

CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

**A Pressure Based
Charge Control System For The
DSPSE NiH2 CPV Battery**

Presented To The NASA Battery Workshop November 16-18, 1993

C. Garner, W. Barnes & G. Hickman

Naval Research Laboratory Code 8134

Washington D.C.

Pgs 26

N94-28127

17 NOVEMBER 1993

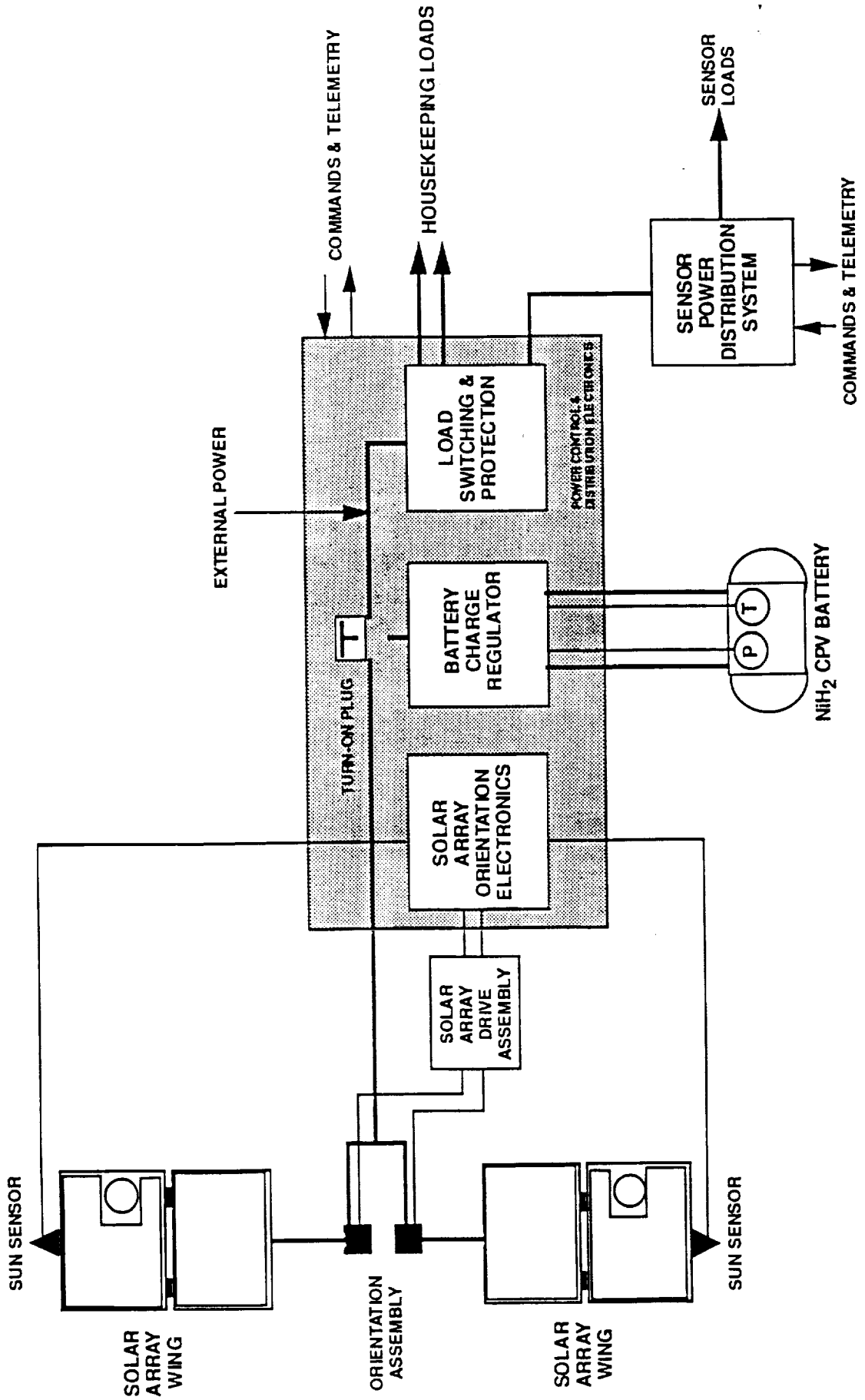
CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

Introduction

- **NRL/BMDO Deep Space Probe Science Experiment (DSPSE) To Orbit Moon & Rendezvous With Asteroid Geographos**
- **Launch In January 1994**
- **DSPSE Spacecraft Will Use NiH2 CPV Battery For Energy Storage**
- **DSPSE Charge Control System Will Monitor NiH2 CPV Pressure For Switch From High Rate Charge To Trickle Charge**

CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

DSPSE Electrical Power Subsystem



17 NOVEMBER 1993

CHARGE CONTROL FOR THE DSPSE NIH2 CPV BATTERY

DSPSE Eclipse Energy Requirements

<u>Mission Phase</u>	<u>Eclipse Duration (Hrs)</u>	<u>Load (Watts)</u>	<u>AH Out @ 27.5 Volts</u>
Low Earth Orbit	0.60	146	3.19
Lunar	1.17	226	9.62
Trans-Lunar	2.05	121	9.00

