3kW Electronic Load

Custom CP/CC model
For testing of telecommunications supplies

16th November 1997 | Product datasheet

- **3kW CP from 48V to 65V (at 25°C)**
- **Selectable 24V to 33V @ 3kW range**
- **Constant power mode 0 to 5kW**
- **Constant current mode 0 to 70A**
- **Low electrical noise**
- **Temperature controlled fans**
- **Remote box or 0-5V demand input**
- **Desktop PC style case**

Description

This model load is derived from the ADX 3.6kW Electronic Load (used for testing 50V telecommunications power systems, and also useful as a general purpose constant current load).

This custom version is designed to draw a constant 3kW over a DC input voltage range of 45V (67A) to 70V (43A). (Ratings reduce the specified limit slightly).

Our loads are similar to conventional FET adjustable electronic loads, but the big difference is that they incorporate series power resistors. These (usually) do most of the dissipation work, allowing a significant cost saving over a pure electronic load, or significant time saving over wiring resistors up manually. However, the safe operating area of this type of load is more complex than either type of load on its own (see SOA graph).

The “pure electronic load” section of this custom load is required to dissipate double the power of our original 3.6kW load, despite the apparently smaller rating. The “3kW” in the name relates to the 45V to 70V range, operation from zero to 5kW is possible for different voltage ranges (see SOA graph again).

Internally, there are two separate load banks which can be switched into series (default) or parallel range settings.

The load is designed with robust simplicity in mind. While it does provide many features found on more expensive units, we prefer to improve the simplicity and intuitive operation of existing features rather than add new ones.

A prototype load

System includes:
- Load unit
- Remote box
- Power cable, packing case
- User manual
- Carry handle strapping (option)

Specifications

Specification or rating	*Min*	*Typ*	*Max*	*Comments*
3kW constant power operation				
DC Input Voltage (Note 1)	48 V		65 V	70V range (Hi)
DC Input Current	62.5 A		46 A	from V*I = 3000W
DC Input Voltage (Note 1)	24 V		32.5 V	35V range (Lo)
DC Input Current	125 A		92.3 A	from V*I = 3000W
Current limit while in CP mode		65A		Soft knee
Internal series resistance		0.7 ohms		70V range (Hi)
Absolute Maximum limits at 3kW CP				
DC Input Voltage minimum		45 V		Resistance limited
DC Input Voltage maximum, 25°C			70V	Getting hot…
(Note 2)				
Load setting range				
Constant power mode (Note 3)	0 A		5 kW	either range
… corresponding control voltage	0 V		5V	? TBD
Constant current mode	0 A		65 A	70V range (Hi)
	0 A		130 A	35V range (Lo)
… corresponding control voltage	0 V		5.41V	5V = 60A/120A
AC characteristics				
Noise, wideband (Note 4)		TBD	adequate	Customer check
Noise, psophometric		TBD	adequate	Customer check
AC response constant current mode		1 MHz ?		
AC response constant power mode (Note 5)		160 Hz		RMS to AVERAGE
Input programming cutoff frequency		100 Hz		To be verified
Environmental				
Ambient temperature at 70V, 3kW	Unknown		25 °C	
Derating factor beyond 25°C		? W/°C		

Notes:

1. Input is assumed to be DC only. Any AC component will be filtered as described in note 5. For ratings purposes, these figures are assumed to be the peaks in your input. For typical applications do not worry, as these ratings have headroom built in.
2. Constant power operation at 45V may not be able to draw the full 3kW due to internal series resistance. Operation at 70V is limited by fet junction temperatures. Long term operation above this level may damage the unit. If operating at this limit, be careful not to exceed the voltage or the ambient temperature of 25°C.
3. Power drawn is continuously variable between 0 and V^2/Rinternal, and is safe for all voltages up to 65V (33V in 'Lo' range). Demand is limited to these figures by the remote box, the so-called "0-5V" input can actually go much higher. Take care not to exceed the limits imposed by the SOA graph below.
4. Wideband current noise is measured across a 100mE shunt from a clean source. How this translates into voltage noise on your system will depend on the output impedance of the system under test.
5. Above some frequency, the load stops behaving as an ideal current or power sink, and reacts instead to the average input voltage. Input demand is low-pass filtered internally.

