excelsys

Solo Designer Manual

Ultra compact 500W and 1000W single output power supplies

- *High Efficiency*
- *Convection Cooled*
- *Digital Communications*

Xsolo

Ultra-high efficiency 1U size

FEATURES

- Single output: 24V, 36V or 48V
- IEC60950 2nd Edition, IEC60601-1 2nd & 3rd Edition & IEC60601-1-2 4th Edition EMC compliant
- Ultra high efficiency, >92%
- Low profile: 1U height (40mm)
- Convection Cooled 500W
- Fan Cooled 1000W (variable speed fan)
- 12V/300mA bias standby voltage provided
- Remote ON/OFF Signal
- Power Good Signal
- MIL810G
- 2 MOPP
- SEMI F47 Compliant
- Suitable for Type B and BF rated applications
- Optional I²C PMBus™ Communications
- Optional OR-ing Function
- 5 Year Warranty
- Adjustable output voltage
- 5000m altitude for EN60950 applications
- All models feature active power factor correction as standard
- Product Options: Conformal Coating, Low Leakage Current and Ruggedised

APPLICATIONS INCLUDE

- Industrial
- Test & Measurement
- Medical
- Hi-Rel COTS

The Xsolo family of single output power supplies provides up to an incredible 1008W in an extremely compact package.

Available in two package types, the high efficiency Xsolo delivers an incredible ***convection cooled 504W*** in an open-frame U-channel form factor and up to ***1008W in an enclosed, fan cooled chassis.***

The Xsolo platform comes with a host of features including: variable speed fan, 12V/300mA isolated bias supply, remote ON/OFF, output voltage control and parallel operation for higher power applications. Nominal output voltages are 24, 36V and 48V with wide adjustment ranges and user defined set-points. Xsolo carries ***dual safety certification***, ***EN60950 2nd Edition*** for Industrial Applications and ***EN60601-1 2nd and 3rd Edition*** for Medical Applications, meeting the stringent creepage and clearance requirements, 4KVAC isolation and <300uA leakage current. Xsolo is designed to meet ***MIL810G*** and is also compliant with ***SEMI F47*** for voltage dips and interruptions as well as being compliant with all relevant EMC emission and immunity standards.

Optional features include I²C digital communications and OR-ing Function for N+1 redundancy. The product can also be conformal coated and ruggedised for use in harsh environments. With convection cooled power capability of over 500W, the Xsolo is ideal for use in a wide range of applications: industrial, Hi-Rel MIL-COTS applications, as well as acoustically sensitive laboratory and medical environments.

5 YEAR Warranty

XS Models

	Model	Power (W)	Output Voltage	Output Current (A)	Medical Approval UL/EN60601-1 3rd edition	Industrial Approval UL/EN60950 2nd edition
XS	XS500-24	504	24	21.0	Yes	Yes
	XS1000-24	1008	24	42.0	Yes	Yes
	XS500-36	504	36	14.0	Yes	Yes
	XS1000-36	1008	36	28.0	Yes	Yes
	XS500-48	504	48	10.5	Yes	Yes
	XS1000-48	1008	48	21.0	Yes	Yes

	Model	Vnom (V)	Power (W)	Description	Set Point Adjust Range (V)	Dynamic Vtrim Range (V)	Imax (A)	Remote Sense	Power Good
XS	XS500-24	24	504	Convection Cooled U-Channel	19-28	14-28	21.0	Yes	Yes
	XS1000-24	24	1008	Enclosed Fan Cooled	19-28	14-28	42.0	Yes	Yes
	XS500-36	36	504	Convection Cooled U-Channel	26-40	20-40	14.0	Yes	Yes
	XS1000-36	36	1008	Enclosed Fan Cooled	26-40	20-40	28.0	Yes	Yes
	XS500-48	48	504	Convection Cooled U-Channel	36-58	29-58	10.5	Yes	Yes
	XS1000-48	48	1008	Enclosed Fan Cooled	36-58	29-58	21.0	Yes	Yes

* Full part numbering information including product options and ordering information on page 65.

INPUT

Parameter	Conditions/Decription	Min	Nom	Max	Units
Input Voltage Range	Universal Input 47-440Hz	85 120		264 380	VAC VDC
Power Rating	XS500 XS1000		504 1008		W W
Input Current	XS500 XS1000		5 10		A A
Inrush Current	230VAC @ 25°C			25	A
Undervoltage Lockout	Shutdown	65		74	VAC
Fusing	XS500 250VAC XS1000 250VAC		F8A HRC F12A HRC		

OUTPUT

Parameter	Conditions/Description	Min	Nom	Max	Units
Output Voltage Range	XS500/1000-24: Multi-turn potentiometer XS500/1000-24: Dynamic Vtrim range XS500/1000-36: Multi-turn potentiometer XS500/1000-36: Dynamic Vtrim range XS500/1000-48: Multi-turn potentiometer XS500/1000-48: Dynamic Vtrim range	19 14 26 20 36 29		28 28 40 40 58 58	VDC VDC VDC VDC VDC VDC
Output Current Range	XS500-24 XS1000-24 XS500-36 XS1000-36 XS500-48 XS1000-48			21 42 14 28 10.5 21	A A A A A A
Load & Cross Regulation	For 25% to 75% load change ORing Option			±0.2 ±0.4	% %
Transient Response	For 25% to 75% load change Voltage Deviation Settling Time			2.5 500	% µs
Ripple and Noise	XS500/1000-24: 20MHz XS500/1000-36: 20MHz XS500/1000-48: 20MHz		240 360 480		mV pk-pk mV pk-pk mV pk-pk
Overvoltage Protection	XS500/1000-24: Latching XS500/1000-36: Latching XS500/1000-48: Latching	33 44 61	34 47 63	37 52 69	VDC VDC VDC
Overcurrent Protection	Straight line with hiccup activation at <30% of Vnom.	105	115	130	%
Line Regulation	For ±10% change from nominal line		±0.5		%
Remote Sense				0.5	VDC
Overshoot				2	%
Rise Time	Monotonic		3	5	ms
Turn-on Delay	From AC in From Remote On/Off		500 10	800	ms ms
Hold-up Time	For nominal output voltages at full load.	17			ms

