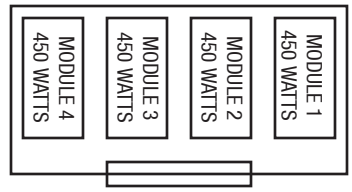
REDUNDANT POWER SYSTEMS

INTRODUCTION

Power systems users are always trying to find the right balance of power, performance, and price. To make the right decision for the application, users need to have a clear idea of what the capabilities are of the power system that they are considering. Many people assume that all power supplies are created equal, which is not the case. Especially in fault tolerant systems, there is a large variance in what some manufacturers call a 'fault tolerant' system.

This application note describes common fault tolerant power features, and presents the advantages of the ICT N+1 system.



TOTAL SYSTEM POWER
1350 WATTS (3 x 450 WATTS)
WITH REDUNDANCY

WHAT IS AN N+1 SYSTEM?

Fault tolerant power supplies are used in applications where the system cannot be interrupted by the failure of a power supply module. Even the best power supplies with current limiting, voltage limiting, over–temperature shutdown, and input surge/spike protection can fail. Fault tolerant systems have become a standard feature in most telecom and information technology applications.

A fault tolerant power supply is often called an N+1 configuration, and consists of two or more power supply modules. The power supply is usually specified so that if one module goes down, the remaining modules have the capacity to supply the load. The failure of a module should not cause any disturbance to the DC bus. In practical N+1 systems, it is not realistic that a module failure will not cause any disturbance on the DC bus, as the other modules do have a fixed response time related to the change in load. A momentary disturbance in bus must be small and fast enough that it can be tolerated by load.

Input Connector: IEC type 20A, 250v
Terminal Block: 115A, 400v
EMI: FCC Class A
Safety Approvals:
CSA C22.2 No.107.1
UL 1012 (6th edition)

SPECIFICATIONS

		Configs.		Input Voltage Range	Output Voltage	# of Modules	Output Current (Cont.)	Output Current (Peak)	Current Limiting	Redundant Current	Line Regulation	Load Regulation	Output Ripple (Max)	Efficiency (Typical)
		N	NM											
	ICT22012-70	●	●	105–130/ 205–250 VAC	13.8 VDC +/– 150 mV	2	34.0 Amps	75.0 Amps	80.0 Amps	34.0 Amps	1.00%	1.00%	40 mV RMS	79%
	ICT22012-100	●	●	105–130/ 205–250 VAC	13.8 VDC +/– 150 mV	3	68.0 Amps	110.0 Amps	120.0 Amps	34.0 Amps	1.00%	1.00%	40 mV RMS	79%
	ICT22012-140	●	●	105–130/ 205–250 VAC	13.8 VDC +/– 150 mV	4	83.0 Amps (90A @ 240V)	150.0 Amps	160.0 Amps	34.0 Amps	1.00%	1.00%	40 mV RMS	77% (80% @ 240V)
	ICT22024-35	●	●	105–130/ 205–250 VAC	27.6 VDC +/– 300 mV	2	17.0 Amps	38.0 Amps	40.0 Amps	17.0 Amps	1.00%	1.00%	40 mV RMS	83%
	ICT22024-50	●	●	105–130/ 205–250 VAC	27.6 VDC +/– 300 mV	3	34.0 Amps	57.0 Amps	60.0 Amps	17.0 Amps	1.00%	1.00%	40 mV RMS	83%
	ICT22024-70	●	●	105–130/ 205–250 VAC	27.6 VDC +/– 300 mV	4	41.0 Amps (51A @ 240V)	76.0 Amps	80.0 Amps	17.0 Amps	1.00%	1.00%	40 mV RMS	83% (84% @ 240V)
Modules	ICT12-30	●		105–130/ 205–250 VAC	13.8 VDC	––	32.5 Amps	35.0 Amps	36.0 Amps	––	1.00%	1.00%	35 mV RMS	80%
Modules	ICT24-17	●		105–130/ 205–250 VAC	27.6 VDC	––	17.5 Amps	18.5 Amps	19.0 Amps	––	1.00%	1.00%	40 mV RMS	80%

N - Standard **NM** - with LCD Meter

All complete systems are CSA C22.2 No 107.1, UL 1012 Approved & FCC class A Compliant

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WHAT FEATURES ARE IMPORTANT IN A REDUNDANT SYSTEM?

Output Or-ing Diode

An output Or–ing diode is critical to redundant power systems. The purpose of this diode is to completely isolate a failed power module from the rest of the circuit. Some low–quality N+1 systems don't include this feature, but it is not optional if the system requires true redundancy.

The Or–ing diode guarantees that no matter what type of failure occurs in the module, it will not drag the DC bus down. Without the diode, if there is a failure on the secondary, the bus could see a short through the module with catastrophic results.

The ICT N+1 system features high–quality schottky rectifiers in each module.

Current Sharing

When modules are paralleled to power a load, it is very important that they share that load equally. If one of the modules takes a substantially larger share of the load, it will be much more prone to failure, while the other modules power less than their share of the load.

This situation can be avoided by trimming the output voltage of the modules to exactly the same level, but the exact output voltage depends on components, ambient temperature, the power paths connecting the modules to the bus, and other conditions. There are ways to compensate for these factors to a reasonable degree in both design and installation, but it is very difficult to compensate for all conditions.

To resolve these issues, the ICT N+1 system makes use of a technique called active current sharing, where an active circuit continuously monitors the current output of all modules on the bus, and adjusts the feedback circuitry of each module to maintain a good balance.

Quality Power Connections

As the purpose of a redundant system is to provide power in critical applications, all power connections must be capable of performing reliably. In the ICT N+1 system, each module is interfaced to the main bus through a custom power connector with guide pins designed specifically for this application, capable of 100,000 operations. Unlike some low quality N+1 systems, there is no internal wiring between modules or from modules to the backplane that reduces reliability of the system. The entire ICT N+1 system terminates in a high power connector, capable of 110 Amps continuous. This high quality output connector ensures that enough mating force is supplied to minimize the voltage drop across this connection.

Remote Signal Circuitry

With a redundant power system, it is very important to know the status of the system at any time. The ICT N+1 system provides a DB–25 connector that has +15 and +5V power good signals, Fan fail alarm, 0 to 5V system current sense signal, module 1 to 4 power good signals, over–temperature signal, and an output DC voltage signal.

LED Status Display

ICT N+1 system comes with a standard LED status display. The display indicates the status of each module, whether the module is working or bad/not connected. The display also shows the status of AC input power and DC output power.

Battery Backup

Even though a typical N+1 system has extra supply modules to backup from module failure. However if an AC power failure occurs, the extra supply modules would have no effect at all. Therefore ICT N+1 system provides a battery backup connection. When the AC power is present, the power supply would provide all the power to the output and float charge the battery that is connected to the battery backup terminal. If an AC failure occurs, the battery would continuously supply the necessary power to the output and makes the unit truly uninterruptible.

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