Other specifications

(modified from web page http://www.adx.co.nz/load2.htm)
[16/11/97]

Case:	PC Mini Tower
Rating:	See Electrical Specifications above (see safe operating area graph)
Features:	Constant current, Constant power modes, front panelswitchable Low noise in the audio band Temperature controlled fans, Thermal cutout Relay mode switching with emergency breaker function Isolated from mains earth Parallel operation of any number of loads, intrinsic sharing
Front panel:	Power switch, voltage range switch, indicator LEDs, CC/CR mode switch Connector for control box / 0-5V demand input High current connectors (AMP power lock, 2 parallel pairs)
Options: **(none supplied!)**	RS232 (SCPI) programmable current, GPIB programmable current Shunt Switching for 1200W 'no series resistor' mode CR, CV modes in addition to CI and CP EMC full compliance passes
Weight:	Approx. 13kg (29 lb.)

Various details follow, from email and other communications.
New info in italics.
Ratings may not be guaranteed from here on, please inquire if suspect...

Constant Power Operation

The constant power circuit has accurate constant power operation over the full voltage range, *typically 0.1% accuracy over a 20V range*. It is also subject to a "fixed" current limit (internally adjustable) of 60A, *at the moment there is no visual indication when this is happening*. There *is* provision for switching to CC mode.

Operation in parallel

Multiple loads can be paralleled from a common 0-5V demand input. *Stability is assured in constant current mode. CP mode may be a different story if rectifier output voltages vary, we will make all reasonable efforts to get it right should problems occur.*

Also, ground reference shifts could be a problem. We have included two options on the PCB: Reference all signals to the load's -ve terminal and use our remote cable wiring scheme, or use a pseudo-differential input (demand 'ground' must stay within 5V of load's –ve terminal).

All 4 loads will be supplied with the constant power configuration and identical calibration in case you need to use 4 in parallel.

