

The MBK-600 *Rejutor*[™] Calibration Tool is a platform for parallel adjustment of multiple Rejutor-based circuits. It is suitable for high-volume production with Rejutors. There are three elements to the MBK-600; the National Instruments NI-DAQ Chassis, *MultiCal* Rejust-it Software and MB-12x series power modules.

Based on the National Instruments NI-DAQ architecture the MBK-600 is intended for high-volume production, or production environments that require measurement traceability. NI CompactDAQ modules (available from National Instruments) feature built-in connectivity and signal conditioning for analog, digital and sensor measurements, including temperature, pressure, flow and vibration, etc. Microbridge recommends purchasing the NI-DAQ chassis along with the required plug-in modules from National Instruments.

The MBK-600 implements Microbridge's closed loop calibration system allowing multiple units to be calibrated to high-precision typically within 1-2-seconds.

The MB-12x series of power modules provide the interface between Rejutors and the *MultiCal* system. Up to four modules can be configured per chassis. They are hardwired to correspond to software channel numbers:

- MB-121 – Channel 1 to Channel 4
- MB-122 – Channel 5 to Channel 8
- MB-123 – Channel 9 to Channel 12
- MB-124 – Channel 13 to Channel 16

Each power module supports up to four devices, where a device refers to a user circuit which requires calibration by means of a Rejutor.

APPLICATIONS

- In-circuit adjustment of all Rejutor products
- High-volume production
- Integrated production test equipment

FEATURES

- Stacking the MB-121, MB-122, MB-123, MB-124 in a single MBK-600 allows multiple access to 64 individual Rejutors and adjustment of up to 16 user circuits simultaneously
- Efficient, high-volume calibration system

Each MB-12x Power Module:

- Supports simultaneous calibration of up to 4 devices under test
- Supports simultaneous calibration of up to 16 individual Rejutors, housed in up to 4 user circuits
- Power-Controlled Rejutor Calibration (Patent Pending)
- Compatible with NI9263-AO and NI9205-AI CompactDAQ modules
- Compatible with Microbridge's *MultiCal* Rejutor Calibration software

BENEFITS

- Easy to use
- Can be integrated with other National Instruments modules
- Low cost



Figure 1: MBK-600 *MultiCal* System
Shown with MB-121, MB-122 and MB-123 installed. MB-124 is shown in the foreground

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GENERAL DESCRIPTION

MB-12x power modules are designed to support the calibration process for a device under test (DUT) which requires adjustment. Examples of DUTs include sensors, voltage references, amplifiers, or any in-circuit application using Rejutors to facilitate calibration.

The MBK-600 *MultiCal* Rejutor Calibration System consists of:

- One CompactDAQ USB data acquisition platform cDAQ-9172¹;
- NI drivers for cDAQ-9172¹;
- *MultiCal* software calibration DLL, compatible with LabVIEW, C or Visual Basic;
- From one to four *MultiCal* power modules MB-12x, depending on the number of simultaneous adjustments required;
- One 4-channel, 16-bit analog output module NI9263¹;
- One 32-channel, 16-bit analog input module NI9205¹ (depending on user-specific technical requirements the system may include other analog input (AI) modules compatible with cDAQ-9172).

The main feature of the *MultiCal* Rejutor Calibration System is the ability to adjust all selected DUTs “simultaneously, in parallel”. That means the adjustment session starts and stops synchronously for the all DUTs, reducing the total adjustment time in comparison with adjusting sequentially.

MB-12x DETAILED DESCRIPTION

All MB-12x Power Modules have the same internal architecture and serve the same purpose. The difference between the four modules (e.g. between MB-122 and MB-123, for example), is that each module has a different hardware pre-programmed analog output identifier corresponding to the channel numbers in Rejust-it MultiCal software. Module MB-121 is pre-assigned to soft channels 1 to 4, The MB-122 is hardwired to correspond with soft channels 5 through 8. Similarly, MB-123 and MB-24 are assigned for channels 9 through 12 and 13 through 16 respectively. The modules can be installed in any physical slot in the cDAQ-9172 chassis. Because of this architecture;

