# 4100

# LOAD MODULES

# HARDWARE REFERENCE MANUAL

**Part No. 09-0300**

**REVISION A**

**December 09, 2009**

## Document History

| | | | |
|---|---|---|---|
| **Rev A** | **Preliminary** | **12/09/2009** | **J. A.** |

## Proprietary Rights Notice

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# 1. GENERAL INFORMATION

## 1.1 Overview

The 4100 Series Modular Dynamic Load Modules also use a "Constant Power" design. These loads use a state-of-the-art thermal management system to achieve a power density of 300W per slot, for a maximum of 1800W per 5¼ inch S300 chassis. A unique multi-range design is used to cover test requirements from 0.7V to 450V, and current from milliamps to 60A, in five different output ranges. The power handling capability can be expanded through paralleling additional modules.

### 1.1.1 Topology

The 4100 Series Loads employ a linear power design for fastest response time and quiet operation. Constant current, constant power, constant resistance, and constant voltage operating modes are provided, along with a true hardware SCR and relay crowbar-type short circuit mode. An advanced Texas Instruments DSP processor is used to tightly synchronize paralleled modules, as well as provide programmable output waveforms with unprecedented accuracy compared with older, more limited analog designs.

### 1.1.2 Model Number Description

| Model Number | NHR P/N | Description |
|---|---|---|
| S300 | 1108049 | Power Subsystem IEEE488.2 |
| 4100 | 1108299 | LOAD, 60A, 450V, 300W |
| 4110 | 1108277 | LOAD, 60A, 80V, 300W |

## 1.2 Dynamic Load Module Specification

### 1.2.1 Specified Operating Conditions

Speed and accuracy specs apply at the following operating conditions:

| | |
|---|---|
| Ambient Air: | 27 +/-5 °C |
| Warm-up time: | 10 minutes |
| UUT impedance: | non-inductive (<300nH) |

Units operate at reduced speed and accuracy up to the limits of the environmental specifications.

### 1.2.2 Operating Conditions

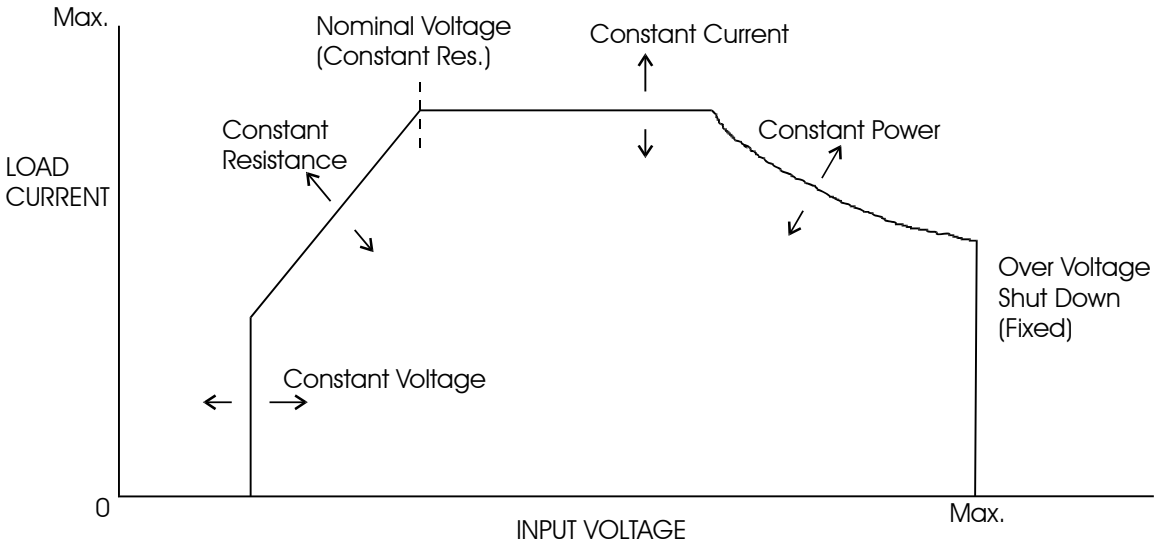
**Power:** 300W Continuous @<35°C, sea level; above 35°C derates by 15W per °C to 150W max at 45°C.

| | 60A ,120/450V LOAD | | | |
|---|---|---|---|---|
| | Voltage | Current | Power | |
| | | | Continuous | Maximum |
| Range 1: | 0.2 - 120Vdc | 0 - 660mA | 40W | 40W |
| Range 2: | 0.2 - 120Vdc | 0 - 6A | 300W | 450W |
| Range 3: | 2.1 - 120Vdc | 0 - 60A | 300W | 450W |
| Range 4: | 4 - 450Vdc | 0 - 660mA | 40W | 40W |
| Range 5: | 4 - 450Vdc | 0 - 6A | 300W | 450W |

| | 60A ,8/80V LOAD | | | |
|---|---|---|---|---|
| | Voltage | Current | Power | |
| | | | Continuous | Maximum |
| Range 1: | 0.1 - 8Vdc | 0 - 6A | 48W | 48W |
| Range 2: | 0.7 - 8Vdc | 0 - 60A | 300W | 450W |
| Range 3: | 0.7 - 80Vdc | 0 - 660mA | 40W | 48W |
| Range 4: | 0.7 - 80Vdc | 0 - 6A | 300W | 450W |
| Range 5: | 0.7 - 80Vdc | 0 - 60A | 300W | 450W |

### 1.2.3 Operating Modes

The native operating mode of the S300 is Auto Mode, in which the unit auto switches between Constant Resistance, Current, and Power Modes, depending on the applied input voltage. This allows smooth, automatic switching between operating modes driven only by the input voltage. To understand this operation, refer to the following drawing:




Each setting (voltage, resistance, current, or power) sets a maximum that the load cannot exceed. However, the load may be operating at a *lower* setting if the input voltage puts it in some other mode.