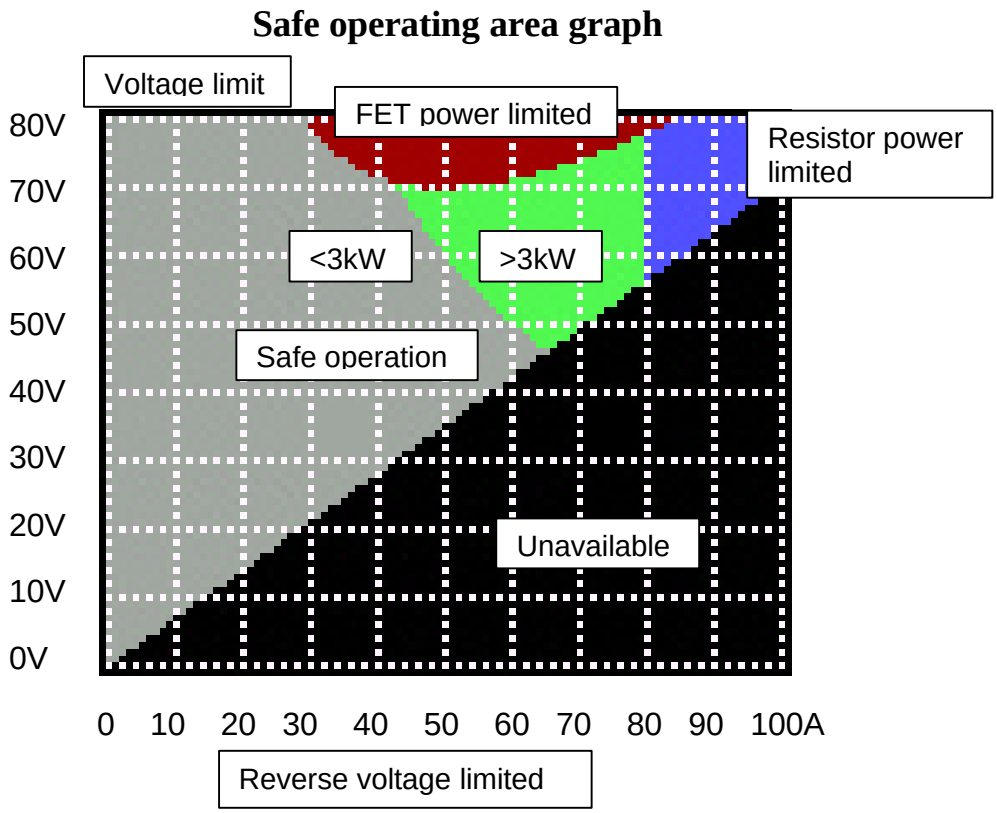
Noise performance

In CC mode, noise performance should be as for the standard load. Noise performance in CP mode has been quickly tested by us, and there were no problems at all. You had a prototype, which we assume performed adequately.

SOA Graph (from user manual, updated for the new rating)

The load is not 'foolproof' – it does not attempt to prevent overloading, but a thermal trip will occur if the fet or resistor temperatures get too high (beeper beeps, red LED lights).

The safe operating area of the load is limited by voltage, fet power and resistor power. Maximum current is self-limited by the internal resistance, it is not possible to draw high currents at low voltage. The graph is an unusual shape due to the combination of fet and resistor dissipation., and applies for an ambient temperature of 25°C.



For 35V mode, this graph applies with half the voltage and double the current.

As you can see the rating can be 5kW under some conditions, so the *70V 3kW* rating is more of a model number than a useful limit. It is possible to dissipate in excess of these limits short term (or long term with *very much* reduced reliability), but this is not recommended *at all for this model*. Resulting damage may not be covered by our warranty (though we will attempt to provide replacement parts at cost).

Other ways you can blow it up:

- Reverse connection will cause full current to flow (limited by the power resistors). While this itself will not damage the load, the fans won't run properly and the relay protection will not work.
- Applying more than about *60V* in parallel mode may cause the FETs to zener regardless of current/*power* setting. Long term operation like this is likely to destroy fets and current sense resistors.
- Very high intensity RF fields (enough to cause significant change in current setting) may unbalance the sharing of the individual load banks within the load, and stress the FETs.
- Blocking off airflow, running at extremely high ambient temperatures (eg 60°C) or operation in enclosed spaces where hot air simply recirculates.
- Forgetting to reattach control or power looms within the load – the load may appear to work but fets won't share power and may be damaged.

EMC

This is what we're aiming for (however we're not planning to send them out for full compliance testing for a while):

Type of EMC test	Test Spec	EC standard
Radiated emissions	EN 55022 class B	EN 50081-1
Conducted emissions	EN 55022 class B	EN 50081-1
ESD	IEC 801-2	EN 50082-1
Radiated immunity	IEC 801-3 20V/m	EN 50082-1
Conducted immunity	IEC 801-4	EN 50082-1

We can't do full precompliance testing of the last two in-house, but can roughly simulate them using radio transmitters.

I'm not familiar with the latest EC specs, but I believe radiated emissions calls up CISPR11 class B, which our units should romp through as there's no micros *(NOW INCORRECT?)*, brush motors, oscillators or switching circuitry in there.

Same for conducted emissions. *If the first two loads have been tested, behaviour should be roughly similar. If we fit a micro, we will check (precompliance) to ensure it passes both emissions and suscepibility.*

We have done some susceptibility investigations, and *we have moved* to a double sided board with ground plane, modified the circuitry, filtering inputs and better sheilding *of* the case. I see this as being the most important EMC requirement, because there's nothing worse than a piece of test equipment misbehaving during some critical test! *Performance of these units was adequate.*

General improvements

This applied to the last lot too, except for *italics*

- internal assy hinges out, heatsinks slide out on rails
- simplified power wiring (now all silicone), less connectors
- *spot* welded power resistors, stainless screws etc
- improved stability and HF impedance
- DC impedance essentially infinite – *CC mode*