- Each of 64 analog outputs (AO) has its own unique ID, and therefore, a user doesn’t have to sort out all 64 AOs
- MB-12x Power Modules are stackable (up to four). As the number of devices that must be simultaneously calibrated increases, add additional power modules to the calibration system (refer to Table1, below);
- If a device under test requires more than four Rejutors for calibration (for example seven in the case of a Wheatstone Bridge network), configure any two power channels as a single channel with eight analog outputs;
- Do not use power modules with the same part number in the same Calibration System. For example, don’t use MB-122, MB-124 and MB-124. The second MB-124 will cause a bus conflict. Use MB-121 or MB-123 instead of the second MB-124;
- Just one NI9263 AO module is needed for all MB-12x in the same Calibration System;
- The type and number of AI modules required for calibration are defined by the user’s needs. The AI Modules must be compatible with NI cDAQ-9172 chassis.

Table 1: Relationship between number of Simultaneous adjustments and number of MB-12x Power Modules

Number of user circuits which have to be calibrated simultaneously	Number of individual Rejutors needed for calibration	Required Number of MB-12x Modules
1 to 4	Up to 16	1
1 to 8	Up to 32	2
1 to 12	Up to 48	3
1 to 16	Up to 64	4

The functional block diagram of the MB-121 is shown in Figure 2. There are four power channels inside each MB-12x Power module. Each channel within the module includes a track-and-hold amplifier (T/H) and a power amplifier (V-to-W) which outputs power proportional to input voltage. Each power channel has four analog outputs (AO) addressable by means of the 4-channel multiplexer (MUX). The power channels deliver the analog adjustment pulses to up-to four Rejutors. During the calibration process each power channel of the MB-12x is assigned to an individual DUT, hence making it possible to control from one to four user circuits simultaneously. Each user circuit in turn, may carry up to four individual Rejutors which can be selected by means of the 4-channel MUX. For example, if an op-amp’s gain can be calculated as $Gain=1+Rj1/Rj2$, then two Rejutors (Rj1 and Rj2) are needed to adjust the gain to the target. Note; in this case leave the two unused analog outputs floating. Figure 3 shows an example of a “fully loaded” MB-121 – all sixteen analog outputs (AO) are used in the calibration process of four user-selected devices, each containing two MBD-series Rejutor dividers.