Starting from 0V, the load current will stay at 0A until the Constant Voltage setting is reached. If the current capability of the voltage source is less than the voltage divided by the Constant Resistance setting, then the load will stay in Constant Voltage Mode. Otherwise, the load goes into Constant Resistance Mode. As the input voltage rises further, up to the Nominal Voltage setting, the load will go into Constant Current Mode. If the input voltage is raised further, the load may go into Constant Power Mode. Finally, if the input voltage is raised above the maximum rated voltage, the load will shut down completely, with the current going to 0.

Note that not all of these modes may actually be used, depending on the settings. For example, if the Resistance setting is too small, or the Voltage setting too large, the load will go directly from Voltage to Current Mode. Or, if the Resistance is high enough and the Power is low enough, the load may go directly from Resistance to Power Mode.

The Voltage Mode may also be used as a programmable under voltage turn off. See the discussion under "Anti-Saturation/Auto Shut Off/Under Voltage Lockout" below for more information.

Software commands are also available which program Constant Voltage, Current, Resistance, and Power Modes by setting the other modes to maximum or minimum default values, pushing them as far out of the way as possible.

**Constant Current:**

| Current Ranges: | Accuracy: |
|---|---|
| 0 - 660mA | 660uA + 2uA/V |
| 0 - 6A | 30mA + 2uA/V |
| 0 - 60A | 60mA + 2uA/V |

Resolution: 12 bits (0.025%FSR) [FSR = Full Scale of Range]

**Constant Voltage:**

This mode may be turned off completely by programming a negative voltage.

| Voltage Ranges: | 60A,120/450V | 60A,8/80V |
|---|---|---|
| | 0.1V - 120V | 0.1V - 8V |
| | 1.5V - 450V | 0.5V - 80V |
| Resolution: | 12 bits (0.025%FSR) | |
| Accuracy: | 0.1%FSR | |

**Constant Resistance:**

In this mode, the load sets a maximum current equal to the nominal voltage setting divided by the resistance setting. The load will current limit at this maximum current setting. Below this setting, the current is proportional to the voltage; above this setting, the current stays at its limit value without regard to voltage. The load functions this way to allow smooth switching between Constant Current and Constant Resistance Modes as a function of the input voltage in Auto Mode.

Two separate DACs are used for nominal voltage and maximum current to ensure compatibility with NH Research Powertest® automated power supply test systems.

60A,120/450V Module

| Current | Nominal Voltage | Resistance |
|---|---|---|
| 0 - 660mA | 0.2 - 120Vdc | 2.5 to 10K ohms |
| 0 - 6A | 0.2 - 120Vdc | 0.25 to 1K ohms |
| 0 - 60A | 0.2 - 120Vdc | 0.025 to 100 ohms |
| 0 - 660mA | 4 - 450Vdc | 6.6 to 10K ohms |
| 0 - 6A | 4 - 450Vdc | 0.66 to 10K ohms |

60A,8/80V Module

| Current | Nominal Voltage | Resistance |
|---|---|---|
| 0 - 6A | 0.1 - 8Vdc | 0.03 to 200 ohms |
| 0 - 60A | 0.1 - 8Vdc | 0.01 to 100 ohms |
| 0 - 660mA | 0.7 - 80Vdc | 2.5 to 10K ohms |
| 0 - 6A | 0.7 - 80Vdc | 0.1 to 2K ohms |
| 0 - 60A | 0.7 - 80Vdc | 0.01 to 1K ohms |

Resolution and accuracy as a *percentage* of the set *resistance* is given by the following formulas, where R is the set resistance value *in ohms* and V is the input voltage *in volts*:

Typical Accuracy: 0.5%

**Constant Power:**

660mA Range:

| | |
|---|---|
| Range: | 0 to 48W |
| Resolution: | 15mW |
| Accuracy: | 1% of setting + 0.3W |

6Amp Range:

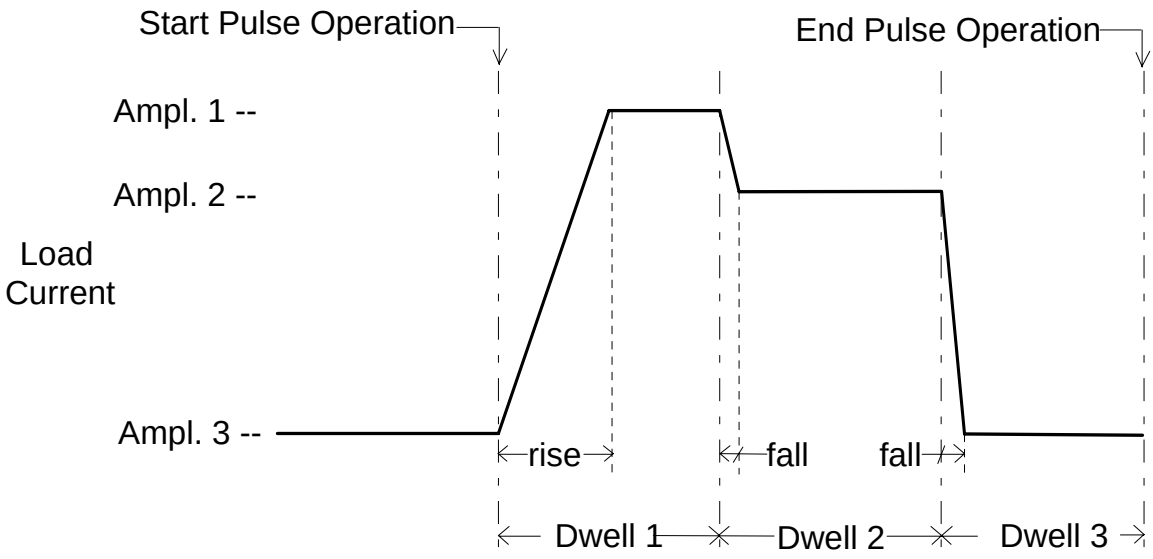
| | |
|---|---|
| Range: | 0 to 450W |
| Resolution: | 0.15W |
| Accuracy: | 1% of setting + 3W |

60Amp Range:

| | |
|---|---|
| Range: | 0 to 450W |
| Resolution: | 0.15W |
| Accuracy: | 6W + 75mW/V |

### 1.2.4 Pulse Mode Operation

In this mode the load puts out a sequence of up to 3 programmable current settings. The time delay between each new current setting is independently programmable. This feature, along with the programmable rise/fall times, allows the user to synthesize a wide range of multi-leveled square, pulse, ramp, or triangle waveforms. The output sequence may be synchronized to other modules for parallel operation.




