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Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

Overview

The DBK45 combines the features of the DBK17 (SSH) and the DBK18 (low-pass filter) cards. Each DBK45 provides 4 input channels to a LogBook or Daq device system. Each of the main 16 analog input channels can accept four DBK45s, for a maximum of 64 DBK45s and 256 analog input channels. The simultaneous sample-hold function is activated at the beginning of each channel scan and freezes all signals present on DBK45 inputs for the duration of the scan, allowing for non-skewed readings of all channels.

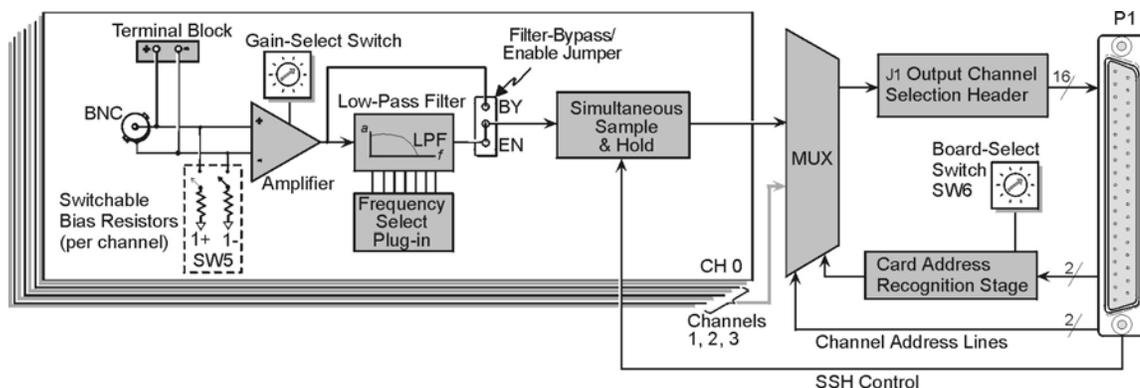


You should never set a DBK45 channel as the 1st channel in a scan due to timing of the SSH line.

For each of the four channels, a separate filter and a sample-hold stage follow the input stage. The outputs are connected to a 4-channel multiplexer stage. The enabled-output MUX allows four DBK45s to share a common analog input channel.

The DBK45 has an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a gain resistor for custom gain-selection instead of the 5 factory-default gains. Gain for any channel can be set to any value between unity and $\times 500$ by installing an appropriate resistor. Four separate filter stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled output MUX allows four DBK45s to share a common analog base channel.

Input can be connected to a channel's BNC or terminal block connector. The differential inputs are provided with switchable $100\text{ k}\Omega$ bias resistors to analog common.



Hardware Setup

Card Connection

CAUTION	
	Input voltage levels must not exceed ±5 V bipolar or 10 V unipolar.

DBK45 is equipped with a BNC connector for each of the four differential analog inputs. The card includes terminal block connections, which can be used instead of the BNC connectors if desired.

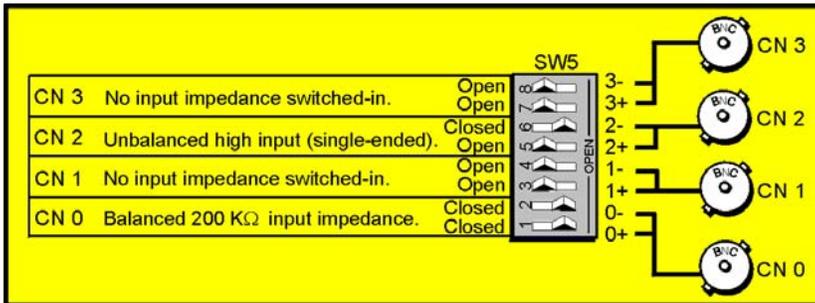
Card Configuration

Factory Defaults:

- **100K bias resistors – Enabled**
- **Low pass filter – Disabled (bypassed)**
- **Gain – x1**
- **SSH - Enabled**

Input Termination

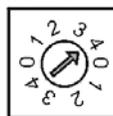
DBK45 provides two 100 KΩ bias resistors for each analog input. For balanced 200 KΩ input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The switches must be in the closed position to engage the termination resistors. For unbalanced high input, only the (-) resistor should be used. If neither resistor is used, some external bias current path is required. Examples of SW5 switch positions and the resulting impedance selection follows.