¹ These items should be ordered directly from National Instruments

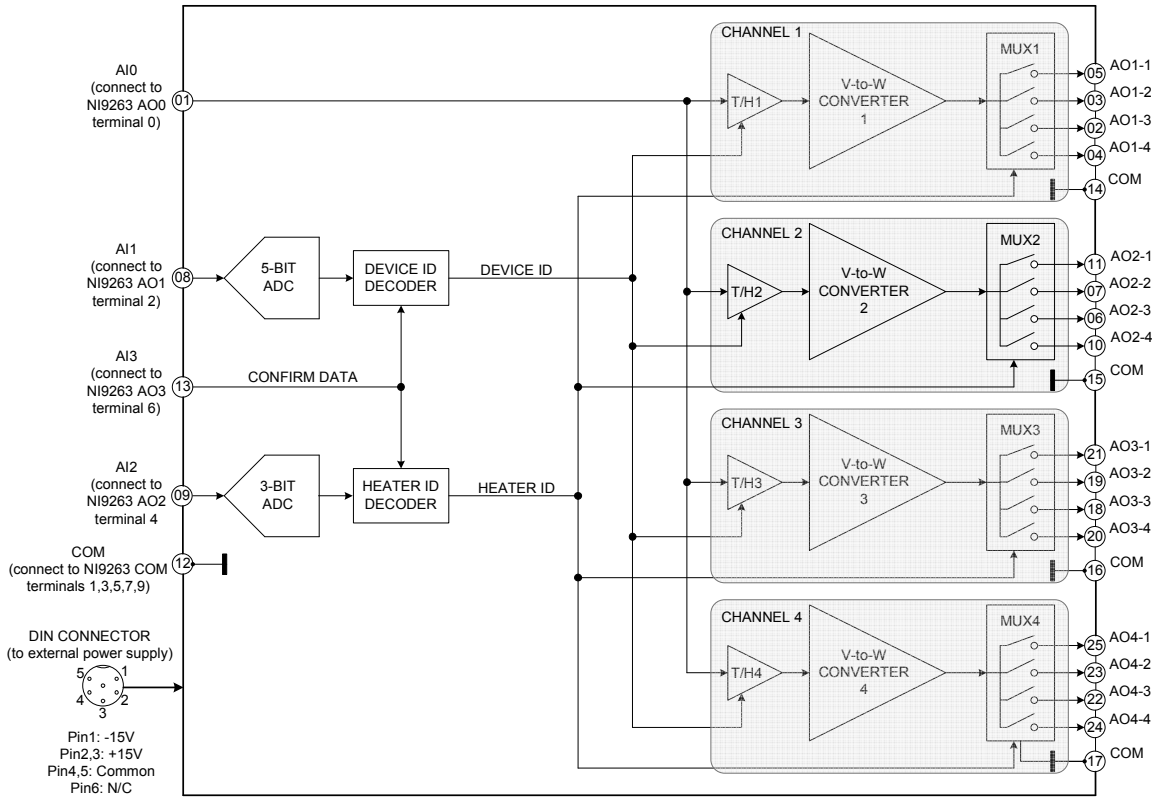


Figure 2: Functional Block Diagram for One MB-121 Module

Each MB-12x Power Module will deliver and redistribute sufficient power to adjust the Rejustrors. Each module requires an external power supply which provides:
 +15VDC @ 2A
 -15VDC @ 1A

The recommended supply is the "Portable, low-cost, switching power supply DTMPU50-210" from Wall Industries.

