

# POWER PAGE

PP46

JULY 1998

## APPLYING UFM500/UFM1K AC-to-DC CONVERTERS

### Overview

The Universal Front-end Module (UFM) contains the entire front-end of a switching power supply — including inrush current limiting, under and overvoltage protection, and all of the power switching and control circuitry necessary for auto-ranging rectification. In addition, the UFM also provides Bus O.K. (BOK) and module enable (EN) signals for orderly power controls.

Used with most industry standard DC-to-DC converters, including various models available from Powercube, the UFM offers a high reliability, high density, small size off-line switching power solution. The only external components needed are a filter, an input fuse, transient protection and appropriate hold-up capacitors.

The UFM module interfaces directly with worldwide AC mains at its input, and any

DC-to-DC converter with an input range of 200 to 400 VDC at its output. Available in a very small size (1.45" x 2.28" x 0.5") UFM500 and UFM1K can provide 500 W and 1000 W output, respectively, for an input of 90 to 132 VAC. For 180 to 265 VAC input, the output power increases to 750 W and 1500 W, respectively. The UFM contains a microcontroller that continuously tracks the AC line input and automatically configures itself into voltage doubler mode (for 90 to 130 VAC input) or bridge rectifier mode (for 180 to 265 VAC input). This eliminates any possibility of damage due to incorrect input voltage.

The output of the UFM can be connected to any number and type of 300 V input DC-to-DC converters, as long as their total power requirement is less than the maximum output power of the UFM.

### Off-Line Power Supply Configuration

Figure 1 shows connection for an Off-line Power Supply System. The input of the UFM is connected to AC mains through an AC fuse and a filter. The filter configuration and component values depend on the conducted emission limits and other application specific requirements which are beyond the scope of this Power Page.

The output of the UFM is connected to the input of DC-to-DC converter(s) through a fuse.