Total Period: 40usec to 10Sec (25kHz to 1Hz)

| | |
|---|---|
| Delay between settings: | 20uSec to 10Sec |
| Resolution: | 10uSec |
| Accuracy: | 1% + 5uSec |
| Modes: | Single Burst, Continuous |

### 1.2.5 Programmable Rise Time

Programmable rise time is only used in Constant Current Mode. All other modes always run at maximum speed. The rise time control is implemented digitally with a DSP processor, giving high accuracy and flexibility over a wide range without any calibration. The rise and fall time can be programmed independently, without restrictions.

Range: 10uSec to 8 Sec
Resolution: < 2uSec
Accuracy: 1% of setting + 5uSec

Fastest slew rates are specified at 10% to 90% of the step magnitude, at a current step of 10% to 100% of full-scale. Slewing up or down from 0A (load shut down) may be slower due to turn-on delays.

### 1.2.6 Dynamic Performance

Within a single operating range, changing from one current setting to another, or changing between Constant Current, Voltage, Resistance, or Power Modes, is continuous and glitch free in Auto Mode at all settings within the normal specified operating conditions.

The load is turned off when changing operating ranges, to avoid transients. The user selects an operating range explicitly via a range select command at the beginning of each test. The load does not change ranges under any other conditions, to avoid glitching.

### 1.2.7 External Modulation

The output current can be modulated with an external analog signal. This signal is referenced to the output common (the low side), and not isolated. The external modulation is controlled by an enable bit that can be set by a software command.

| | |
|---|---|
| Input range: | 0 to +5.0V |
| Bandwidth: | DC to 25 kHz |
| Accuracy: | 10% of FS |
| Input impedance: | 1 M Ohm |

### 1.2.8 Metering

**Metering Speed:**

The A/D converter completes each measurement cycle to rated accuracy within 70 msec. Through IEEE488 communication the overall response time to get a reading is approximately 160mS.

**DC Voltage:**

Resolution: 0.000013%FS
Accuracy: 0.01% reading + 0.01%FS

**DC Current:**

Resolution: 0.00001%FS

Accuracy:
660mA Range: 0.3mA + 2uA/V
6 Amp Range: 5mA + 2uA/V
60 Amp Range: 15mA

**Power:**

Calculated in software from voltage/current measurements.

Ranges:

| Load Type | 120v/450v | 8v/80v |
|---|---|---|
| Range 1 | 0 to 40W | 0 to 48W |
| Range 2 | 0 to 400W | 0 to 400W |
| Range 3 | 0 to 400W | 0 to 40W |
| Range 4 | 0 to 40W | 0 to 400W |
| Range 5 | 0 to 400W | 0 to 400W |

Accuracy:

| Load Type | 120v/450v | 8v/80v |
|---|---|---|
| Range 1 | 19mW worst case | 40mW worst case |
| Range 2 | 1.9W worst case | 120mW worst case |
| Range 3 | 1.9W worst case | 24mW worst case |
| Range 4 | 67mW worst case | 400mW worst case |
| Range 5 | 6.7W worst case | 1.2W worst case |

Resolution:

| Type | 120v/450v | 8v/80v |
|---|---|---|
| Range 1 | 300μW worst case | 600μW worst case |
| Range 2 | 3mW worst case | 2mW worst case |
| Range 3 | 30mW worst case | 380μW worst case |
| Range 4 | 1.2mW worst case | 6.3mW worst case |
| Range 5 | 12mW worst case | 19mW worst case |

**Heat Sink Temperature:**

Range: +2 to +100 deg C
Accuracy: 5 deg C

### 1.2.9 Protection Circuits

**Over Current:**

In all operating modes, current through the output FETs is limited to a maximum level set by the constant current DAC. Higher or lower current limit values may be programmed by changing the constant current setting.

**Over Voltage, 120/450V Load:**

The output is protected by a varistor device, which will clamp any transient voltages above 450VDC. In addition, all components connected to the output are rated for at least 500VDC continuous. The load also includes an overvoltage trip circuit that shuts down the load in the presence of an overvoltage condition in either the 120V or 450V ranges.

**Over Voltage, 8/80V Load:**

Each FET is avalanche rated for 150volts. This FET will turn on to prevent the source from applying a greater voltage, thereby protecting itself. The load also includes an overvoltage trip circuit that shuts down the load in the presence of an overvoltage condition in either the 8V or 80V ranges.

**Over Power:**

The power limit can be programmed from 0 up to the maximum allowed setting. The load will always limit the power to this level to prevent damage from an over power condition. The power is limited by a real-time analog multiplier circuit for protection against fast transients.

**Over Temperature:**

In addition to the above power limit, the unit also shuts down when the temperature of the heat sink exceeds a preset limit, for maximum safety and reliability.

**Reverse Voltage:**

Each FET has an internal reverse parallel diode to short the output in the presence of a reversed DC voltage input.

**Anti-Saturation/Auto Shut Off/Under Voltage Lockout:**

Auto switching between operating modes in the Auto Mode gives us a unique degree of flexibility in handling an under voltage condition. The load will automatically switch to Constant Resistance Mode below nominal voltage, which will help the UUT power up. Also, to prevent the UUT from going into a fully on state at 0V, the constant voltage can be set which will turn the load completely off below this voltage. Thus, the exact turn on behavior is fully programmable without any special operating modes.

### 1.2.10 Short Circuit

The load includes a short circuit capability as standard equipment. The initiation of a short circuit can be synchronized with multiple modules to allow parallel operation or simultaneous shorting of multiple outputs. A unique circuit design ensures proper operation when multiple loads are used in parallel, without damage. Under static conditions, the load looks like a low-resistance short circuit in series with a high current diode.