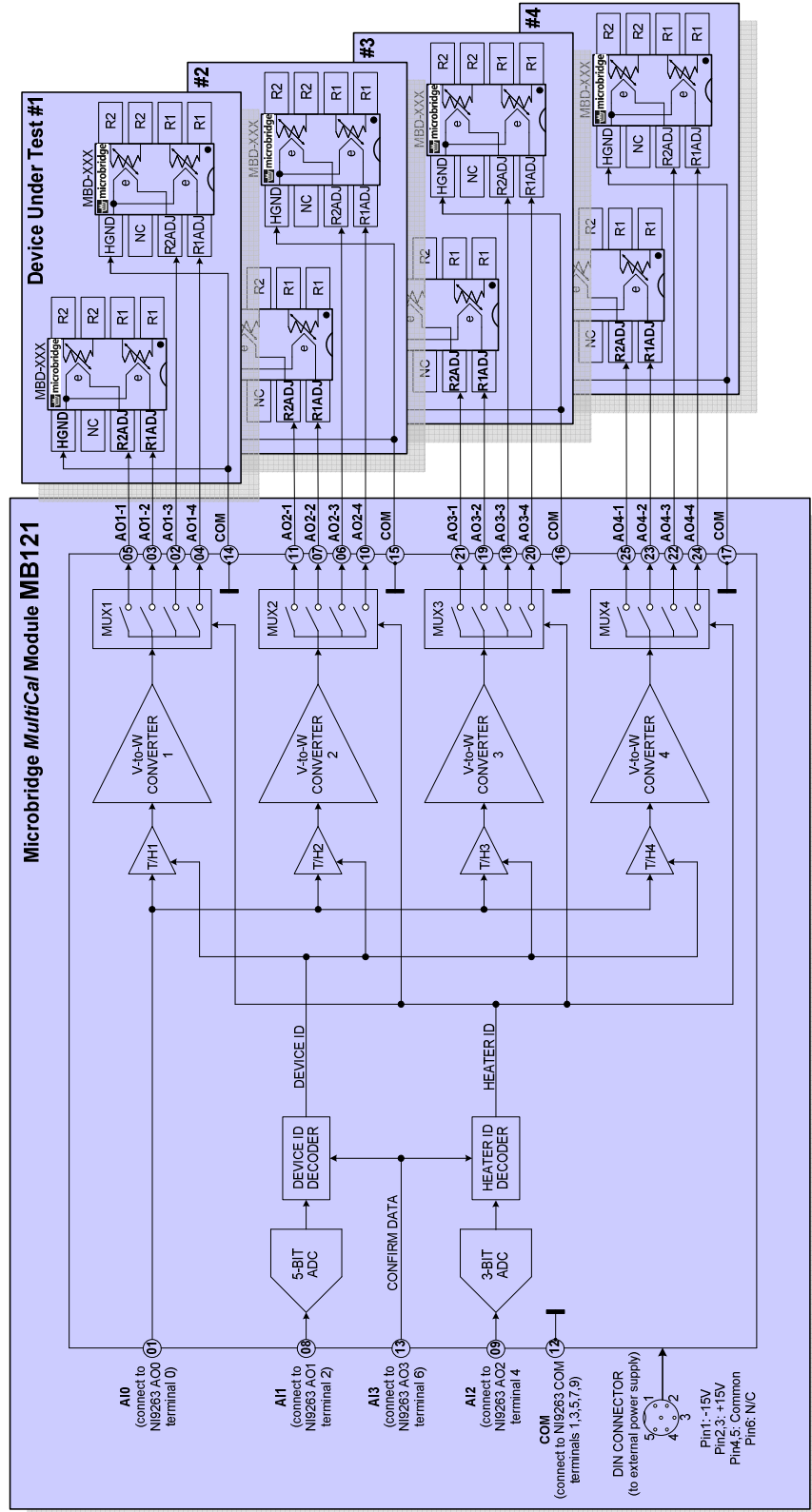


Figure 3: Connecting MB-121 to four DUTs (each DUT includes four MBD series Rejustrors in two SOIC packages)

The MB-12x Power Modules have a DB25-Pin Male D-Sub connector. An interface cable is required to connect the DUTs to the MBK-600. For production efficiency, it is recommended that the user build some form of quick-connect system to interface the DUTs to the interface cable. Examples include edge connectors and bed-of-nails test jigs. The pin-out for the DB25 connector on each module is identical and provided in Table 2, below.

Note that the analog outputs are grouped sets of 4-pins each. This allows up to four Rejistor adjustment signals that correspond to a single DUT (or a single analog input). Groups of four can be ganged together to influence a single DUT, however, the groups can not be sub-divided.

Table 2. MB-12x Pin Description (Refers to the DB25 Front Side Connector)

Pin	Name	Function
1	AIO	Analog Input 0. Connect AIO to Terminal 0 of NI9263
2	AO1-3	Analog Outputs. Provide Adjustment Pulse Sequences for the <u>SAME</u> Device Under Test. Connect to pin R1ADJ or R2ADJ of selected Rejistor.
3	AO1-2	
4	AO1-4	
5	AO1-1	
6	AO2-3	Analog Outputs. Provide Adjustment Pulse Sequences for the <u>SAME</u> Device Under Test. Connect to pin R1ADJ or R2ADJ of selected Rejistor.
7	AO2-2	
10	AO2-4	
11	AO2-1	
8	AI1	Analog Input 1. Connect AI1 to terminal 2 of NI9263
9	AI2	Analog Input 2. Connect AI2 to terminal 4 of NI9263
12,14,15,16,17	COM	Common. Connect to NI9263 COM and to all Rejistor HGNDs.
13	AI3	Analog Input 3. Connect AI3 to terminal 6 of NI9263
18	AO3-3	Analog Outputs. Provide Adjustment Pulse Sequences for the <u>SAME</u> Device Under Test. Connect to pin R1ADJ or R2ADJ of selected Rejistor.
19	AO3-2	
20	AO3-4	
21	AO3-1	
22	AO4-3	Analog Outputs. Provide Adjustment Pulse Sequences for the <u>SAME</u> Device Under Test. Connect to pin R1ADJ or R2ADJ of selected Rejistor.
23	AO4-2	
24	AO4-4	
25	AO4-1	

MBK-600 DETAILED DESCRIPTION

The MBK-600 Rejistor Calibration system is designed to support up to 16 circuits where each circuit may include up to 4 Rejistors. This provides a maximum capability to simultaneously adjust up to 64 combinations. Table 3 provides the mapping for the physical channels.

