCS 2U module	6.8 kg (15 lbs)	100 Watts	Liquid Cooled
Front End Power Supply	Front End Enclosure	ARCS 2U module	8.2 kg (18 lbs)	820 Watts	Liquid Cooled
CRYO/EEC Power Supply	CRYO/EEC Enclosure	ARCS 2U module	6.8 kg (15 lbs)	100 Watts	Liquid Cooled

Table 10: Estimated dimensions and weight for the DC Power Supply system.

8 Safety

The DC Power Supply system will be designed to be used and operable under expected conditions as identified in the Safety Risk Analysis Procedure [AD12].

9 Appendix

9.1 Abbreviations and Acronyms

Acronym	Description
A	Amps
AC	Alternating Current
AD	Applicable Document
ARCS	Advanced RFI Containment System
Aux	Auxiliary
C	Celsius
COTS	Commercial Off the Shelf
Cryo	Cryogenics
DBE	Digital Back End
DC	Direct Current
DTS	Data Transmission System
EMC	Electromagnetic Compatibility
FE	Front End
IF	Intermediate Frequency
IRD	Integrated Downconverter/Digitizer
ICD	Interface Control Document
LNA	Low Noise Amplifier
LO	Local Oscillator
LRU	Line Replaceable Unit
M&C, M/C	Monitor and Control
MIB	Module Interface Board
ngVLA	Next Generation VLA
NROA	National Radio Astronomy Observatory
NSF	National Science Foundation
RD	Reference Document
RF	Radio Frequency
Sec	Seconds
TBD	To Be Determined
VLA	Jansky Very Large Array
WVR	Water Vapor Radiometer

020.30.50.00.00-0002-DSN-B-DC_Power_Supply_Design_Description

Final Audit Report 2022-02-03

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By:	Anne Lear (alear@nrao.edu)
Status:	Signed
Transaction ID:	CBJCHBCAABAAPmz9SxKiFPZ5vqsEi7Xl1BQdS3T5uOZ2

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