GENERAL

Parameter	Conditions/Description	Min	Nom	Max	Units
Isolation Voltage	Input to Output Input to Chassis Output to Chassis	4000 1500 1500			VAC VAC VAC
Efficiency	230VAC, 1008W @ 24V/36V/48V		>92		%
Safety Agency Approvals	EN60601-1 2nd and 3rd Edition, cTUVus 60601-1 EN60950 2nd Edition, cTUVus 60950				
Leakage Current	264VAC, 60Hz, 25°C 264VAC, 60Hz, 25°C (Option 4)			300 150	µA µA
Signals	See Page 3				
Bias Supply	Always on, current 300mA, 50mA XS500		12.0		VDC
Weight	XS500 XS1000		1.1 1.3		Kg Kg
MTBF	Telecordia SR-332, 40°C ground benign, parts count.			550,000	Hours

EMC

Parameter	Standard	Level	Units
Emissions			
Conducted	EN55011, EN55022, FCC	Class B	
Radiated	EN55011, EN55022, FCC	Class B	
Harmonic Distortion	EN61000-3-2 Class A	Compliant	
Flicker & Fluctuation	EN61000-3-3	Compliant	
Immunity			
Electrostatic Discharge	EN61000-4-2	Level 2	
Radiated Immunity	EN61000-4-3	Level 3	
Fast Transients-Burst	EN61000-4-4	Level 3	
Input Line Surges	EN61000-4-5	Level 3	
Conducted Immunity	EN61000-4-6	Level 3	
Voltage Dips	EN61000-4-11, SEMI F47 Compliant.(1)	Compliant	

ENVIRONMENTAL

Parameter	Conditions/Description	Min	Nom	Max	Units
Operating Temperature		-40		+70	°C
Storage Temperature		-40		+85	°C
Derating	See Page 62 for full temperature deratings				
Relative Humidity	Non-condensing	5		95	%RH
Shock and Vibration	Designed to meet MIL810G (2)		55		G
Altitude	EN60601-1 Operational: 3000m, Storage 8000m EN60950 Operational: 5000m, Storage 8000m			3000 5000	m m

Xsolo

Ultra-high efficiency 1U size

Section 6.1
Overview of Xsolo

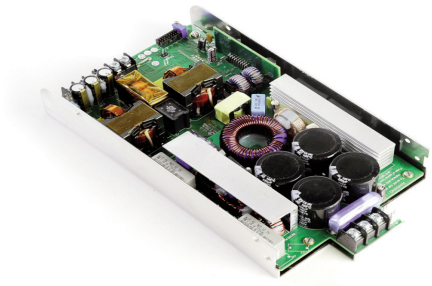
The Xsolo family of single output power supplies provides up to an incredible 1008W in an extremely compact package. Available in two package types, the high efficiency Xsolo delivers an incredible convection cooled 504W in an open-frame U-channel form factor and up to 1008W in an enclosed, fan cooled chassis.

The Xsolo platform comes with a host of features including: variable speed fan, 12V/300mA isolated bias supply, remote ON/OFF, output voltage control and parallel operation for higher power applications. Nominal output voltages are 24V, 36V and 48V with wide adjustment ranges and user defined set-points. Xsolo carries dual safety certification, EN60950 2nd Edition for Industrial Applications and EN60601-1 2nd and 3rd Edition for Medical Applications, meeting the stringent creepage and clearance requirements, 4KVAC isolation and <300uA leakage current. Xsolo is designed to meet MIL810G and is also compliant with SEMI F47 for voltage dips and interruptions as well as being compliant with all relevant EMC emission and immunity standards.

Optional features include I2C digital communications and OR-ing Function for N+1 redundancy. The product can also be conformal coated and ruggedised for use in harsh environments. With convection cooled power capability of over 500W, the Xsolo is ideal for use in a wide range of applications: industrial, Hi-Rel MIL-COTS applications, as well as acoustically sensitive laboratory and medical environments.

Section 6.2
Xsolo Features

- EN60950 2nd Edition & EN60601-1 2nd and 3rd Edition
- MIL810G
- 2 MOPP
- SEMI F47 Compliant
- Ultra high efficiency, >92%
- Low profile: 1U height (40mm)
- Convection Cooled 500W/Fan Cooled 1000W (variable speed fan)
- 12V/300mA bias standby voltage provided
- Remote ON/OFF Signal, Power Good Signal
- 5 Year Warranty
- Suitable for type B and BF rated applications
- Adjustable output voltage
- 5000m altitude for EN60950 applications
- Product Options: Conformal Coating, Low Leakage Current, Ruggedised , PMBus, & OR-ing function



APPLICATIONS INCLUDE

- Industrial
- Test & Measurement
- Medical
- Hi-Rel/MIL-COTS
- Communication

Section 6.3
Installation Considerations

The Xsolo models may be mounted on any of three surfaces using standard M3 screws. The chassis comes with four mounting points on the base. Maximum allowable torque is 2Nm. The maximum penetration depth is 6mm. Maintain a 50mm minimum clearance at both ends of the Xsolo power supply and route all cables so airflow is not obstructed. The XS1000 unit draws air in on the input side and exhausts air out the load side. If airflow ducting is used, avoid sharp turns that could create back pressure. XS500 units are convection cooled. See Excelsys Application Note: AN1504 on
website.