**For application information on the fuse selection and other safety consideration,**

Ask for

**POWER  PAGE**

PP41, Information for Standard Usage  
DC-to-DC Converters, PD Series



**POWERCUBE**  
A NATEL COMPANY

ISO 9001 CERTIFIED  
TEL: 1-800-866-3590 • FAX: 1-800-866-3589  
9340 OWENSMOUTH AVENUE • CHATSWORTH • CALIFORNIA 91311

# POWERPAGE

PP46

APPLYING UFM500/UFM1K — AC-TO-DC CONVERTERS

JULY 1998

## Off-Line Power Supply Configuration (Continued)

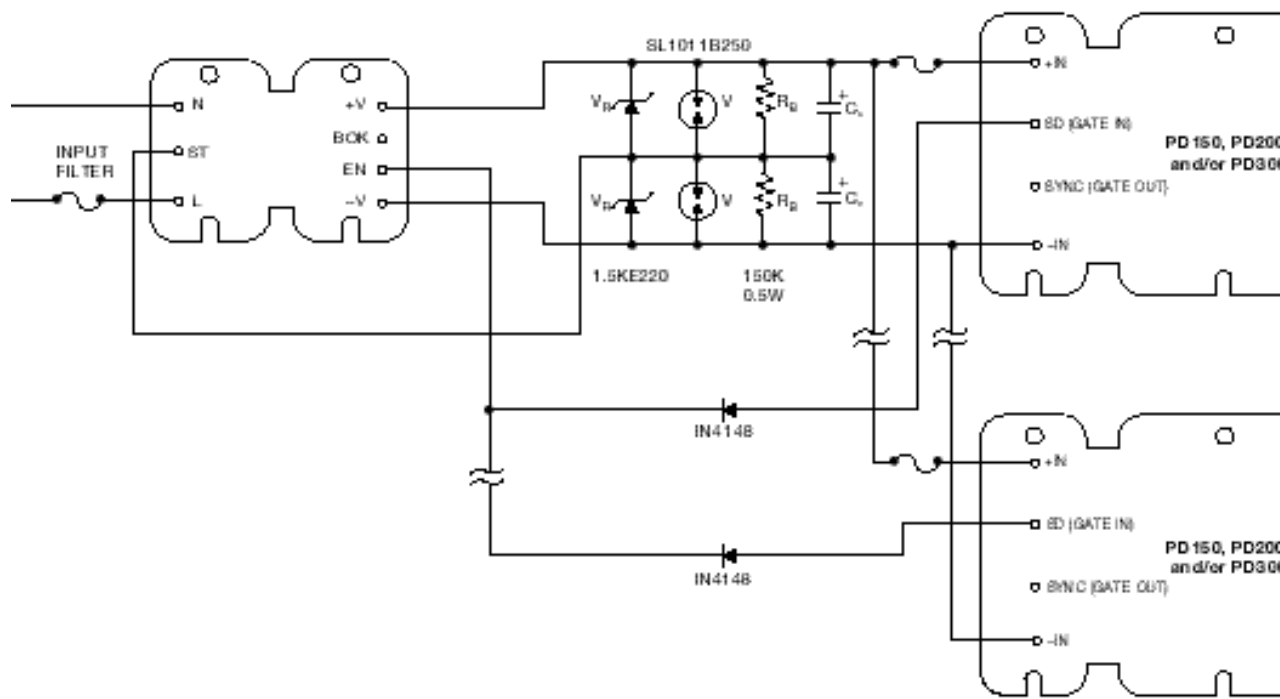


FIGURE 1. Off-Line Power Supply Configuration

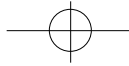
Aluminium electrolytic capacitor with a minimum working voltage rating of 250 VDC should be selected for the Output Capacitors  $C_O$ , (also called filter or hold-up capacitors). Capacitor value is dependent on AC input voltage and line frequency. Recommended values are shown in Table 1. The bleeder resistors  $R_B$  (150 KOhms @0.5 W) are required to discharge the output capacitors when the power is switched off. A combination of gas tubes (V) and zener diodes ( $V_R$ ) is recommended for best transient protection. The zener diodes are much faster, therefore respond quickly (1 psec) and gas tubes, although slow in response, can handle much more energy (20 KVA). The zener diodes shown in Figure 1 are 1.5KE220 from General Instruments. The gas tubes, SL1011B250, are

available from Semitron World Product Inc. at (707) 996-5201. All power connections in Figure 1 must use appropriate size conductors as they carry heavy currents. Only connections that do not

TABLE 1. Output Capacitor

Input Line Frequency	AC Input (VAC)	
	90-132 and 180-265	180-265
47-440 Hz	$(4.4 \times W_o^*) \mu f$	
50 Hz	$(4.4 \times W_o^*) \mu f$	$(2.5 \times W_o^*) \mu f$
60 Hz	$(3.4 \times W_o^*) \mu f$	
400 Hz	$(0.5 \times W_o^*) \mu f$	

$W_o^*$  is output power desired from UFM



# POWERPAGE

PP46

APPLYING UFM500/UFM1K — AC-TO-DC CONVERTERS

JULY 1998

## Off-Line Power Supply Configuration (Continued)

require thick / wide traces are control signals (EN, BOK). Also, to comply with regulatory safety agency requirements, the UFM module baseplate must be connected to safety ground.

**Enable (EN) Pin:** The purpose of the Enable pin is to “disable” the DC-to-DC converter(s) during power-up. Without the Enable pin connection, the DC-to-DC converter would try to start while the hold-up capacitors are being charged, which will prohibit the system from ever powering up properly. The Enable pin connection allows the output capacitor to charge to proper output voltage required for the DC-to-DC converters to function normally. The Enable function also serves the purpose of input overvoltage protection for the DC-to-DC converters. If the output voltage of UFM exceeds 400 VDC, the Enable function will shut down the DC-to-DC converters. Also, if due to a fault condition (eg., overload), the output voltage of UFM drops to less than 180 VDC the Enable function will

shut down the DC-to-DC converters.