Examples of Bias Resistor Selection Options

Gain Settings

On the printed circuit board, each channel has one gain-set switch. The switches are labeled GAIN 1, GAIN 2, GAIN3, and GAIN 4. Each channel also has holes in the board for gain resistors labeled RG1 to RG4. The 5 gain values for switch settings 0 to 4 are provided in the following figure. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the board. The gain resistor's value is determined by the formula: $R_{GAIN} = [40,000 / (Gain - 1)] - 50 \Omega$

Gain Values	Gain Switch
0 ×1	
1 ×10	
2 ×100	
3 ×200	
4 ×500	

Setting Channel Gains

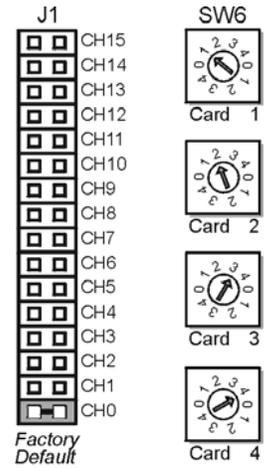
Address Configuration

Up to four DBK45s can be connected to each analog channel. With 16 main channels and 4 inputs per DBK45, 256 inputs are possible. Since this is a daisy-chain interface, each DBK45 must have a unique address (channel and card number). Note that the default setting of SW6 is Card 1.

To configure the module, locate the 16 × 2-pin header (labeled J1) near the front of the board (near P1). The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used.

Note: Two DBK45s in the daisy-chain can have the same channel number as long as their card number is unique.

Set switch SW6 for each DBK45 on a single channel. Verify that only one card in the system is set to a particular channel *and* card number.

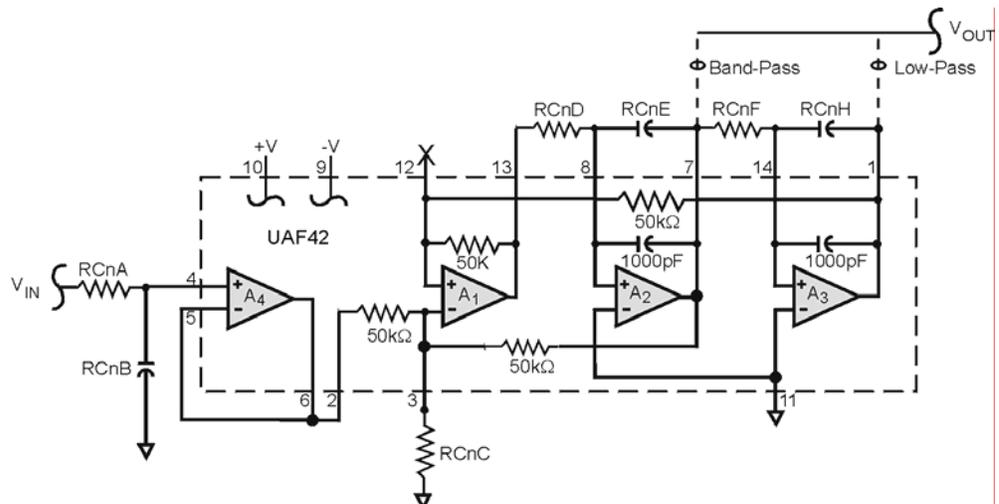


Address Configuration

Configuring DBK45 Filter Sections

There are 4 low-pass, 3-pole active filters on the DBK45. Each filter can be enabled (EN) or bypassed (BY) by placement of the jumper on J3 for channel 0, J4 for channel 1, J5 for channel 2, J6 for channel 3. The factory-default setting is **enabled (EN)** for each channel. Each filter can be configured as a Butterworth, Bessel, or Chebyshev filter with corner frequencies up to 50 kHz. Filter properties depend on the values of resistors and capacitors installed in several circuit locations. Above 10 Hz, installing capacitors is unnecessary because capacitors in the ICs are sufficient. In all cases, three resistors are required to complete the active filter circuits contained mostly within the UAF42 ICs.

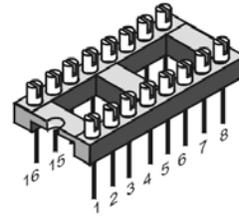
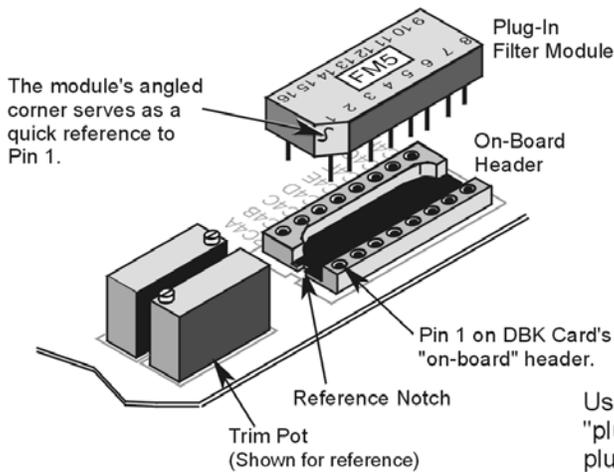
The following circuit diagram shows the active filter IC in a typical section of the DBK45. The resistors and capacitors outside the IC have a physical location in a DIP-16 socket (dual in-line, 16 pins) with an RCnn designator. The RC indicates the needed part is a resistor or capacitor; the 3rd character is the channel number; and the 4th character corresponds to the socket position (A-H).