Avoid excessive bending of output power cables after they are connected to the Xsolo *powerMods*. For high current outputs, use cable-ties to support heavy cables and minimise mechanical stress on output studs. Be careful not to short-out to neighbouring output studs.

The maximum torque recommended on output connectors is 3Nm. Avoid applications in which the unit is exposed to excessive shock or vibration that exceed the specified levels. In such applications, a shock absorption mounting design is required.

Section 6.4
Xsolo Control and Signals (Analog)

Voltage Adjustment

The Xsolo has been designed with maximum user flexibility as a key objective. The output voltage can be adjusted over a wide range by a number of methods.

Voltage adjustment and setting may be achieved by:
1. Voltage Setting via the on board potentiometer.
2. Remote voltage programming by applying a control voltage (Vcontrol) between J5 Pin 9 (Vtrim) and J5 Pin 10 (-Sense)
3. Remote voltage programming by applying a resistor between J5 Pin 9 (Vtrim) and J5 Pin 10 (-Sense).

An Excel spreadsheet has been developed to help users calculate output voltage and control values. These are available to download from the support section of our website;
http://www.excelsys.com/technical-support/

XS500-24 and XS1000-24

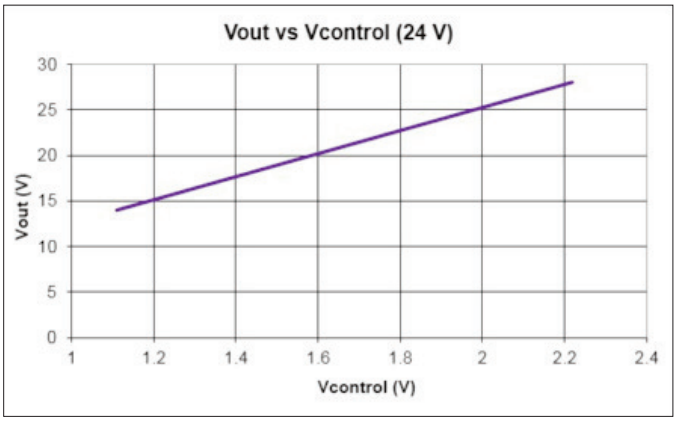
By applying a control voltage (Vcontrol) between J5 Pin 9 (Vtrim) and J5 Pin 10 (-Sense) the output voltage of XS1000-24 and XS500-24 may be adjusted over a wide range. Vcontrol can be read from the graph below or calculated with the formula:

Voutput = 12.59 x Vcontrol

Important: Vcontrol must not exceed 2.5V

Example.
Setting the output voltage to 20VDC via the Vtrim Pin
Voutput/12.59 = Vcontrol
20V/12.59 = 1.59V.
Vcontrol = 1.59V

See Graph for full range.



XS500-48 and XS1000-48

Using an external Voltage source (Vcontrol), the output voltage of the XS1000-48 and XS500-48 may be adjusted over a wide range.

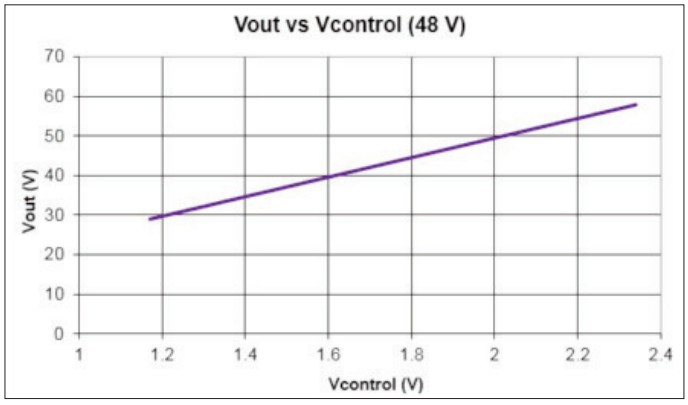
By applying a control voltage (Vcontrol) between J5 Pin 9 (Vtrim) and J5 Pin 10 (-Sense) the output voltage of XS1000-48 and XS500-48 may be adjusted over a wide range. Vcontrol can be read from the graph below or calculated with the formula

Voutput = 24.75 x Vcontrol

Important: Vcontrol must not exceed 2.5V

Example.
Setting the output voltage to 40VDC via the Vtrim Pin
Voutput/24.75 = Vcontrol
40V/24.75 = 1.62V.
Vcontrol = 1.62V

See Graph below for full range.