LEO Period Is 1.5 Hour

~ 50 LEO Cycles

Lunar Orbit Period Is 5 Hours

~ 300 Lunar Cycles

3 Trans-Lunar Eclipses Expected

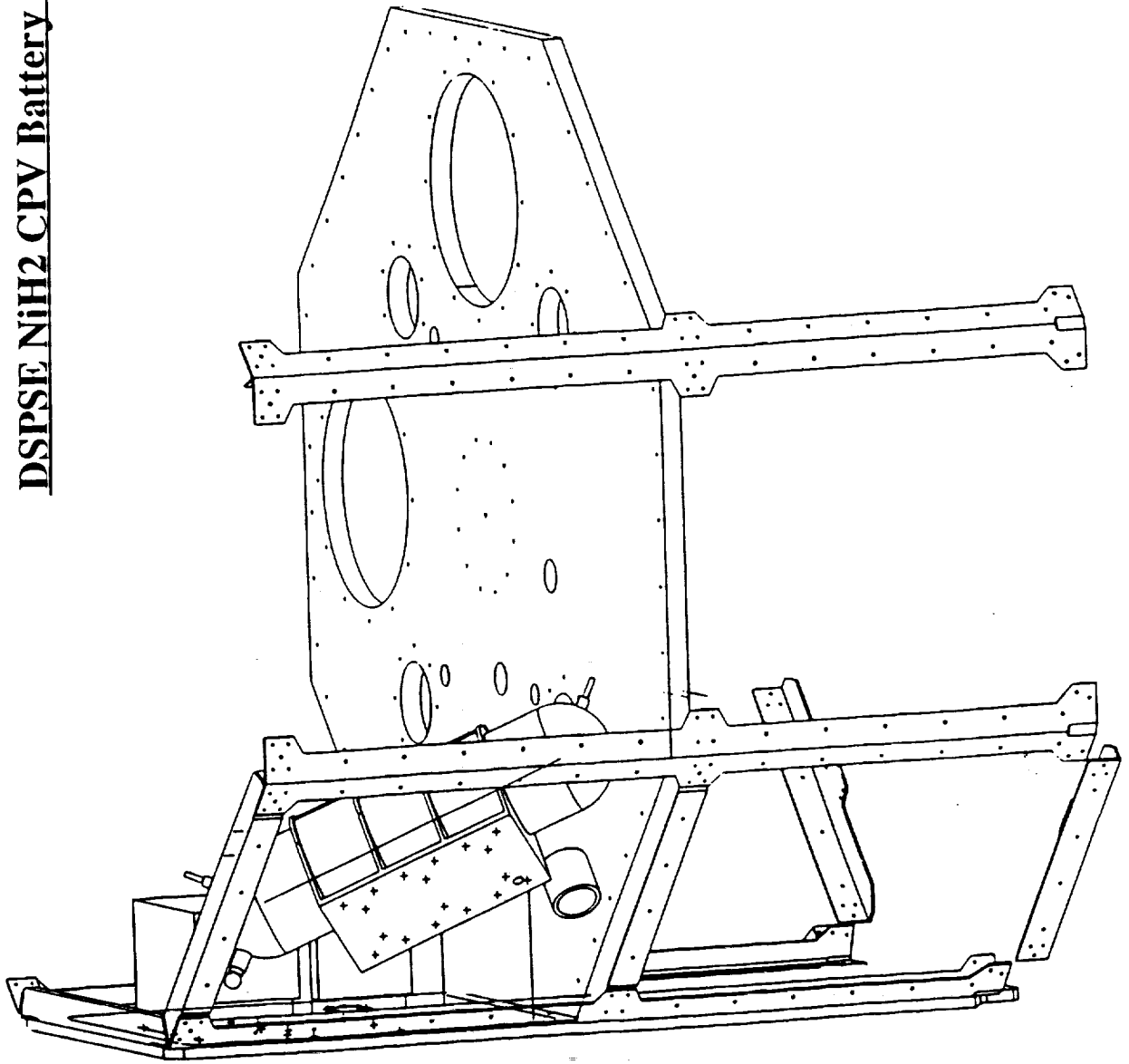
CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

DSPSE NiH2 CPV Battery

- **Nickel Hydrogen Common Pressure Vessel Battery**
- **Manufacturer** Johnson Controls Inc
- **Part No** 28015SCK
- **Nameplate Capacity** 15.0 Ampere Hour
- **No. Of Cells** Twenty-Two
- **Length** 21.0 inches
- **Diameter** 5.0 inches
- **Weight** 17.60 lbs
- **Pressure Vessel** Inconel 718 0.030 inch thick
- **Separator** Asbestos
- **Electrolyte** Potassium Hydroxide (31%)
- **Graphite Epoxy Battery Structure**
- **R Cubed Composites**
- **Material P120 Thermal & T300 Graphite Fibers In ERL 1939-3 Resin**
- **Weight** 2.30 lbs
- **Total Battery Weight** 21.20 lbs

CHARGE CONTROL FOR THE DSPSE NiH₂ CPV BATTERY

DSPSE NiH₂ CPV Battery On Spacecraft



17 NOVEMBER 1993

CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

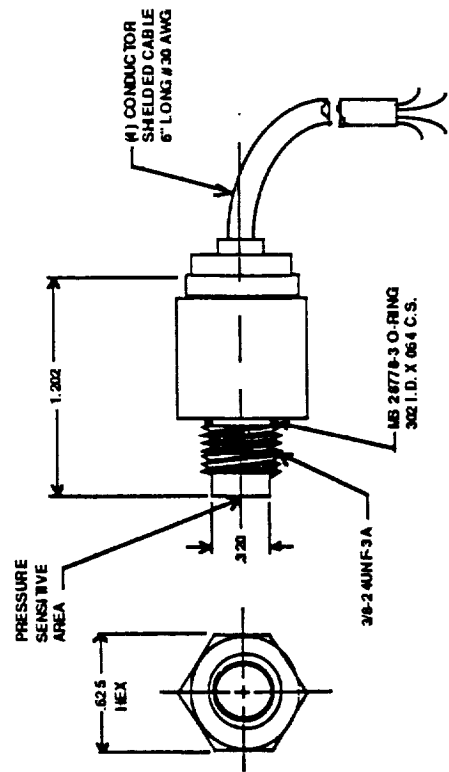
Pressure Based Charge Control

- **Charge Battery At High Rate (C/5 Amps) To Pressure Switch Point**
- **Lower Charge Rate To (C/100 Amps) For Remainder Of Orbit**
- **Characterize All Potential Flight Batteries**
 - **Establish Temperature (-10,0,10 & 20°C)**
 - **Charge At High Rate To Voltage Rollover**
 - **Discharge To 22.0 Volts At C/2 Amps**
- **Select Two Pressure Set Points For Flight Operation**
- **Cycle Battery Using P-based Charge Control**

CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

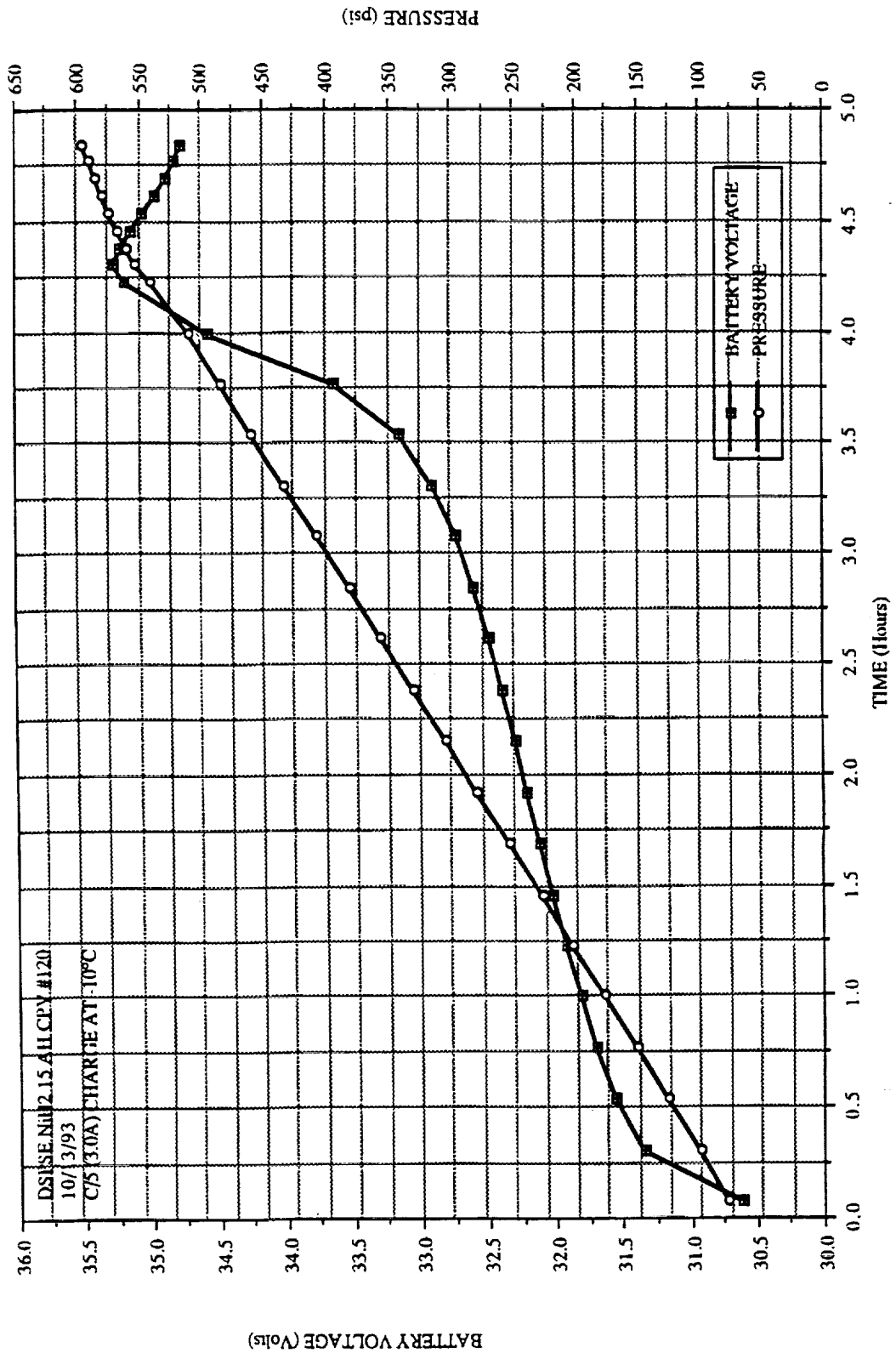
DSPSE Battery Pressure Transducer

- **Manufacturer** Kulite
- **Model No.** ETM - 341-375 -1000A
- **Sensing Principle** Fully Active Four Arm Wheatstone Bridge
- **Pressure Range** 0 - 1000 psia
- **Full Scale Output** 10 Vdc
- **Excitation** +12 Vdc
- **Maximum Current** 25 mA
- **Weight** 35 g (1.23 oz)



CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

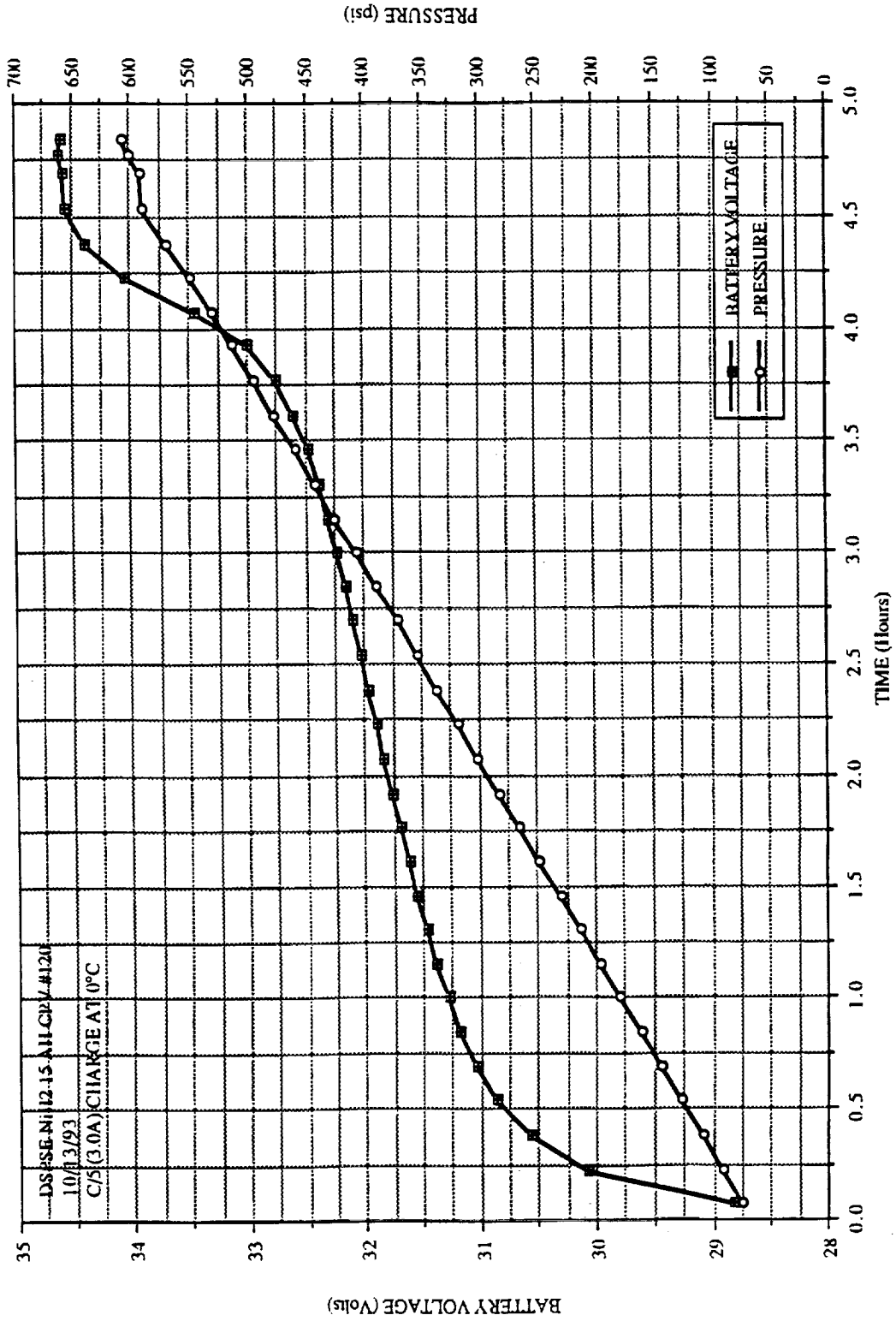
3.0 A Charge @ -10°C



17 NOVEMBER 1993

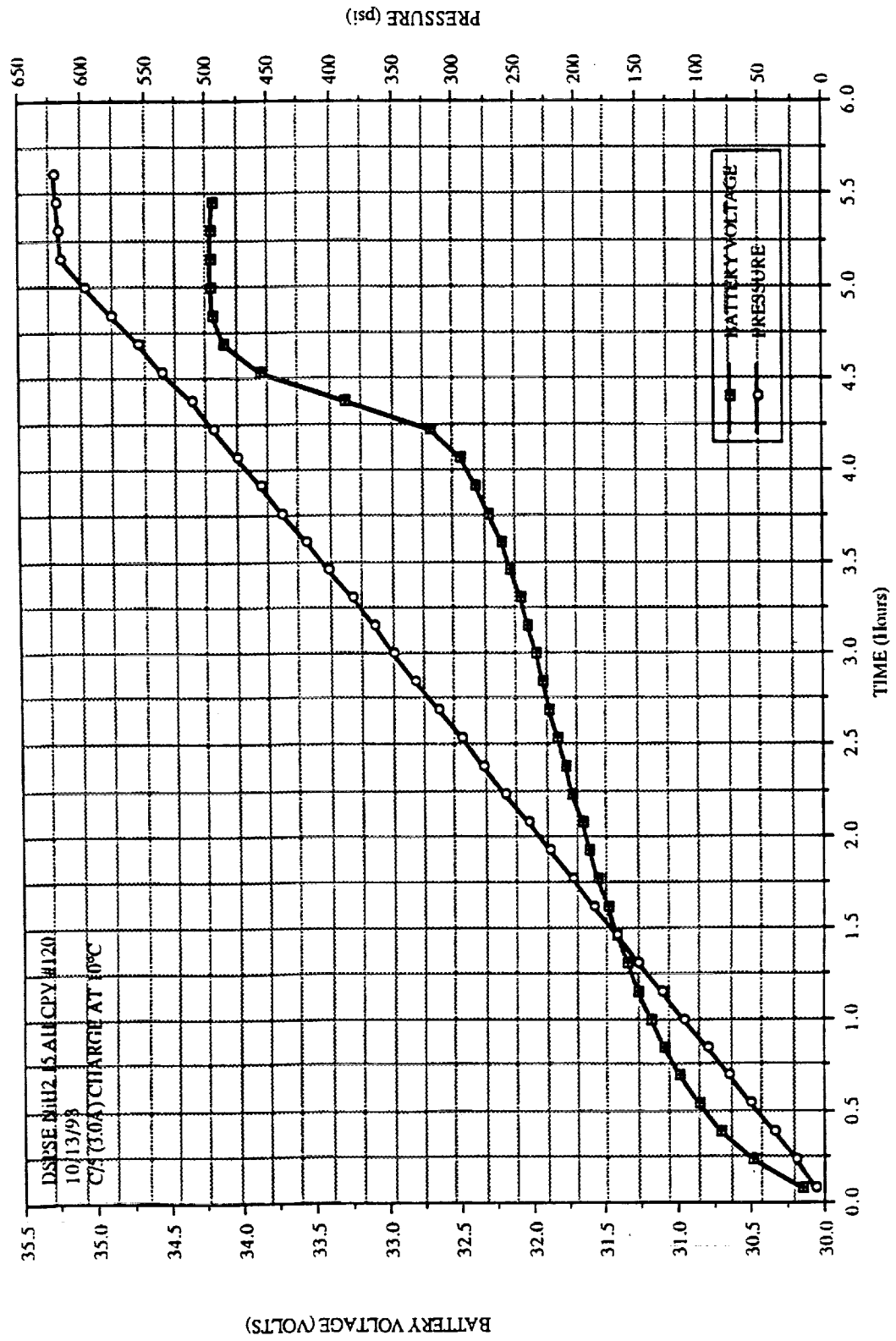
CHARGE CONTROL FOR THE DSPSE NIH2 CPV BATTERY

3.0 A Charge @ 0°C



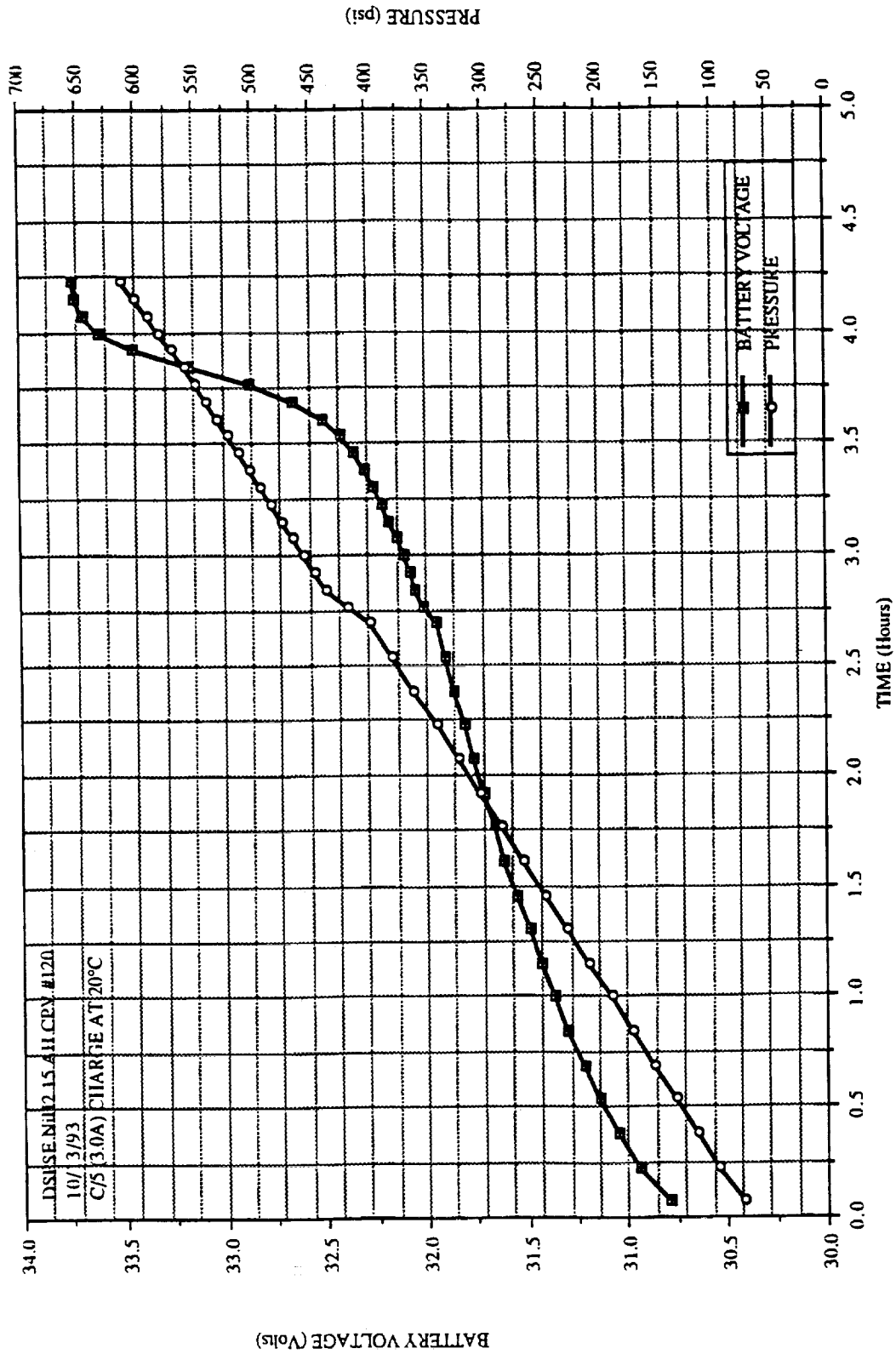
CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