Transient Crowbar Current: 500A peak max
Maximum Current (Continuous): 110% of full scale for each range
Maximum Voltage Drop: 2.1V(120/450v),0.7V(8/80V) @ 60A

### 1.2.11 Leakage Current

When shut down, the leakage current does not exceed 100uA + 2uA/V @27deg C.

### 1.2.12 Trigger Output

The load includes a trigger output synchronized to a programmed load current step, for triggering external measurement devices, such as an oscilloscope. The trigger output consists of an open collector optocoupler, isolated up to 500V from the load common, which pulses closed for 11 μSec when the current setting is changed. This may be turned on or off under software control.

### 1.2.13 Current Monitor Output

An analog current monitor signal is provided. The signal is referenced to the load output common (the low side) with a Kelvin sensed return lead.

Output Range: 0 to +5V for full scale current in each range

| Load Part Number | Current Monitor Accuracy |
|---|---|
| 1108277, 1108299 | 10% Full Scale |
| 1108677 | Same as DC Current Metering Accuracy(1.4.8)* |

* To achieve this accuracy calibration coefficients must be applied to raw current monitor voltage reading. Actual Current = $Dx^3 + Cx^2 + Bx + A$ , x is the Current Monitor Voltage reading. Refer to 7.2 Diagnostic Subsystem to obtain coefficients D, C, B and A for each current range.

### 1.2.14 Isolation

The load is isolated from chassis ground so that any point in the isolated circuitry can be floated up to +/-500VDC from the chassis ground.

### 1.2.15 Remote Voltage Sense Input

Remote voltage sense input lines are provided to avoid errors in voltage measurements due to drops in the main output cables. These sense lines should always be properly connected. The unit will still operate with the remote sense lines unconnected, but with significantly reduced accuracy. The remote sense will function with a drop of 2VDC between each sense and power lead. The voltage sense input is fully protected against reverse input and over voltage conditions, up to the full isolation rating of +/-500V from common. The load will not be damaged or draw excessive current under any voltage sense failure condition.

### 1.2.16 OVPS Relay

For compatibility with NH Research Powertest® automated power supply test systems, a DPST relay is included on the load to connect the UUT input leads to an external OVPS. The relay

drive coil leads are brought out to the signal connector, to allow isolated control via an external 24V DC driver. The relay contacts are rated for 5A maximum.

### 1.2.17 Parallel Loads

Loads can be paralleled in all operating modes, including Short Circuit Mode. Loads can be software configured into logical loads. Load changes are synchronized via the back plane and the on-board DSP processor. No special hardware connections are necessary for synchronization or current sharing.

### 1.2.18 Physical

| | |
|---|---|
| Size: | One S300 chassis slot |
| Weight: | 6 lb. |
| Connectors: | One 8-pin Positronics connector for the power and remote voltage sense leads.<br>One 25-pin DSub connector for the control and signal leads. |

### 1.2.19 Noise

Measured 50Hz - 10MHz, constant I mode, full rated output

Max PARD:

Ranges 1,2,4: 25mA pk-pk 15mA RMS
Ranges 3,5: 2.5mA pk-pk 1.5mA RMS

### 1.2.20 Over Temperature Operation

The overtemperature function protects the module from exceeding its maximum operating temperature and thus damaging itself. This temperature is measured on the module heatsink and may not exceed 90 degrees C.

After an overtemperature trip occurs, the tripped channel must be reset before it may be re-programmed.

## 1.3 Firmware Capability

The S300 firmware contains an extensive command set for control of the instrument over the IEEE-488 bus interface and via an optional front panel interface. These commands include instrument settings as a stimulus, and readback instrumentation capability. Additionally, commands are available for diagnostics, software calibration and configuration/identification readings. Examples of configuration/identification functions are reading instrument model number, serial number and firmware version as well as define and/or review logical/physical settings. Refer to Section 4 for a description of front panel operation. Refer to sections 5, 6, and 7 for a description of SCPI commands.

### 1.3.1 Self-test and Built-In-Test

The instrument contains advanced on-command and continuous Built-in-test. Two levels of self-diagnostics are supported:

CONTINUOUS BIT

The instruments firmware continuously monitors numerous fault flags. Should any failure or out-of-tolerance condition result the instrument will automatically alert the host computer and turn off the output, thus providing protection to the UUT. If the optional isolation relay is installed the output will be switched to a high impedance state. The fault flags are:

| Fault | Load | DC Source |
|---|---|---|
| Over current | No | Yes |
| Over voltage | Yes | Yes |
| Under Voltage | No | Yes |
| Over temperature | Yes | Yes |

SELF-TEST

The self-test assures early detection of hardware problems and minimum time to repair when a failure does occur. A main status word (1 byte) summarizes the hardware status and firmware error detection flags. A discrete fault line is also provided. Should more detailed information be required, status registers provide complete status information on the performance and state of the hardware. All output voltages shall be isolated from the output terminals via the isolation relay option during testing. If this option is not installed the set voltage and overvoltage tests are not performed. The test runs in less than 3 minutes and identifies over 90% of all possible faults.

### 1.3.2 Closed Cover Calibration

Software calibration is provided for the DC Source modules. The DC Source may be fully calibrated through the IEEE-488 interface bus - no internal adjustments are required.

Load calibration requires a Load Calibrator due to the high accuracy tolerance of the load.

Calibration parameters are stored on EEPROM, which resides on each module. Thus, replacing failed modules does not require recalibration of the instrument.

## 1.4 Design and Construction

The instrument is designed and built to MIL-STD-28800C Type III hardware requirements for commercial off-the-shelf hardware as well as MIL-STD-45208 quality assurance standards.

### 1.4.1 Reliability

The fully loaded instrument with six 400W modules installed has a total system MTBF of 15,000 hours as a minimum.