Remote voltage programming by an external resistor/potentiometer can also be implemented on the Xsolo. Simply apply the appropriate resistor value between J5 Pin 9 (Vtrim) and J5 Pin 10 (-Sense). An Excel spreadsheet has been developed to help users calculate output voltage and resistor values. These are
available to download from the support section of our website;
http://www.excelsys.com/technical-support/

Current Limit Adjustment (Voltage)

The Xsolo has been designed to allow users to adjust the onset of Current Limit for reduced power or constant current applications. By applying a voltage (Vcontrol) between the Itrim pin, (J5 Pin 13), and -Vout, current limit of the Xsolo can be adjusted from 0 A to the max rated current of the supply.

An Excel spreadsheet has been developed to help users calculate output current and control voltage values. These are available to download from the support section of our website;
http://www.excelsys.com/technical-support/

Current Limit Adjustment on XS500-24

By applying a control voltage (Vcontrol) between Itrim (J5, Pin 13) and -Vout, current limit can be adjusted from 0-21A. Vcontrol can be read from the graph below or calculated with the formula

Ioutput = 15.27 x Vcontrol

Important: Vcontrol should not exceed 1.5V for XS500-24

Example.
Setting the output current limit of the XS500-24 to 15A via the Itrim Pin
Ioutput/15.267=Vcontrol
15A/15.267 = 0.98V.
Vcontrol = 0.98VDC

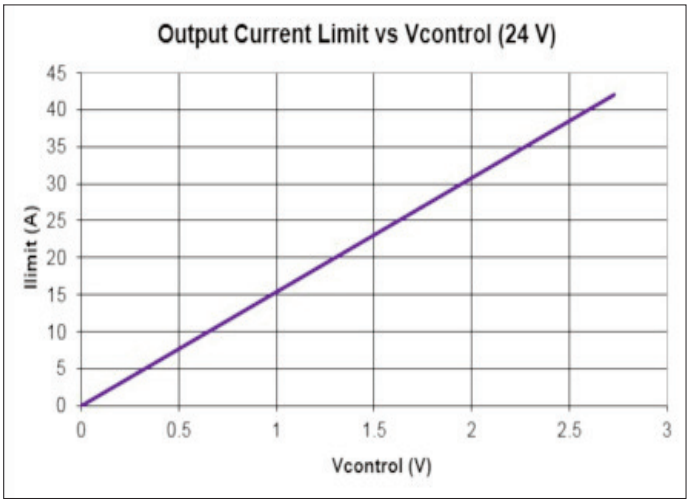
Current Limit Adjustment on XS1000-24

By applying a control voltage (Vcontrol) between Itrim (J5, Pin 13) and -Vout, current limit can be adjusted from 0-42A. Vcontrol can be read from the graph below or calculated with the formula
Ioutput = 15.267 x Vcontrol

Important: Vcontrol should not exceed 3.0V for XS1000-24

Example.
Setting the output current limit of the XS1000-24 to 30A via the Itrim Pin
Ioutput/15.267=Vcontrol
30A/15.267 = 1.96VDC.
Vcontrol = 1.96VDC

See Graph for full range.



Current Limit Adjustment on XS500-48

By applying a control voltage (Vcontrol) between Itrim (J5, Pin 13) and -Vout, current limit can be adjusted from 0-10.5A. Vcontrol can be read from the graph below or calculated with the formula

Ioutput = 8.06 x Vcontrol

Important: Vcontrol should not exceed 1.5V for XS500-48

Example.
Setting the output current limit of the XS500-48 to 7.5A via the Itrim Pin
Ioutput/8.06 = Vcontrol
7.5A/8.06 = 0.93V.
Vcontrol = 0.93VDC

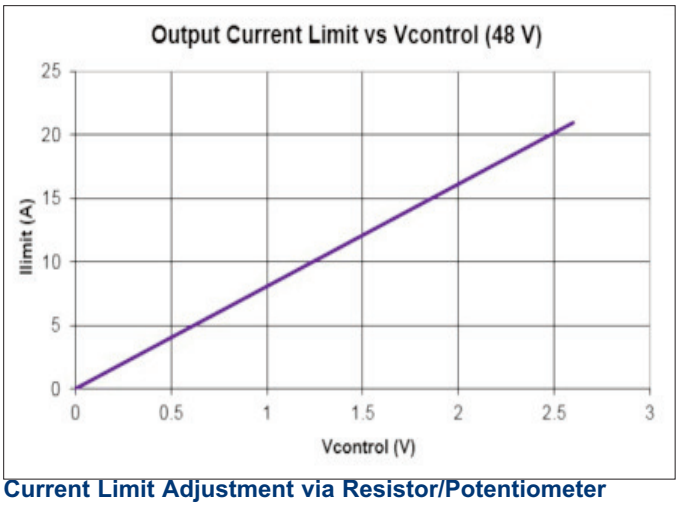
Current Limit Adjustment on XS1000-48

By applying a control voltage (Vcontrol) between Itrim (J5, Pin 13) and -Vout, current limit can be adjusted from 0-21A. Vcontrol can be read from the graph below or calculated with the formula

Ioutput = 8.06 x Vcontrol

Important: Vcontrol should not exceed 3.0V for XS1000-48

Example.
Setting the output current limit of the XS1000-48 to 15A via the Itrim Pin
Ioutput/8.06 = Vcontrol
15A/8.06 = 1.86VDC.
Vcontrol = 1.86VDC
See Graph for full range.