Table 3. Connecting Device Under Test (DUT) to MB-12x

Module Number	Part Number MB-12x	DUT Number	Rejistor Number	Rejistor Heater Number
1	MB-121	1	Rj ₁₋₁ / Rj ₁₋₂ / Rj ₁₋₃ / Rj ₁₋₄	H ₁₋₁ / H ₁₋₂ / H ₁₋₃ / H ₁₋₄
1	MB-121	2	Rj ₂₋₁ / Rj ₂₋₂ / Rj ₂₋₃ / Rj ₂₋₄	H ₂₋₁ / H ₂₋₂ / H ₂₋₃ / H ₂₋₄
1	MB-121	3	Rj ₃₋₁ / Rj ₃₋₂ / Rj ₃₋₃ / Rj ₃₋₄	H ₃₋₁ / H ₃₋₂ / H ₃₋₃ / H ₃₋₄
1	MB-121	4	Rj ₄₋₁ / Rj ₄₋₂ / Rj ₄₋₃ / Rj ₄₋₄	H ₄₋₁ / H ₄₋₂ / H ₄₋₃ / H ₄₋₄
2	MB-122	5	Rj ₅₋₁ / Rj ₅₋₂ / Rj ₅₋₃ / Rj ₅₋₄	H ₅₋₁ / H ₅₋₂ / H ₅₋₃ / H ₅₋₄
2	MB-122	6	Rj ₆₋₁ / Rj ₆₋₂ / Rj ₆₋₃ / Rj ₆₋₄	H ₆₋₁ / H ₆₋₂ / H ₆₋₃ / H ₆₋₄
2	MB-122	7	Rj ₇₋₁ / Rj ₇₋₂ / Rj ₇₋₃ / Rj ₇₋₄	H ₇₋₁ / H ₇₋₂ / H ₇₋₃ / H ₇₋₄
2	MB-122	8	Rj ₈₋₁ / Rj ₈₋₂ / Rj ₈₋₃ / Rj ₈₋₄	H ₈₋₁ / H ₈₋₂ / H ₈₋₃ / H ₈₋₄
3	MB-123	9	Rj ₉₋₁ / Rj ₉₋₂ / Rj ₉₋₃ / Rj ₉₋₄	H ₉₋₁ / H ₉₋₂ / H ₉₋₃ / H ₉₋₄
3	MB-123	10	Rj ₁₀₋₁ / Rj ₁₀₋₂ / Rj ₁₀₋₃ / Rj ₁₀₋₄	H ₁₀₋₁ / H ₁₀₋₂ / H ₁₀₋₃ / H ₁₀₋₄
3	MB-123	11	Rj ₁₁₋₁ / Rj ₁₁₋₂ / Rj ₁₁₋₃ / Rj ₁₁₋₄	H ₁₁₋₁ / H ₁₁₋₂ / H ₁₁₋₃ / H ₁₁₋₄
3	MB-123	12	Rj ₁₂₋₁ / Rj ₁₂₋₂ / Rj ₁₂₋₃ / Rj ₁₂₋₄	H ₁₂₋₁ / H ₁₂₋₂ / H ₁₂₋₃ / H ₁₂₋₄
4	MB-124	13	Rj ₁₃₋₁ / Rj ₁₃₋₂ / Rj ₁₃₋₃ / Rj ₁₃₋₄	H ₁₃₋₁ / H ₁₃₋₂ / H ₁₃₋₃ / H ₁₃₋₄
4	MB-124	14	Rj ₁₄₋₁ / Rj ₁₄₋₂ / Rj ₁₄₋₃ / Rj ₁₄₋₄	H ₁₄₋₁ / H ₁₄₋₂ / H ₁₄₋₃ / H ₁₄₋₄
4	MB-124	15	Rj ₁₅₋₁ / Rj ₁₅₋₂ / Rj ₁₅₋₃ / Rj ₁₅₋₄	H ₁₅₋₁ / H ₁₅₋₂ / H ₁₅₋₃ / H ₁₅₋₄
4	MB-124	16	Rj ₁₆₋₁ / Rj ₁₆₋₂ / Rj ₁₆₋₃ / Rj ₁₆₋₄	H ₁₆₋₁ / H ₁₆₋₂ / H ₁₆₋₃ / H ₁₆₋₄

A sample system configuration is shown in Figure 4. The Multi-Cal software operates on a Windows compatible computer under Windows XP. The software communicates to the MBK-600 *MultiCal* Rejistor Calibration Tool through the USB port. The NI9205 measures each DUT as part of the closed-loop feedback system for in-circuit adjustment. Up to four analog inputs can be configured for each available MB-12x Power Module. A user interface cable is required to connect the analog outputs of the DUTs to the analog inputs on the NI9205.