3.0 A Charge @ 10°C



CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

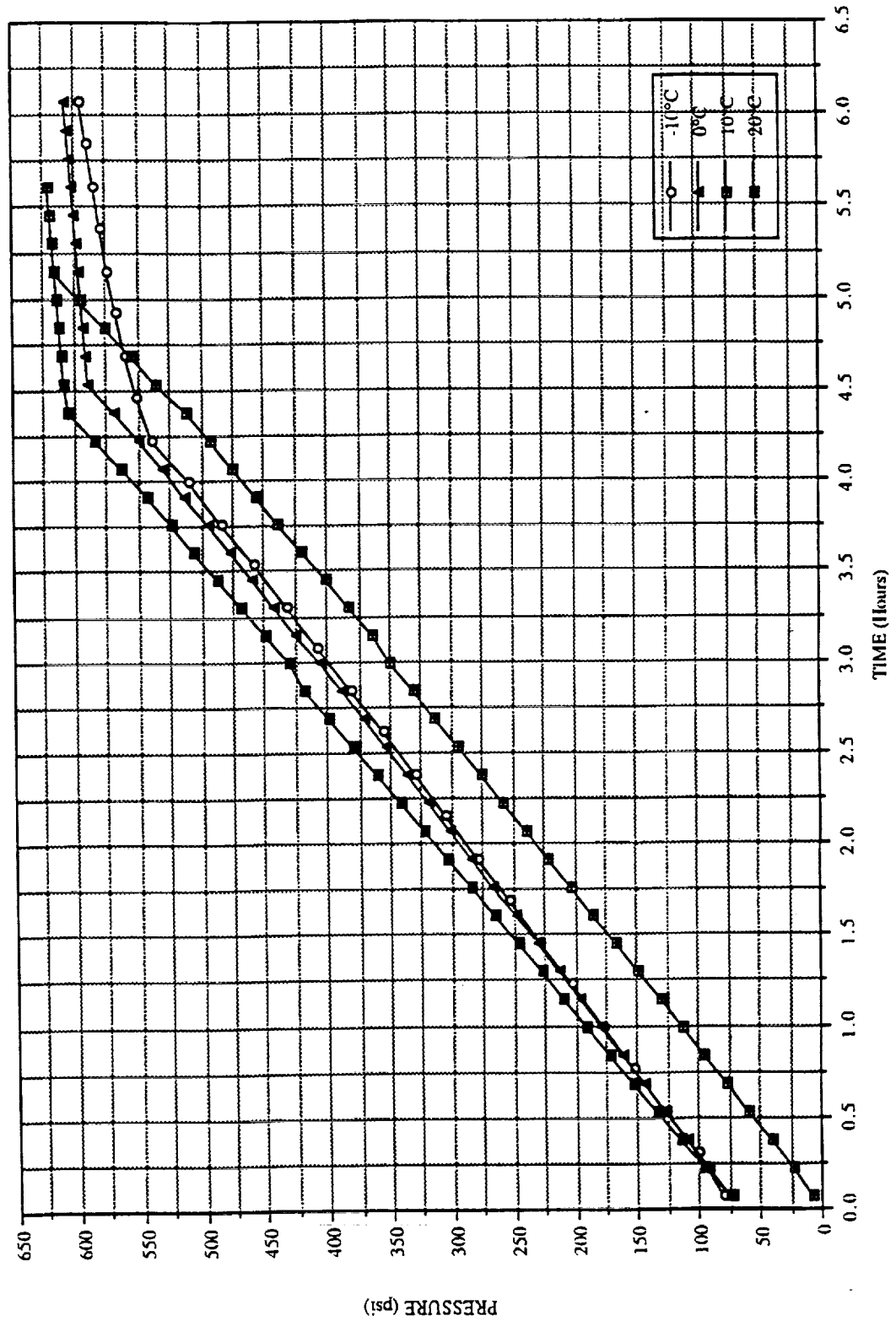
3.0 A Charge @ 20°C



17 NOVEMBER 1993

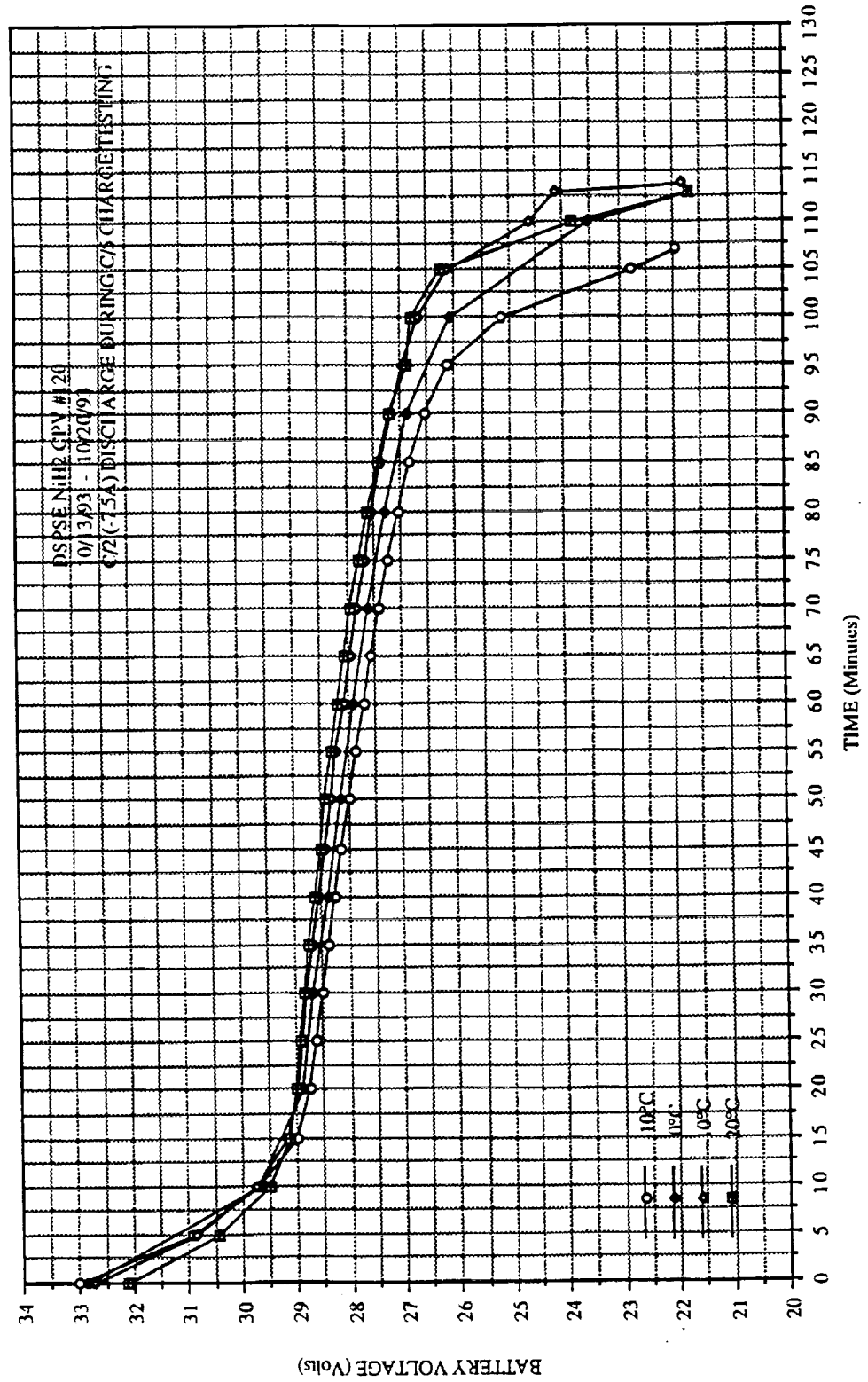
CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