Current Limit Adjustment via Resistor/Potentiometer

The Xsolo has been designed to allow users to adjust the onset of Current Limit by applying a resistor between the Itrim pin, (J5 Pin 13), and -Vout. An Excel spreadsheet has been developed to help users calculate the appropriate resistor values to set output current. These are available to
download from the support section of our website;
http://www.excelsys.com/technical-support/

Current Limit Programming (Foldback)

The Current Limit characteristics of the Xsolo can be programmed to be either Straight Line or Foldback. The previous sections refer to setting the Straight Line Current Limit of the Xsolo. To implement Foldback Current Limit, an Excel spreadsheet has been developed to help users calculate the appropriate resistor values to define the onset and final current limit points of the foldback current curve These are available to download from the support section of our website;
http://www.excelsys.com/technical-support/

Remote ON/OFF

The Xsolo may be inhibited by means of an appropriate signal applied to an opto-isolated input (diode of an opto-isolater) on pins J5 connector Pin 2 (positive) and Pin 1 (negative). The delay from Inhibit to output turning OFF is typically <1ms.

Maximum current source allowed is 6.5mA.
Maximum applied voltage allowed is 13V.

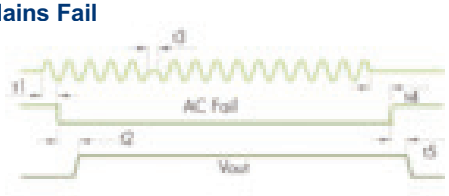
Fan Fail

Fan Fail is an Open collector signal indicating that at least one of the Xsolo fans has failed. This does not cause power supply shutdown. The power supply will continue to operate for 10ms after the temperature alarm signal is generated.

The Fan Fail signal is accessed via J5 connector Pin 12. There is an on-board series current limit resistor of 2k connecting Pin 12 to the collector of an NPN transistor opto-coupler output. The emitter is connected to J5 Pin 8 – or Pin 14 (Common). When a fan-fail condition is detected this transistor turns off.

Maximum current source allowed is 6.5mA.
Maximum applied voltage allowed is 13V.

AC Mains Fail



80ms < t1 < 600ms

10ms < t2 < 20ms

t3 = 10ms

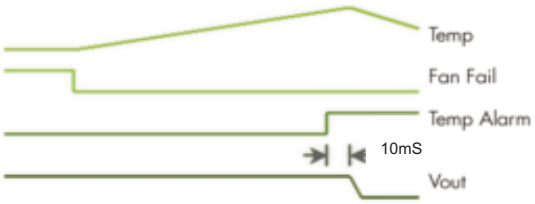
t4 > 10ms

t5 > 2ms

AC Mains fail signal is accessed through J5 connector Pin 6. There is an on-board series current limit resistor of 2kohm connecting Pin 6 to the collector of an NPN transistor opto-coupler output. The emitter is connected to J5 Pin 8 or Pin 14 (Common).During normal operation the transistor is ON. When input voltage is lost or goes below 80VAC the opto-transistor is turned OFF at least 2 ms before loss of output regulation. (The output voltage waveform above assumes a pull-up resistor to a maximum voltage of +13V)
Maximum current source allowed is 6.5mA.
Maximum applied voltage allowed is 13V.

Over-Temperature Protection (OTP)

This is an opto-isolated open collector transistor signal indicating that excessive temperature has been reached due to fan failure or operation beyond ratings. This signal is activated at least 10ms prior to system shutdown. The OTP signal is accessed via J5 connector Pin 7. There is an on-board series connect limit resistor of 2Kohm connecting Pin 7 to the collector of an NPN transistor opto-coupler output.The emmitter is connected to J5 Pin 8 or Pin 14 (Common).



The Fan Fail and Temp Alarm signal waveforms in the diagram assume connection via a pull-up resistor to the 12 V bias source or an external voltage.

Remote Sense

Remote sensing can be used to compensate for voltage drops in the output loads.

Remote sensing may be implemented by connecting the Positive Sense pin (J5 pin 11) to the positive side of the remote load and the Negative Sense pin (J5 pin 10) to the negative side of the remote load. The maximum line drop, which can be compensated for by remote sensing, is 0.5V, subject to not exceeding the maximum module voltage at the output terminals.

Power Good Signal

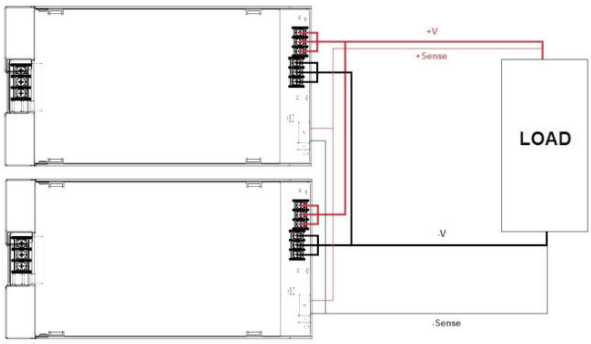
The Xsolo contains an internal comparator which monitors the output voltage and determines whether this voltage is within normal operation limits. When the output voltage is within normal limits, the PowerGood signal is activated. The signal is implemented by an open collector of an opto-isolater which is available on J5 Pin 3 (collector) and J5 Pin 4 (emitter) (transistor ON = Power Good).