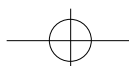
For option “P,” the Enable output (EN) is open drain of an N channel MOSFET and can be pulled up externally to a maximum of 30 VDC with respect to –V. For option “V,” the Enable output is internally pulled up to 15 VDC through a 150 KOhm resistor. Table 2 shows control specifications for the EN output.

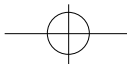
When more than one converter is used a small signal diode (1N4148 or equivalent) must be connected in series with and physically close to shut down “SD” (or Gate-In) pin of each converter to avoid any interference of control signals between different DC-to-DC converters.

**Strap (ST) Pin:** For proper auto-ranging operation, the ST pin must be connected to the junction of output capacitors C<sub>O</sub>. (See Figure 1.)

**TABLE 2. Enable Output (EN) Control Specifications**

Parameter	Specification	Remark
ON-State Resistance ON-State Current (option “V”) (option “P”)	15 Ohms maximum 50 mA maximum 50 mA maximum	Converters disabled 150 KOhms pull-up to 15 VDC Open drain
OFF-State Voltage (option “V”) (option “P”)	15 VDC typical 30 VDC maximum	With respect to “–V” External pull-up
Converter Enable Output Voltage Converter Not-enabled Output Voltage	235 to 380 VDC 180 to 190 VDC	





# POWERPAGE

PP46

APPLYING UFM500/UFM1K — AC-TO-DC CONVERTERS

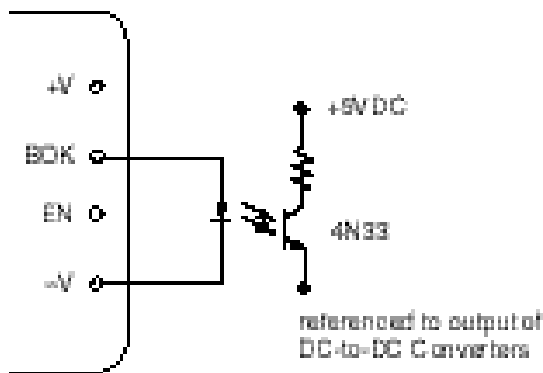
JULY 1998

**Bus-OK (BOK) Pin:** Bus OK pin provides a logic “0” during normal operation and a logic “1” (15 VDC with respect to negative output pin -V) if there is a power failure. Table 3 shows control specifications for the BOK output.

If BOK output is used on the output of DC-to-DC converters, it must be isolated with an optocoupler. The UFM does not provide any Input-to-Output isolation.

Recommended circuit is shown in Figure 2. A high-gain optocoupler 4N33 or equivalent is recommended for the application. The BOK signal can be used as an advanced warning of an eminent loss of power. Note that the off-state threshold of BOK is 205 VDC, yet the converter not-enabled threshold is 185 VDC. The BOK signal can warn the system of impending loss of power, thus initiating an

orderly shutdown of vital functions. To increase this warning time, make the output capacitor values larger than those shown in Table 1.



**FIGURE 2. Isolated, Power Status, Bus OK Indicator**

**TABLE 3. Bus OK (BOK) Control Specifications**

Parameter	Specification	Remark
ON-State Resistance ON-State Current	15 Ohms maximum 50 mA maximum	Normal operation
OFF-State Voltage OFF-State Current	15 VDC typical 100 µA maximum	Power failure BOK pulled up internally with a 27 KOhm resistor to +15 VDC
ON-State Output Voltage Threshold OFF-State Output Voltage Threshold	240 VDC typical 205 VDC typical	

Powercube makes no representation that use of its modules in the circuits described herein, or use of other technical information contained herein will not infringe on existing or future patent rights nor do the descriptions contained herein imply the granting of license to make, use, or sell equipment constructed in accordance therewith.



A NATEL COMPANY  
Specifications subject to change without notice  
Printed in USA Copyright © 1998 Powercube

ISO 9001 CERTIFIED

TEL: 1-800-866-3590 • FAX: 1-800-866-3589  
9340 OWENSMOUTH AVENUE • CHATSWORTH • CALIFORNIA 91311

