

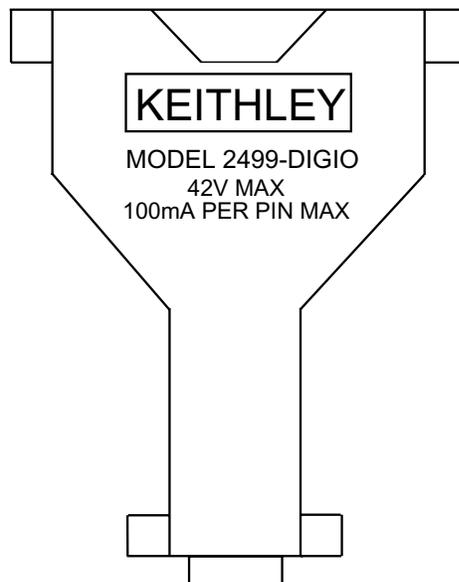
## Overview

The Model 2499-DIGIO (shown in Figure 1) is a digital I/O expansion option for Keithley SourceMeters. With the Model 2499 connected to the SourceMeter, the Digital I/O Port is expanded to provide 16-bit operation (16 output lines). This allows you to utilize more component bins for limit testing. When using a category pulse component handler, up to 16 bins can be used in your test system. When using a category register component handler, you can use as many bins as you need.

The digital I/O port of the SourceMeter can also be used to control other external devices.

**NOTE** This packing list provides supplemental operating information. Refer to the SourceMeter User's manual for details on the digital I/O and limit testing.

**Figure 1**  
Model 2499-DIGIO



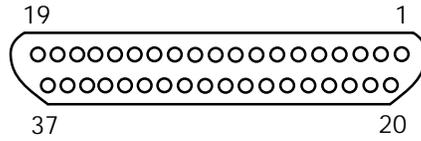
**WARNING** The Model 2499-DIGIO is not intended for use in circuits carrying voltages in excess of 30V RMS, 42.4V peak, or 60VDC.

## Connections

The Model 2499 has a female DB-9 connector on one end and a standard female DB-37 connector on the other end. The end with the DB-9 connector mates directly to the digital I/O port on the rear panel of the SourceMeter. Make sure the SourceMeter is turned off before connecting the Model 2499.

Use a cable terminated with a standard male DB-37 connector to connect your external circuit(s) to the digital I/O port. Pin identification for the DB-37 connector of the Model 2499 is provided in Figure 2. Note that EOT, /EOT, BUSY, and /BUSY use a dedicated line (pin 34) when the Model 2499 is used.

**Figure 2**  
DB-37 pinout



Bank A:

- Output 1 = Pin 5
- Output 2 = Pin 6
- Output 3 = Pin 7
- Output 4 = Pin 8
- Output 5 = Pin 9
- Output 6 = Pin 10
- Output 7 = Pin 11
- Output 8 = Pin 12

Bank B:

- Output 9 = Pin 24
- Output 10 = Pin 25
- Output 11 = Pin 26
- Output 12 = Pin 27
- Output 13 = Pin 28
- Output 14 = Pin 29
- Output 15 = Pin 30
- Output 16 = Pin 31

- +5V = Pin 14
- Ground = Pins 13 and 32
- /Interlock = Pin 15
- SOT = Pin 33
- EOT, /EOT, BUSY, /BUSY = Pin 34

## 16-bit output patterns

### Digital output size

In order to set a 16-bit output pattern, the 16-bit digital output size must be selected. From the front panel, the following menu sequence selects the 16-bit digital output size:

Press CONFIG > press LIMIT > select DIGOUT > select SIZE > select 16-BIT.

For remote operation, the following command selects the 16-bit digital output size:

```
:SOURce2:BSIZE 16
```

**NOTE** The rest of the information in this packing list assumes that the 16-bit digital output size is selected.

### Output pattern formats

When using the Model 2499, the SourceMeter, you can output binary bit patterns from 0 to 1111111111111111. From the front panel, an output bit pattern must be entered as a decimal value (0 to 65535). Table 1 shows the decimal weight of each output line. For example, if you want output lines 10 and 3 to be high (1000000100), you would set the output pattern to 516.