The NI9263 maps the analog inputs from the DUT to individual input channels on each MB-12x Power Module. The physical connection between the analog output channel (on the NI9263) and the analog inputs (on the MB-12x Power Modules) must be made in the wiring harness. The inputs are on pins 1, 8, 9 and 13 of the MB-12x.

The MB-12x Power modules drive the adjustment pulses into the Rejutors to change their resistance. This in turn changes the output voltage of the DUT which is monitored on the Analog input channels. The process iterates until the resistance of the Rejutors has been adjusted to provide the required output.

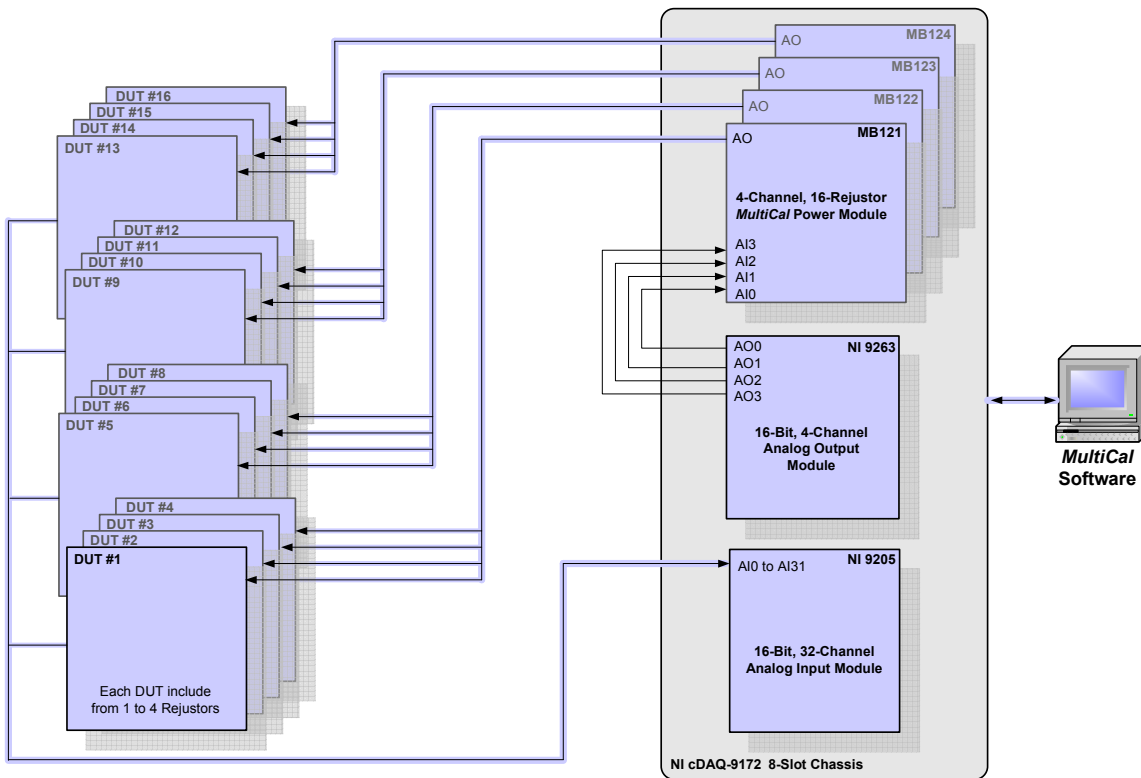


Figure 4: Calibration System Functional Block Diagram

MB-12x ABSOLUTE MAXIMUM RATINGS

Continuous Current (AO, COM)	100mA
Peak Current Pulsed at 1ms, 10% duty cycle (any AO to COM).....	300mA
Input Voltage Range.....	- 0.5V to + 10.5V
Supply voltage, V+ to V-.....	32V

MB-12x POWER REQUIREMENTS

Each MB-12x requires individual power supply which provides:

- +15VDC @ 2A
- 15VDC @ 1A

Recommended solution:

Portable, low-cost, switching power supply DTMPU50-210 from Wall Industries
http://www.wallindustries.com/productcart/pc/viewCat_P3.asp?idCategory=264

Please check with Microbridge Technologies Inc prior to design to ensure you have the latest revision of the datasheet for this part.