### 1.4.2 Vibration and Environmental

The S300 meets the following requirements:

Temperature:

Temp (op): -10 to 50 deg C (Max inlet air temperature)
Temp ( non-op): -40 to 85 deg C

Humidity:

95% @ 50 deg C, (Non condensing environments only)

Altitude:

Altitude (op): 6,000 ft
Altitude (non-op): 40,000 ft

Vibration:

3 g's in three planes for 15 minutes as follows:

Freq: 10-2000 Hz
Excursion: 0.015 inches

Shock:

15g's on three axis for 11mSec duration using half sinewave shock waveforms.

EMI/RFI:

The instrument is compliant with MIL-STD-461C.

## 1.5 Deliverable Documentation

NH Research delivers a manual with each instrument:

The User's Manual includes all documentation and procedures to install and interface the instrument. Included are initial inspection procedures, power and grounding requirements, safety and hazard warnings, environmental information and operating instructions.

## 1.6 Quality Provisions

NH Research designs and manufactures its instrumentation products to normal commercial practices and conforms to MIL-I-45208A quality assurance standards and MIL-STD-28800C performance requirements. Each instrument undergoes 100 hours of elevated temperature burn-in testing (50 deg C) prior to final acceptance testing and delivery. Written verification and performance data are delivered with each unit.

## 1.7 Applicable Specifications

The instrument complies with the following specifications:

| | |
|---|---|
| MIL-STD-28800D Type III, Class 3 | MIL-STD-45208 Quality Standards |
| MATE Spec 2806763C | VDE Compliant |
| UL Compliant | CSA Compliant |
| IEC 435 Safety and Isolation | IEC 380 Safety Requirements |

MIL-STD-461C EMI Part 7 (for commercial test equip.)

# 2. CONTROL CABLING HOOKUP

Load Module Connections

**Power**:

Power unit under test (UUT) connection is made via a cable attached to the power connector labeled "OUTPUT" located on the rear of a Load module.

LOAD MODULE "OUTPUT" CONNECTOR

| PIN # | DESCRIPTION | PIN # | DESCRIPTION |
|---|---|---|---|
| 1 | UUT+ | 5 | UUT- |
| 2 | UUT+ | 6 | UUT- |
| 3 | UUT+ | 7 | UUT- |
| 4 | VSENSE+ | 8 | VSENSE- |

**Auxiliary Output Connection**:

Auxiliary connections are made through the male 25 pin D-sub connector labeled "INTERFACE" on the rear of a Load module.

LOAD MODULE INTERFACE CONNECTOR

| PIN # | DESCRIPTION | PIN # | DESCRIPTION |
|---|---|---|---|
| 1 | RSYNC- | 14 | - |
| 2 | RSYNC+ | 15 | - |
| 3 | OVPS_REL_COIL+ | 16 | OVPS_REL_COIL- |
| 4 | - | 17 | - |
| 5 | - | 18 | - |
| 6 | COM (isolated) | 19 | V_MODULATE+ |
| 7 | - | 20 | - |
| 8 | COM (isolated) | 21 | - |
| 9 | IMON-OUT | 22 | - |
| 10 | - | 23 | - |
| 11 | - | 24 | OVPS_POWER- |
| 12 | OVPS_POWER+ | 25 | OVPS_POWER- |
| 13 | OVPS_POWER+ | | |

RSYNC_O consists of an open collector optocoupler, isolated up to 500v from the source common. This is normally open and will go closed for 11 microseconds upon a current change. A maximum of 1 milliamp and 20 volts are allowed.

IMON-OUT is an analog signal 0 to 5 volts representing 0 to full scale output current. **This signal is not isolated**, it is referenced the Load output common.

V_MODULATE the peak instantaneous input voltage is limited to +5VDC. Input impedance 1 Megohms. **This input is not isolated**, it is referenced the Load output common. 5 Volts in

equals FS current out. This input may be enabled or disabled under software control. See 7.8 Current Subsystem..

All other pins are used internally.

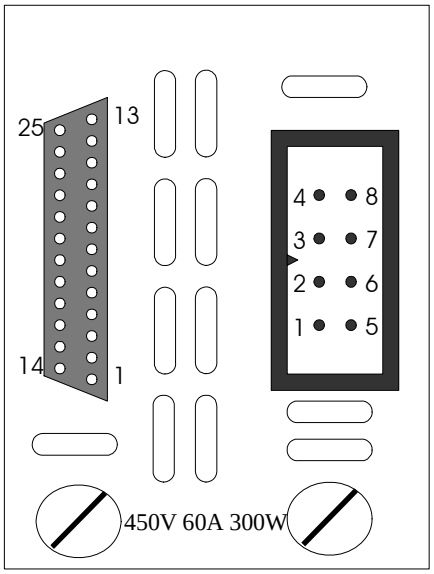
V_MODULATE and XMOD are referenced to COM, the isolated load common, which is tied to the load -UUT line. They are NOT referenced to earth ground.

NOTE: No external connections should be made to any unused pins on this connector. Many of these are connected to internal test points for use during manufacturing test and calibration. Damage to the load may result if external connections are made to these pins.