Section 6.5

Parallel Connection and N+1 Redundant operation

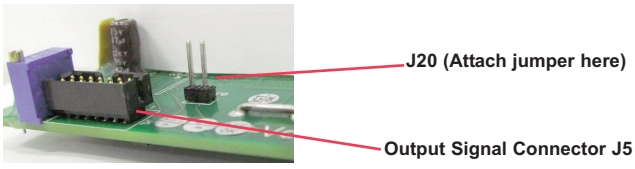
How to Connect in Parallel

To achieve increased current capacity, 2 or more Xsolo power supplies may be connected in parallel. To connect in parallel the current share header J20 must be added to each Xsolo product, all -Vo pins must be connected together and then the outputs must be trimmed to within 5mV of each other using the on-board potentiometer. Only then can the positive parallel connectors be attached, and the parallel supplies connected to the load.



For optimal current sharing with OR-ing option a 10% min load is recommended. If paralleling 3 or more Xsolos consult Excelsys for applications support.

Recommended Jumper for J20: HARWIN M7567-05 (Jumper Socket, Black, 2.54mm, 2-way)



How to implement N+1 Redundancy

Xsolo can be utilised in systems that require N+1 redundant operation. The OR-ing option must be selected. Then simply connect the required number of Xsolo power supplies in parallel using the procedure for Parallel Connection of Xsolo.

Section 6.6
Options

Environmental Conformal Coating (Option C)
Xsolo is available with conformal coating for harsh environments and MIL-COTs applications. It is IP50 rated against dust and protected against vertical falling drops of water and non condensing moisture. Conformal coating material is polyurethane based and military qualified.

Ruggedised Option (Option R)
Xsolo is available with extra ruggedisation for applications that are subject to extremes in shock and vibration. These parts have been tested on 3 axes, for a total of 300hours at 1.67g's rms.

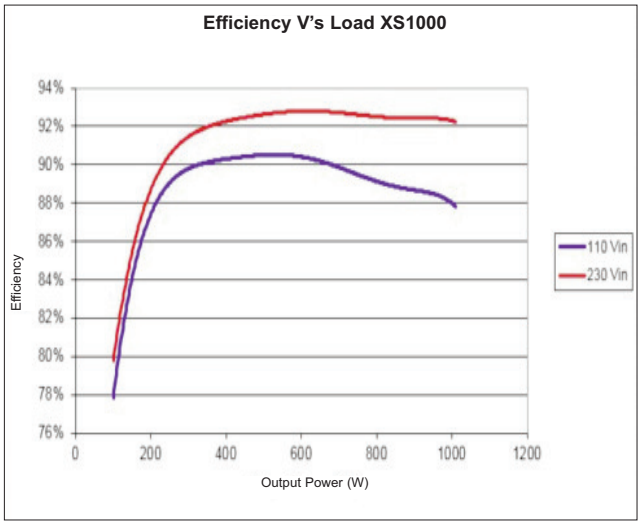
Conformally Coated and Ruggedised (Option S)

Features Options
00 = no options
01 = I2C/PMBus
02 = OR-ing Function
03 = 2C/PMBus + OR-ing Function
04 = Low Leakage
05 = I2C/PMBus + Low Leakage
06 = OR-ing Function + Low Leakage
07 = I2C/PMBus + OR-ing Function + Low Leakage

Section 6.7
Xsolo Efficiency

The Xsolo series offer unrivalled efficiency with a maximum efficiency of over 92%. It is often the case that power supplies are operating at lower levels than their maximum ratings. Most power supplies have optimised efficiency at a higher load ratings (close to full rating) but perform significantly worse at light or lower loads.

The Xsolo design and component selection ensures that conversion losses are kept to a minimum over a wide range of output loads. For example, in the graph below, The XS1000 is still over 90% efficient at 30% of rated output (300W).



The XS500 is over 90% efficient at loads of 250W or higher.

The XS500 provides up to 504W with no fan cooling and is therefore a silent power supply. The XS1000 has a temperature controlled fan that only operates if and when the output load and internal component temperatures require.

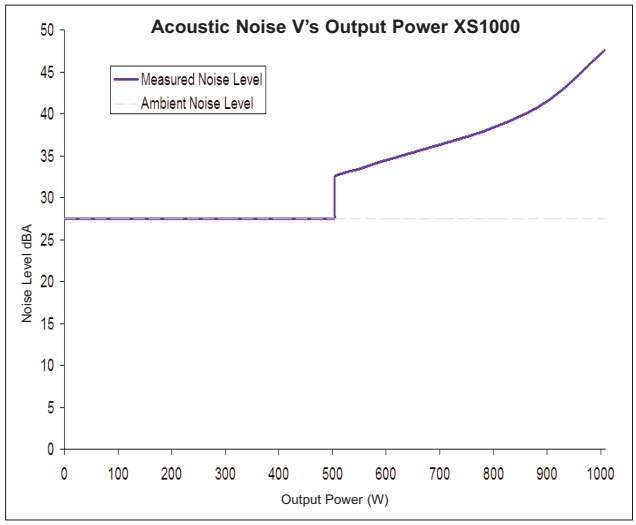
Please refer to the Acoustic Noise vs Output Power XS1000 graph below. At loads below 500W the fan is not required and the XS1000 is silent.

The XS500 can also be cooled using system air flow. Please refer to XS500 derating curves get detailed line and temperature derating of the XS500.