Filter Circuit Diagram

A machined-pin IC socket in each filter RC location can accept resistors and capacitors that plug directly into the socket; however, this is not recommended. Two much better approaches exist. The first is to use pre-configured plug-in filter modules; the second is to configure your own plug-in module using a blank CN-115. Both of these options are illustrated on the following page.

The use of plug-in modules provides excellent “gold-to-gold” contact between the components of the plug-in module and the on-board header.



CN-115, Blank Plug-In Module.
Components are soldered in place.

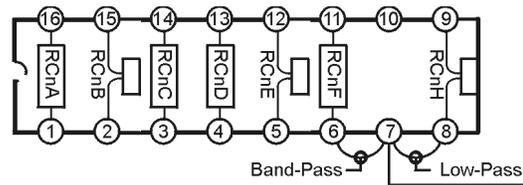
Users have a choice of using pre-configured "plug-in" filter modules; or using their own plug-in module (CN-115), that they can configure themselves by soldering components in place.

The right-hand figure shows the DIP-16 component pattern typical of the 4 filter sections.

Note: "n" corresponds to "channel number."

Pin 7 of the DIP-16 socket:

- connects to pin 8 for low-pass filtering
- connects to pin 6 for band-pass filtering



DIP-16 Component Pattern

The following table lists values of components for common corner frequencies in Butterworth filters. If designing your own filter, software from Burr-Brown provides the component values to create the desired filter. Note that the design math is beyond the scope of this manual.

3-Pole Butterworth Filter Components								
3dB (Hz)	RCnA	RCnB	RCnC	RCnD	RcnE	RCnF	RCnG	RCnH
0.05	3.16 MΩ	1 μF	none	3.16 MΩ	1 μF	3.16 MΩ	none	1 μF
0.10	1.58 MΩ	1 μF	none	1.58 MΩ	1 μF	1.58 MΩ	none	1 μF
0.20	787 kΩ	1 μF	none	787 kΩ	1 μF	787 kΩ	none	1 μF
0.50	3.16 MΩ	0.1 μF	none	3.16 MΩ	0.1 μF	3.16 MΩ	none	0.1 μF
1	1.58 MΩ	0.1 μF	none	1.58 MΩ	0.1 μF	1.58 MΩ	none	0.1 μF
2	787 kΩ	0.1 μF	none	787 kΩ	0.1 μF	787 kΩ	none	0.1 μF
5*	3.16 MΩ	0.01 μF	none	3.16 MΩ	0.01 μF	3.16 MΩ	none	0.01 μF
10*	1.58 MΩ	0.01 μF	none	1.58 MΩ	0.01 μF	1.58 MΩ	none	0.01 μF
20	787 kΩ	0.01 μF	none	787 kΩ	0.01 μF	787 kΩ	none	0.01 μF
50	3.16 MΩ	0.001 μF	none	3.16 MΩ	none	3.16 MΩ	none	none
100*	1.58 MΩ	0.001 μF	none	1.58 MΩ	none	1.58 MΩ	none	none
200	787 kΩ	0.001 μF	none	787 kΩ	none	787 kΩ	none	none
500*	316 kΩ	0.001 μF	none	316 kΩ	none	316 kΩ	none	none
1000*	158 kΩ	0.001 μF	none	158 kΩ	none	158 kΩ	none	none
2000	78.7 kΩ	0.001 μF	none	78.7 kΩ	none	78.7 kΩ	none	none
5000	31.6 kΩ	0.001 μF	none	31.6 kΩ	none	31.6 kΩ	none	none
10000	15.8 kΩ	0.001 μF	none	15.8 kΩ	none	15.8 kΩ	none	none

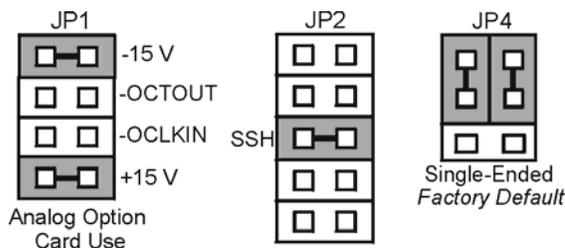
*These pre-configured Butterworth frequency modules are available from the manufacturer.