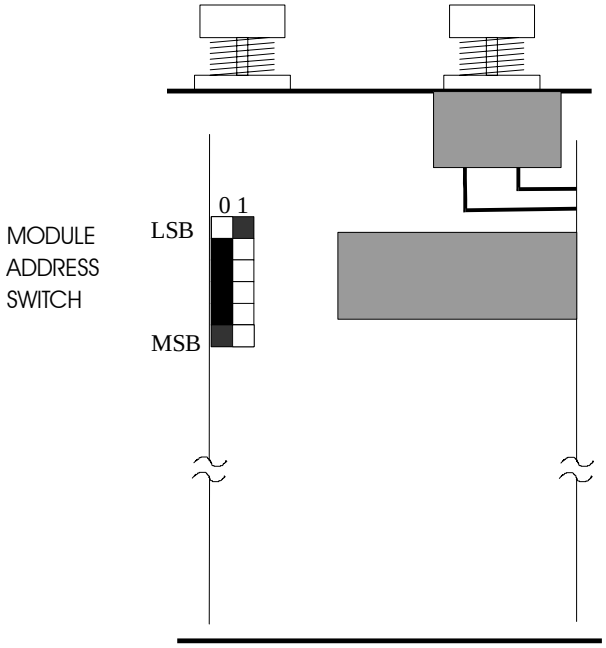
# 300 WATT LOAD MODULE

## REAR VIEW

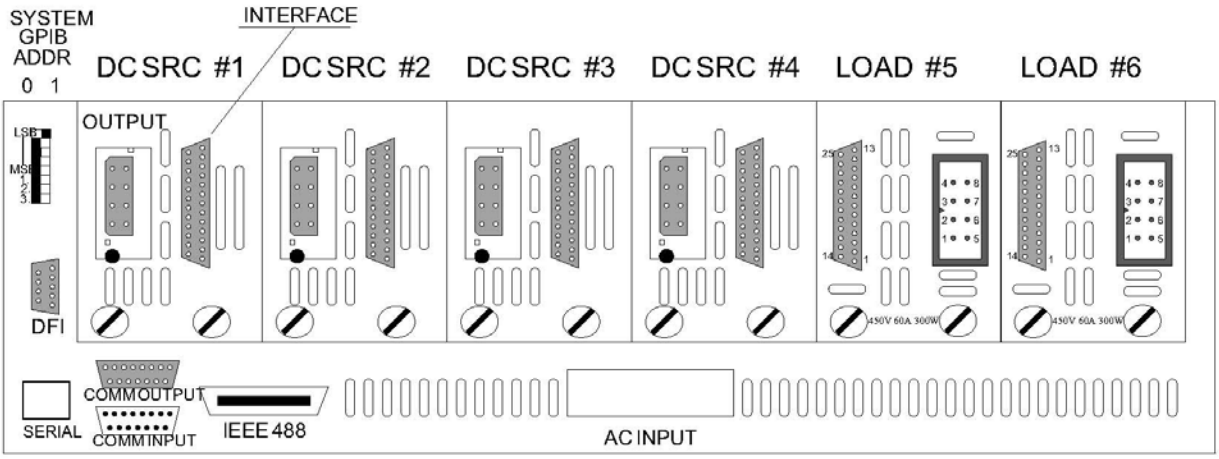
| DESCRIPTION | PIN # |
|---|---|
| - R SYNC OUTPUT | 1 |
| + R SYNC OUTPUT | 2 |
| + OVPS RELAY COIL | 3 |
| COM(ISOLATED | 6 |
| COM(ISOLATED) | 8 |
| + CAPPSOUT | 9 |
| + OVPS POWER | 12 |
| + OVPS POWER | 13 |
| - OVPS RELAY COIL | 16 |
| EXT. MODULATION. | 19 |
| - OVPS POWER | 24 |
| - OVPS POWER | 25 |




| DESCRIPTION | PIN # |
|---|---|
| + UUT | 1 |
| + UUT | 2 |
| + UUT | 3 |
| + V SENSE | 4 |
| - UUT | 5 |
| - UUT | 6 |
| - UUT | 7 |
| - V SENSE | 8 |