3.0 A Charge: Pressure Vs Time



CHARGE CONTROL FOR THE DSPSE NIH2 CPV BATTERY

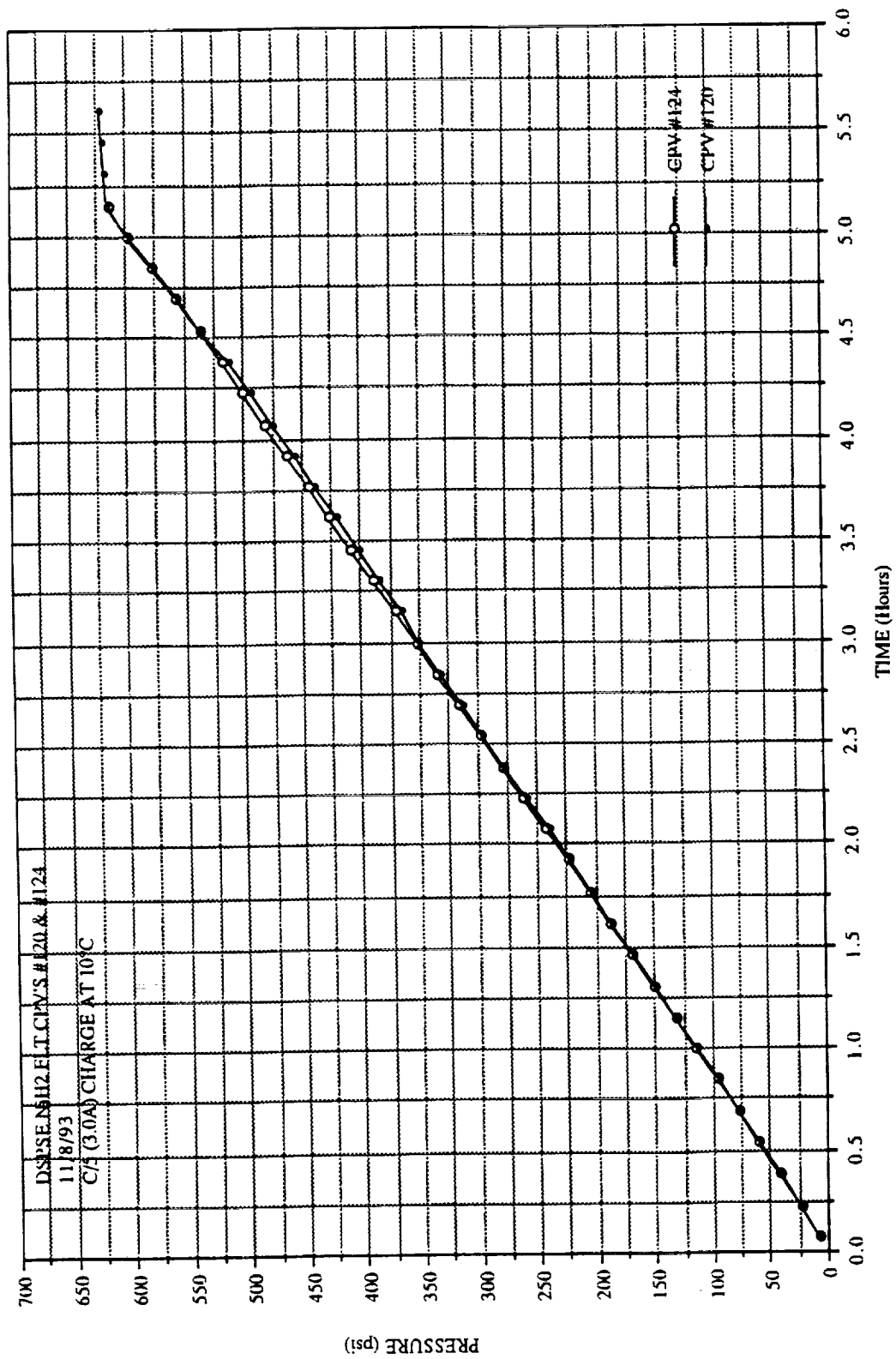
-7.5 A Discharge To 22.0 Volts



17 NOVEMBER 1993

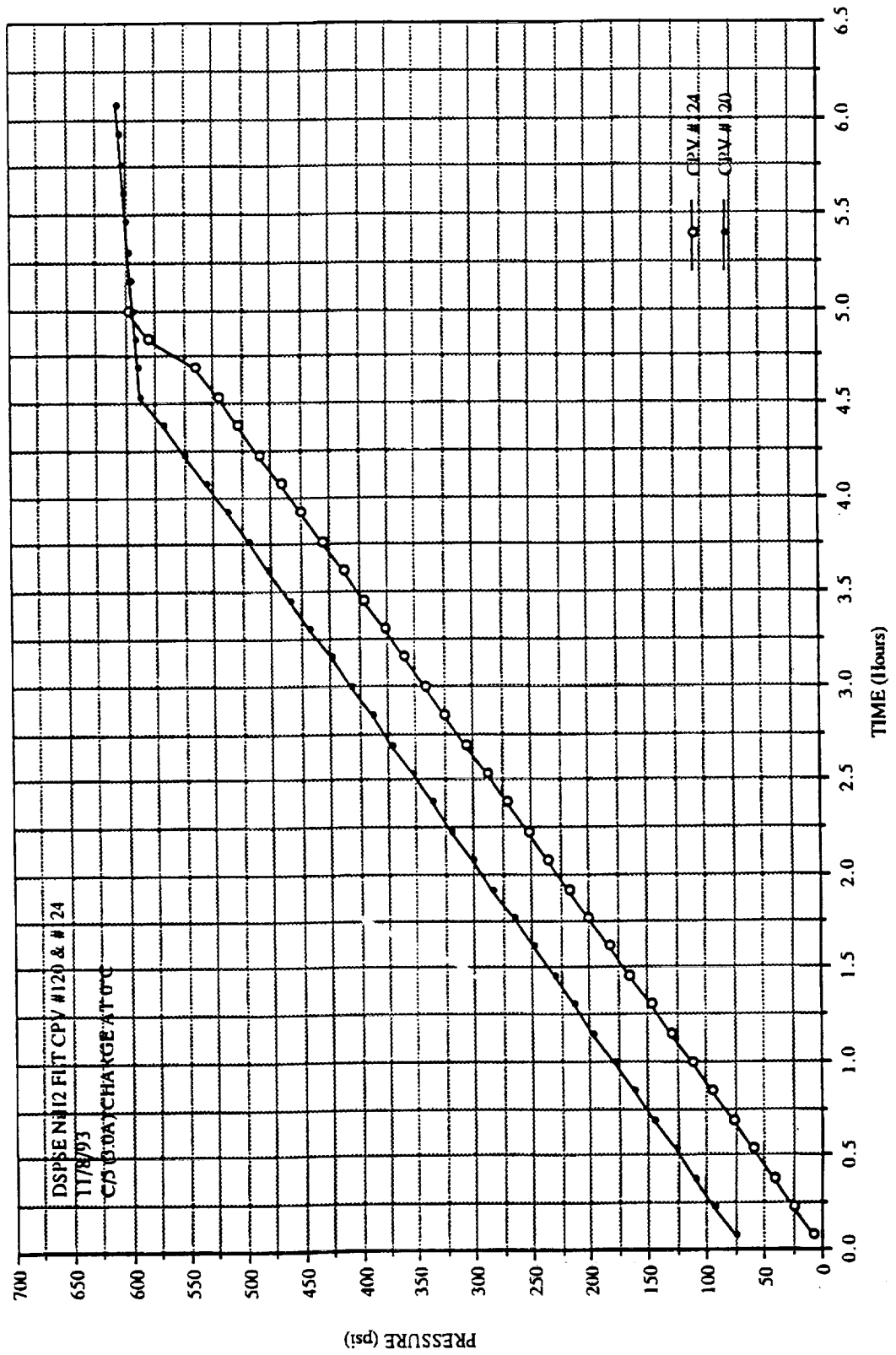
CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

S/N 120 vs S/N 124 @ 10°C



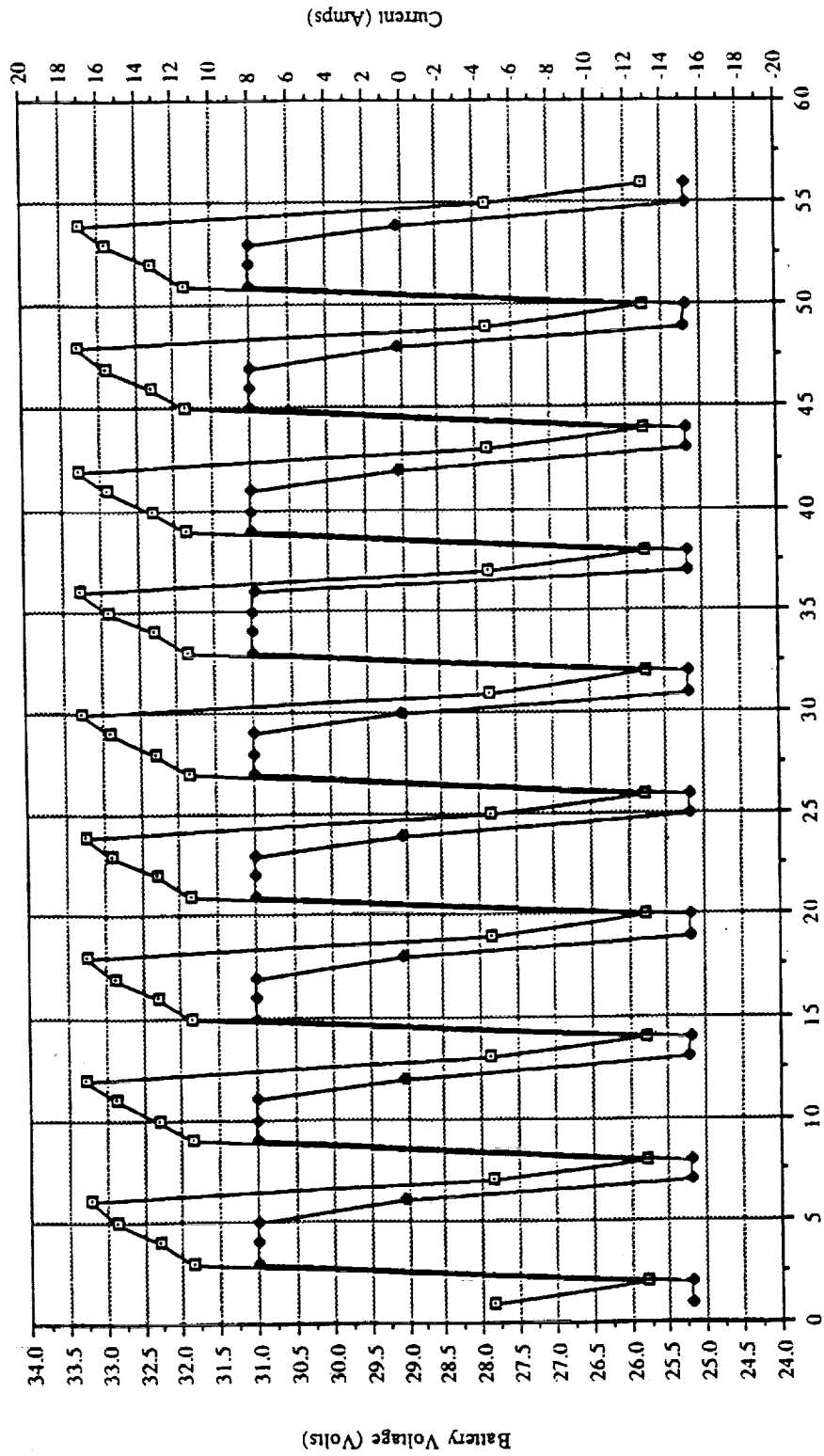
CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