You have the option to configure the filter sections as band-pass filters rather than low-pass filters. The component selection program provides band-pass component values. The program also computes and displays phase and gain characteristics of the filter sections as a function of frequency.

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of the DBK45 requires setting jumpers in **DaqBooks/100 Series & /200 Series devices** and **ISA-type DaqBoards**.

1. If not using auxiliary power, set the JP1 jumper for Analog Option Card Use (also referred to as Analog Expansion Mode).



Jumpers on DaqBook/100 Series, DaqBook/200 Series, and ISA-type DaqBoards



The JP1 default position (Analog Option Card Use) is necessary to power the interface circuitry of the DBK45 via the internal ± 15 VDC power supply. If using auxiliary power, e.g., DBK32A or DBK33, you must remove both JP1 jumpers. Refer to *Power Requirements* in the *DBK Basics* section and the DBK32A and DBK33 sections for more information, as applicable.

2. Place the JP2 jumper in the SSH position.

CAUTION



Do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

3. For DaqBook/100, DaqBook/112 and DaqBook/120 only, place the JP4 jumper in *single-ended* mode.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No hardware configuration is required for DaqBook/2000 Series or DaqBoard/2000 Series devices.

Software Setup



Reference Notes:

- o *DaqView* users - Refer to chapter 3, *DBK Setup in DaqView*.
- o *LogView* users - Refer to chapter 4, *DBK Setup in LogView*.

DBK45 – Specifications

Name/Function: Simultaneous Sample and Hold and Low-Pass Filter Card

Number of Channels: 4

Input Connections: 4 BNC connectors; 4 screw-terminal sets

Output Connector: DB37 male, mates with P1 using CA-37-x cable

Number of Cards Addressable: 64

Dimensions: 8.25" x 3.25"

Input Type: Differential

Voltage Input Ranges:
0 to ± 5000 mVDC
0 to ± 500 mVDC
0 to ± 50 mVDC
0 to ± 25 mVDC
0 to ± 10 mVDC

For Custom Gains: $R_{\text{GAIN}} = [40,000/(\text{Gain}-1)] - 80 \Omega$

Input Amplifier Slew Rate: 12 V/ μs minimum

Acquisition Time:
0.6 μs (10 V excursion to 0.1%)
0.7 μs (10 V excursion to 0.01%)

Channel-to-Channel Aperture Uncertainty: 50 ns

Output Droop Rate: 0.1 $\mu\text{V}/\mu\text{s}$

Input Gains: $\times 1$, $\times 10$, $\times 100$, $\times 200$, $\times 500$, and user-set up to $\times 500$

Input Offset Voltage: 500 $\mu\text{V} + 5000/\text{G}$ maximum (nullable)

Input Offset Drift: $\pm 5 + 100/\text{G}$ $\mu\text{V}/^\circ\text{C}$ maximum

Input Bias Current: 100 pA maximum

Input Offset Currents: 50 pA maximum

Input Impedance: $5 \times 10^{12} \Omega$ parallel with 6 pF

Switchable Bias Resistors: 100 K Ω each to analog common

Gain Errors:

0.04% @ $\times 1$
0.1% @ $\times 10$
0.2% @ $\times 100$
0.4% @ $\times 200$
1.0% @ $\times 500$

Temperature vs Gain:

± 20 ppm/ $^\circ\text{C}$ @ $\times 1$
 ± 20 ppm/ $^\circ\text{C}$ @ $\times 10$
 ± 40 ppm/ $^\circ\text{C}$ @ $\times 100$
 ± 60 ppm/ $^\circ\text{C}$ @ $\times 200$
 ± 100 ppm/ $^\circ\text{C}$ @ $\times 500$

Non-Linearity:

± 0.015 % full-scale @ $\times 1$
 ± 0.015 % full-scale @ $\times 10$
 ± 0.025 % full-scale @ $\times 100$
 ± 0.025 % full-scale @ $\times 200$
 ± 0.045 % full-scale @ $\times 500$

Common-Mode Rejection:

70 dB minimum @ $\times 1$
87 dB minimum @ $\times 10$
100 dB minimum @ $\times 100$
100 dB minimum @ $\times 200$
100 dB minimum @ $\times 500$

Active Filter Device: UAF42 (Burr-Brown)

Number of Poles/Filter: 3

Types of Filters: Bessel, Butterworth, Chebyshev

Frequency Range: 0.1 Hz to 50 kHz
The frequency is set by installation of 4-6 resistors and/or capacitors in provided socket locations.

Frequency Modules: Optional frequency module kits are available that consist of 4 plug-in resistor/capacitor (RC) headers. These RC headers are pre-configured for any of the following frequencies: 5 Hz, 10 Hz, 100 Hz, 500 Hz, or 1 kHz—all are Butterworth-type filters.