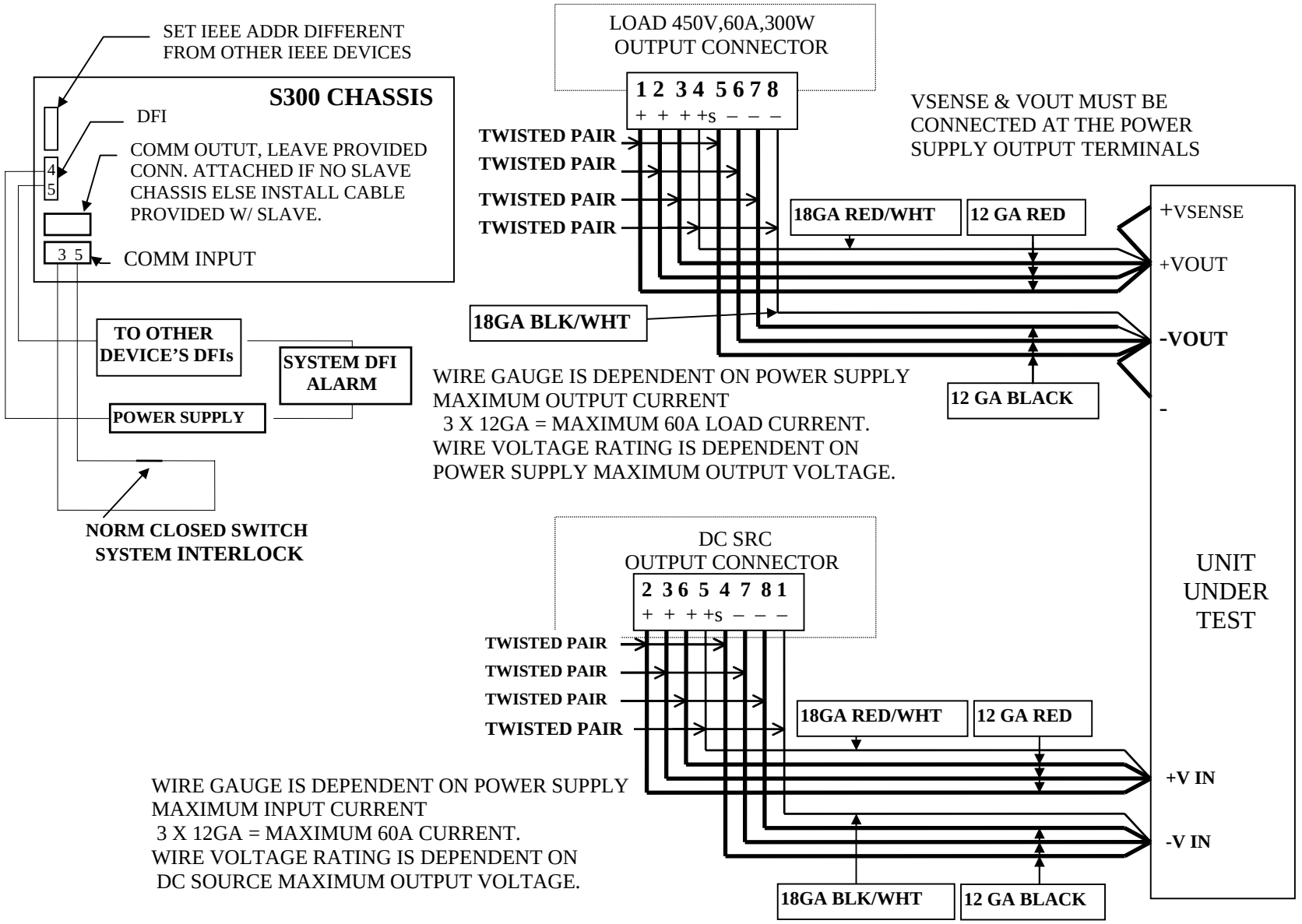



## BOTTOM VIEW




NOTE: SYSTEM INTERLOCK OF THE COMM INPUT
PINS 3 & 5 MUST BE SHORTED TOGETHER
TO ALLOW SYSTEM OPERATION.

1. S6000 Emulation Mode Enable
2. Macro Operator Mode
3. Flash download and Calibrate Enable


SET IEEE ADDR DIFFERENT
FROM OTHER IEEE DEVICES
S300 CHASSIS
DFI
COMM OUTUT, LEAVE PROVIDED
CONN. ATTACHED IF NO SLAVE
CHASSIS ELSE INSTALL CABLE
PROVIDED W/ SLAVE.
4
5
3 5
COMM INPUT
TO OTHER
DEVICE'S DFIs
SYSTEM DFI
ALARM
POWER SUPPLY
NORM CLOSED SWITCH
SYSTEM INTERLOCK
LOAD 450V,60A,300W
OUTPUT CONNECTOR
1 2 3 4 5 6 7 8
+ + + +s – – –
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
18GA BLK/WHT
18GA RED/WHT
12 GA RED
12 GA BLACK
VSENSE & VOUT MUST BE
CONNECTED AT THE POWER
SUPPLY OUTPUT TERMINALS
+VSENSE
+VOUT
-VOUT
-
WIRE GAUGE IS DEPENDENT ON POWER SUPPLY
MAXIMUM OUTPUT CURRENT
3 X 12GA = MAXIMUM 60A LOAD CURRENT.
WIRE VOLTAGE RATING IS DEPENDENT ON
POWER SUPPLY MAXIMUM OUTPUT VOLTAGE.
DC SRC
OUTPUT CONNECTOR
2 3 6 5 4 7 8 1
+ + + +s – – –
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
18GA BLK/WHT
18GA RED/WHT
12 GA RED
12 GA BLACK
WIRE GAUGE IS DEPENDENT ON POWER SUPPLY
MAXIMUM INPUT CURRENT
3 X 12GA = MAXIMUM 60A CURRENT.
WIRE VOLTAGE RATING IS DEPENDENT ON
DC SOURCE MAXIMUM OUTPUT VOLTAGE.
UNIT
UNDER
TEST
+V IN
-V IN

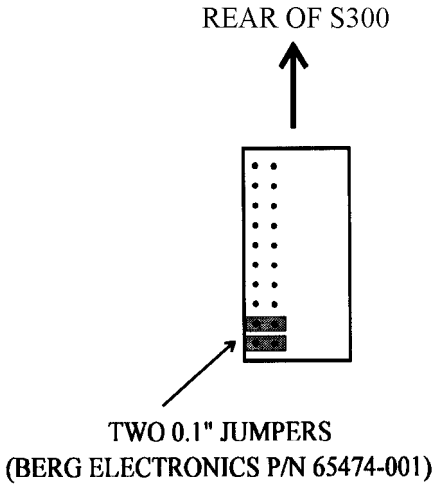
## 2.1 Module Installation and Removal

Before a module is inserted into the S300 chassis, the MODULE ADDRESS needs to be set. The address must be a unique number (for a given controller chassis) between hexadecimal 1 and 3F (decimal 1 and 63). This address is programmed into the module using the dipswitch. On DC source modules, this switch is located in the front (air entry end) of the module; on load modules it is located near the rear of the module, at the bottom edge. To set a binary zero, press the corresponding switch down, to set a one, leave the switch up.

Each S300 module has two connectors which plug into the motherboard inside the S300 chassis. Mate modules with the motherboard from the rightmost slot toward the leftmost with respect to the S300 front panel. If there is a filler panel in that slot, remove it first by unscrewing the two holding screws. Once the module has been placed firmly into the S300 slot, align and tighten the thumbscrews located on the rear of the DC module.

If it is desired to leave a slot blank, two bus continuation connectors must be placed in each slot that is to be skipped.

NOTE: You must not leave a blank slot between paralleled load modules.




## 2.2 Parallel Modules Connections

### 2.3.2 LOAD MODULES

The output power connections MUST, however, be connected in parallel as with DC Sources. The voltage sense lines must also be connected. No special connections are required to synchronize paralleled load modules or connected on each load module for proper operation. Refer to Section 4.4.3 Chassis Configuration for further details on paralleling and unparelling modules from the front panel set up.