S/N 120 vs S/N 124 @ 0°C



17 NOVEMBER 1993

CHARGE CONTROL FOR THE DSPSE NIH2 CPV BATTERY
S/N 120 LEO Cycling Using P-Based Charge Control
Voltage & Current vs Time

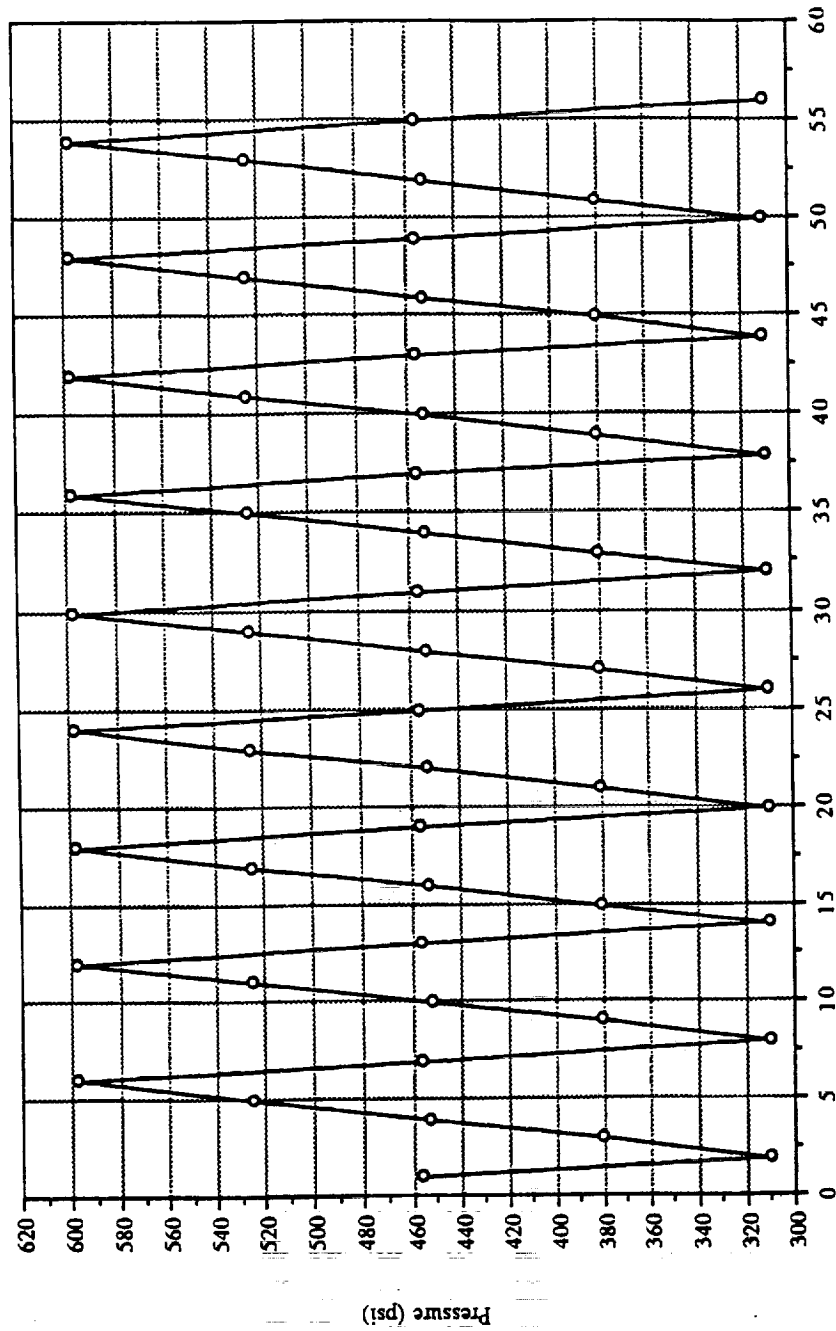


17 NOVEMBER 1993

CHARGE CONTROL FOR THE DSPSE NiH2 CPV BATTERY

S/N 120 LEO Cycling Using P-Based Charge Control

Pressure vs Time



CHARGE CONTROL FOR THE DSPSE NIH2 CPV BATTERY

Summary

- **NRL/BMDO DSPSE Spacecraft To Use NIH2 CPV With Pressure Based Charge Control Method**
- **Pressure Based Charge Control**
 - High Rate (C/5 = 3.0 amps) Pressure Set Point**
 - Low Rate (C/100 = 0.150 amps)**
- **Pressure Set Points Of 600 psi and 650 psi Picked For Flight**
- **Pressure Characterization Of Batteries Important**
- **Further Study with Qual/Flight Spare to Investigate Long Term Performance**