Section 6.8
Xsolo Acoustic Noise

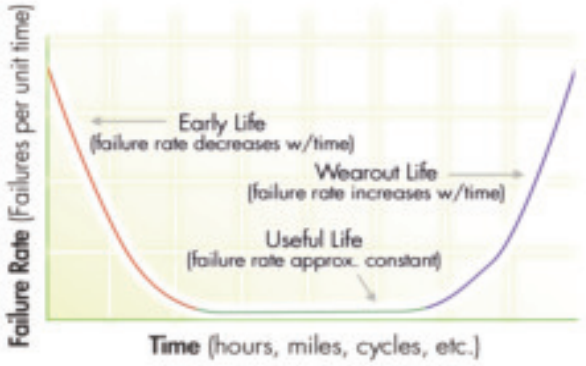
The XS500 provides up to 504W with no fan cooling and is therefore a silent power supply. The XS1000 has an integral temperature controlled fan that only operates if and when the output load and internal component temperatures require. Please refer to the Acoustic Noise vs Output Power XS1000 graph below.

At loads below 500W the fan is not required and the XS1000 is



Section 7 Reliabilty, Safety, EMI and Technical Resources

Section 7.1
Reliabilty



The 'bath-tub' curve shows how the failure rate of a power supply develops over time. It is made up of three separate stages. Immediately after production, some units fail due to defective components or production errors. To ensure that these early failures do not happen while in the possession of the user, Excelsys carries out a burn-in on each unit, designed to ensure that all these early failures are detected at Excelsys. After this period, the power supplies fail very rarely, and the failure rate during this period is fairly constant. The reciprocal of this failure rate is the MTBF (Mean Time Between Failures).

At some time, as the unit approaches its end of life, the first signs of wear appear and failures become more frequent. Generally 'lifetime' is defined as that time where the failure rate increases to five times the statistical rate from the flat portion of the curve.

In summary, the MTBF is a measurement of how many devices fail in a period of time (i.e. a measure of reliability), before signs of wear set in. On the other hand, the lifetime is the time after which the units fail due to wear appearing.

The MTBF may be calculated mathematically as follows:

MTBF = Total x t / Failure , where
Total is the total number of power supplies operated simultaneously.
Failure is the number of failures.
t is the observation period.

MTBF may be established in two ways, by actual statistics on the hours of operation of a large population of units, or by calculation from a known standard such as Telecordia SR-332 and MIL-HDBK-217 and its revisions.

Determining MTBF by Calculation

MTBF, when calculated in accordance with Telecordia, MIL-HDBK-217 and other reliability tables involves the summation of the failure rates of each individual component at its operating temperature. The failure rate of each component is determined by multiplying a base failure rate for that component by its operating stress level.

The result is FPMH, the failure rate per million operating hours for that component.

Then FPMH for an assembly is simply the sum of the individual component FPMH.

Total FPMH = FPMH1 + FPMH2 + …….. +FPMHn

$$\text{MTBF (hours)} = \frac{1{,}000{,}000}{\text{FPMH}}$$

In this manner, MTBF can be calculated at any temperature.

powerMod 0.958 failures per million hours
4slot *powerPac* 0.92 failures per million hours
6slot *powerPac* 0.946 failures per million hours

The figures for the *powerPac* excludes fans.

Example:
What is the MTBF of UX4DD00
UX4 FPMH = 0.92
XgD FPMH = 0.286
Total FPMH = 1.49
MTBF = 670,000 hours at 40°C

Xsolo MTBF

Xsolo has an MTBF of 550,000 hours at 40°C and full load based on the Telecordia SR-332 (fans excluded).

MTBF and Temperature

Reliability and MTBF are highly dependent on operating temperature. The figures above are given at 40°C. For each 10°C decrease, the MTBF increases by a factor of approximately 2. Conversely, however, for each 10°C increase, the MTBF reduces by a similar factor. Therefore, when comparing manufacturer's quoted MTBF figures, look at the temperature information provided. Contact Excelsys for detailed analysis of MTBF for your specific application conditions.

Section 7.2
Safety Approvals

UltiMod and Xsolo carry ***dual safety certification, UL/EN60950 2nd Edition*** for Industrial Applications and ***UL/EN60601-1 2nd and 3rd Edition*** for Medical Applications, meeting the stringent creepage and clearance requirements, 4KVAC isolation and <300uA leakage current. The Xgen series also carries full safety approvals. Refer to individual Xgen Datasheets for the relevant safety approvals carried by each model.

UltiMod, Xsolo and Xgen are designed to meet ***MIL810G*** and are also compliant with ***SEMI F47*** for voltage dips and interruptions as well as being compliant with all relevant EMC emission and immunity standards (Eee individual datasheets for details).

Safety Approvals
Low Voltage Directive (LVD) 2006/95/EC

The LVD applies to equipment with an AC input voltage of between 50V and 1000V or a DC input voltage between 75V and 1500V. The XSolo series is CE marked to show compliance with the LVD.The relevant European standard for UltiMod, Xsolo and Xgen models is EN60950 (Information technology). The 2nd Edition of this standard in now published and all relevant Excelsys power supplies are certified to the latest edition as well as the 1st Edition.

The relevant European standard for UltiMod, Xsolo and Xgen models is EN60601-1 (Medical Devices Directive). The 3rd Edition of this standard is published and all Excelsys medically approved power supplies are certified to this latest edition as well as the 2nd Edition. With appropriate packaging, the UltiMod, Xsolo and Xgen models can also meet the requirements of EN61010-1 for industrial scientific measuring equipment and process control.

UltiMod, Xsolo and Xgen models are certified to comply with the requirements of IEC950, EN60950, UL60950 (1st and 2nd Editions), and CSA 22.2 no. 234 and IEC1010, when correctly installed in a limited access environment.