## 2.4 Mating Connector Part Descriptions

### 2.4.1 Load Module **(KIT N.H. Part Number 1107245)**

| N.H. P/N | DESCRIPTION | QTY | COMMERCIAL PART NUMBER | MANUFACTURER. |
|---|---|---|---|---|
| 6203129 | PWR-LOK 8P FEMALE | 1 | PLB08F0O5O | POSITRONICS |
| 6203157 | PWR-LOK FEMALE CONTACT | 8 | FS112N2 | POSITRONICS |
| 6200644 | DSUB 25PIN SOCKET | 1 | DB25P | ITT CANNON |
| 6201298 | DSUB SHELL | 1 | DB24659 | ITT CANNON |
| 6201309 | DSUB SCREW LOCK | 2 | D20419-21 | ITT CANNON |
| | EXTRACTION TOOL | | 9081 | POSITRONICS |
| | INSERTION TOOL | | 9099 | POSITRONICS |

# 3. RESET AND SELF-TEST FUNCTIONAL DESCRIPTION

## 3.1 Load Reset operation

clear input and output buffers

set default conditions

RES = 1 MEG OHM

DWELL = 1 millisecond

Vrange = 120v

Volt Nom = 0v

Volt = 0v

Fall Time = 10uS

Rise Time = 10uS

Curr:Mode = “Fixed”

Mode = “Curr:Mode”

Current Range = 60A

Ext. Modulation = Disabled

Curr = 0

Pow = 0

Power Range = 120v, 60a

List:Curr f1,f2 = 0, 0

List:Dwell f1, f2, f3 = 1mS, 1mS, 1mS

reset status

reset status buffers

## 3.2 Load Self-test operation

The following listing is the sequence of tests that are completed on the load circuitry. The test number is used by the factory as a diagnostic tool to debug hardware problems. This test number is not supported for customer use.

Test Number = a1 measure control pcb 5V Ref with A/D

Test Number = a2 measure control pcb 0V Ref with A/D

Test Number = a3 measure control pcb 2.5V Ref with A/D

Test Number = a4 measure control pcb 15V Ref with A/D

Test Number = a5 measure control pcb 9V Ref with A/D

Test Number = a6 measure control pcb 11V Ref with A/D

Test Number = a7 measure control pcb -7V Ref with A/D

Test Number = a8 measure control pcb 5.2V Ref with A/D

Test Number = a9 measure control pcb -5.2V Ref with A/D

Test Number = a10 measure control pcb Power DAC Full Scale with A/D

Test Number = a11 measure control pcb Power DAC zero with A/D

Test Number = a12 measure control pcb VDAC Full Scale with A/D

Test Number = a13 measure control pcb VDAC zero with A/D

Test Number = a14 measure control pcb Temp Sensor with A/D

Test Number = b2 measure control pcb V_MET on with A/D

Test Number = b3 measure control pcb Constant R IDACREF off with A/D

Test Number = b4 measure control pcb Constant R IDACREF on with A/D

Test Number = b5 measure control pcb Constant I DAC buffered FS with A/D

Test Number = b6 measure control pcb Constant I DAC buffered zero with A/D

Test Number = b7 measure control pcb Current meter zero with A/D

Test Number = b8 measure control pcb Current meter (IDAC=433) with A/D

Test Number = b9 measure control pcb Current Load shorted (IDAC=0) with A/D

Test Number = b10 measure control pcb Current Load shorted (IDAC=433) with A/D

Test Number = b11 measure control pcb Current monitor out zero with A/D

Test Number = b12 measure control pcb Current monitor out (IDAC=433) with A/D

Test Number = b13 measure control pcb Power DAC (PDRANGE=0) with A/D

Test Number = b14 measure control pcb Power DAC (PDRANGE=255) with A/D

Test Number = 1a-1 measure power pcb 5V with A/D

Test Number = 1a-2 measure power pcb -5V with A/D

Test Number = 1a-3 measure power pcb 18V with A/D
Test Number = 1a-4 measure power pcb -15V with A/D
Test Number = 1a-5 measure power pcb ground with A/D
Test Number = 1b-1 measure power pcb self test voltage off with A/D
Test Number = 1b-2 measure power pcb self test voltage on with A/D
Test Number = 1c-1 measure power pcb current drive ground with A/D
Test Number = 1c-2 measure power pcb buffered current drive off with A/D
Test Number = 1c-3 measure power pcb current drive off with A/D
Test Number = 1c-4 measure power pcb buffered current drive full scale with A/D
Test Number = 1c-5 measure power pcb current drive full scale with A/D
Test Number = 1d-1 measure Load current off with A/D
Test Number = 1d-2 measure Load current on with A/D
Test Number = 1d-3 measure Channel 8 Low Range IGBT current off with A/D
Test Number = 1d-4 measure Channel 8 Low Range IGBT current on with A/D
Test Number = 1d-5 measure Channel 8 Hi Range IGBT current off with A/D
Test Number = 1d-6 measure Channel 8 Hi Range IGBT current on with A/D
Test Number = 1d-7 measure Channel 7 Low Range IGBT current off with A/D
Test Number = 1d-8 measure Channel 7 Low Range IGBT current on with A/D
Test Number = 1d-9 measure Channel 6 Low Range IGBT current off with A/D
Test Number = 1d-10 measure Channel 6 Low Range IGBT current on with A/D
Test Number = 1d-11 measure Channel 5 Low Range IGBT current off with A/D
Test Number = 1d-12 measure Channel 5 Low Range IGBT current on with A/D
Test Number = 1d-13 measure Channel 4 Low Range IGBT current off with A/D
Test Number = 1d-14 measure Channel 4 Low Range IGBT current on with A/D
Test Number = 1d-15 measure Channel 3 Low Range IGBT current off with A/D
Test Number = 1d-16 measure Channel 3 Low Range IGBT current on with A/D
Test Number = 1d-17 measure Channel 2 Low Range IGBT current off with A/D
Test Number = 1d-18 measure Channel 2 Low Range IGBT current on with A/D
Test Number = 1d-19 measure Channel 1 Low Range IGBT current off with A/D
Test Number = 1d-20 measure Channel 1 Low Range IGBT current on with A/D
Test Number = 1d-21 measure Channel 0 Low Range IGBT current off with A/D
Test Number = 1d-22 measure Channel 0 Low Range IGBT current on with A/D
Reset Load

# 4. AVAILABLE OPTIONS

## 4.1 Module Types

| Type | Voltage (V) | Current (A) | Power (W) | Description |
|---|---|---|---|---|
| **0** | **-** | **-** | **-** | **System Controller** |
| **31** | **450** | **60** | **300** | **Load Module** |
| **33** | **80** | **60** | **300** | **Load Module** |

* These module types have been discontinued.

## 4.2 Module Options

There are no installable options for the Load module.