The UltiMod, Xsolo and Xgen series are certified to comply with the requirements of IEC601-1, EN60601-1, UL60601-1 (2nd and

PowerMods are capable of providing hazardous energy levels (>240 VA). Equipment manufacturers must provide adequate protection to service personnel.

Environmental Parameters

The UltiMod, Xsolo and Xgen series are designed for the following parameters

Material Group IIIb, Pollution Degree 2
Installation Category 2
Class I
Indoor use (installed, accessible to Service Engineers only).
Altitude: -155 metres to +3000 metres from sea level.
Humidity: 5 to 95% non-condensing.
Operating temperature -20°C to 70°C
Derate to 70°C. See *powerPac* Derating for details.

Approval Limitations

Use in North America

When these products are used on 180 to 253 Volts AC mains with no neutral, connect the two live wires to L (live) and N (neutral) terminals on the input connector.

Standard

Creepage Distances XL, XC, XK, XQ, XT, XB, XH models
Primary mains circuits to earth: 2.5mm spacing
Primary mains circuits to secondary: 5mm spacing

Dielectric strength XL, XC, XK, XQ, XT, XB, XH models
Primary mains circuits to chassis: 1500VAC
Primary mains circuits to secondary: 3000VAC

Medical

Creepage Distances UltiMod, Xsolo, XM, XV, XR, XZ, XN, XW models
Primary mains circuits to earth: 4mm spacing
Primary mains circuits to secondary: 8mm spacing

Dielectric strength UltiMod, Xsolo, XM, XV, XR, XZ, XN, XW models
Primary mains circuits to chassis: 1500VAC
Primary mains circuits to secondary: 4000VAC

The primary to secondary test is not possible with modules fitted to the unit, as damage to the EMI capacitors will occur.

Output Isolation

Xsolo : Output to Chassis isolation is 1500VAC.

UltiMod, Xgen: Output to Output Isolation is 500VDC
Output to Chassis Isolation is 500VDC

Section 7.3

EMC Characteristics

EMC Directive 2004/108/EC

Component Power Supplies such as the UltiMod, Xsolo and Xgen series are not covered by the EMC directive. It is not possible for any power supply manufacturer to guarantee conformity of the final product to the EMC directive, since performance is critically dependent on the final system configuration. System compliance with the EMC directive is facilitated by Excelsys products compliance with several of the requirements as outlined in the following paragraphs. Although the UltiMod, Xsolo and Xgen series meet these requirements, the CE mark does not cover this area.

EMISSIONS

Power Factor (Harmonic) Correction

The UltiMod, Xsolo and Xgen series incorporates active power factor correction and therefore meets the requirements of EN61000-3-2. Power factor: 0.98.

EN61000-3-3 Flicker & Voltage Fluctuation Limits

UltiMod, Xsolo and Xgen power supplies meet the requirements of the limits on voltage fluctuations and flicker in low voltage supply systems.

EN55022 Class B Conducted Emissions

For system compliance to EN55022, Level B, additional filtering may be required, for technical support, contact our Applications Engineering team.

IMMUNITY

The UltiMod, Xsolo and Xgen series has been designed to meet, and tested to, the immunity specifications outlined below:

EN61000-4-2 Electrostatic Discharge Immunity

8kV Air discharge applied to Enclosure
6kV Contact with Enclosure

EN61000-4-3 Radiated Electromagnetic Field

10Volts/metre 80MHz to 2.5GHz applied to Enclosure

EN61000-4-4 Fast Transients-Burst Immunity

+/-2kV

EN61000-4-5 Input Surge Immunity

Xsolo:
+/-4kV Common Mode 1.2/50 S (Voltage); 8/20uS (Current)
+/-2kV Differential Mode 1.2/50 S (Voltage) 8/20 S (Current)

UltiMod and Xgen:
+/-2kV Common Mode 1.2/50 S (Voltage); 8/20uS (Current)
+/-1kV Differential Mode 1.2/50 S (Voltage) 8/20 S (Current)

EN61000-4-6 Conducted Immunity

10 V/m 150KHz to 80MHz

EN61000-4-11 Voltage Dips

0% 1s Criteria B
40% 100ms Criteria B
70% 10ms Criteria A
Further details on all tests are available from Excelsys.

Guidelines for Optimum EMC Performance

All Excelsys products are designed to comply with European Normative limits (EN) for conducted and radiated emissions and Immunity, when correctly installed in a system. However, power supply compliance with these limits is not a guarantee of system compliance and system EMC performance can be impacted by a number of items.

Cabling arrangements and PCB tracking layouts are the greatest contributing factors to system EMC performance. All cables and PCB tracks should be treated as radiation sources and antenna. Every effort should be made to minimise current carrying loops that can radiate, and to minimise loops that could have noise currents induced into them.

a. Keep all cable lengths as short as possible.
b. Minimise the area of power carrying loops to minimise radiation, by using twisted pairs of power cables with the maximum twist possible.
c. Run PCB power tracks back to back.
d. Minimise noise current induced in signal carrying lines, by twisted pairs for sense cables with the maximum twist possible.
e. Do not combine power and sense cables in the same harness
f. Ensure good system grounding. System Earth should be a “starpoint”. Input earth of the equipment should be directed to the “starpoint” as soon as possible. The power supply earth should be connected directly t

EMI for XF

The Xsolo series of power supplies have been designed for used in harsh environments including military applications. For additional information relating to MIL STD 461F, CE101 and CE102 EMI characterization, please contact Excelsys Technologies.