**Table 1**  
Decimal weighting for output lines

<b>Output line</b>	16	15	14	13	12	11	10	9
<b>Decimal weight</b>	32768	16384	8192	4096	2048	1024	512	256
<b>Output line</b>	8	7	6	5	4	3	2	1
<b>Decimal weight</b>	128	64	32	16	8	4	2	1

For remote operation, an output bit pattern can be set in the decimal, binary, octal, or hexadecimal format. When sending a command to set an output bit pattern, there are two parameter types to express the value. For the decimal format, an <NRf> parameter type is required. For any of the non-decimal formats, an <NDN> parameter type is used. Parameter value ranges for 16-bit operations are as follows:

<NRf> = 0 to 65535	Decimal format
<NDN> = #B0 to #B1111111111111111	Binary format
= #Q0 to #Q177777	Octal format
= #H0 to #HFFFF	Hexadecimal format

When you send a query command to read the output pattern, the returned value will be in the format selected by the following command:

:FORMat:SOURce2 <name>	
where: <name> = ASCII	Decimal format
= BINary	Binary format
= OCTal	Octal format
= HEXadecimal	Hexadecimal format

## Limit testing

Other than increasing the number of output bit patterns that can be set (which allows more component bins to be used), limit test operation is not changed by the Model 2499. For front panel operation, the various output pattern menus let you set bit patterns (in the decimal format) from 0 to 65535.

For remote operation, commands to set and read output patterns are listed in Table 2.

**Table 2**  
Commands to set and read digital output patterns

Command <sup>1</sup>	Description <sup>1</sup>
:CALCulate2:LIMit[1]:COMPLiance:SOURce2 <NRf>   <NDN>	Limit 1 fail pattern.
:CALCulate2:LIMitX:LOWer:SOURce2 <NRf>   <NDN>	Lower limit X fail pattern for grading mode.
:CALCulate2:LIMitX:UPPer:SOURce2 <NRf>   <NDN>	Upper limit X fail pattern for grading mode.
:CALCulate2:LIMitX:PASS:SOURce2 <NRf>   <NDN>	Limit X pass pattern for sorting mode.
:CALCulate2:CLIMits:PASS:SOURce2 <NRf>   <NDN>	Composite pass pattern. Sorting mode only if limits 2, 3, and 5-12 disabled.
:CALCulate2:CLIMits:FAIL:SOURce2 <NRf>   <NDN>	Composite fail pattern for sorting mode.
:SOURce2:TTL[:LEVel][:DEFault] <NRf>   <NDN>	Set digital I/O port output pattern.
:SOURce2:TTL[:LEVel][:DEFault]?	Query default output pattern.
:SOURce2:TTL[:LEVel]:ACTual?	Query actual output pattern.
:CALCulate2:LIMit4:SOURce2 <NRf>   <NDN>	Limit 4 fail pattern <sup>2</sup> .
<NRf> = 0 to 65535	Decimal format
<NDN> = #B0 to #B1111111111111111	Binary format
= #Q0 to #Q177777	Octal format
= #H0 to #HFFFF	Hexadecimal format

1. LIMitX = LIMit2, LIMit3, LIMit5 through LIMit12.

2. LIMit 4 is only available for a 2400 series SourceMeter, and only if the contact check option is installed.

# Controlling other external devices

There are two basic methods to control other external components (such as relays) using the digital I/O port of the SourceMeter: sink operation or source operation. Section 13 of the Model 2400 Series User's Manual describes sink and source operation for the digital I/O port.

## Digital output control

From the front panel, the output pattern (in the decimal format) can be set from 0 to 65535. Use the following menu sequence to set the output pattern.

Press MENU, select GENERAL, select DIGOUT, set the output pattern.

For remote operation, the output pattern can be set in the decimal, binary, octal, or hexadecimal format. Use the following commands to set and read the output pattern:

:SOURce2:TTL[:LEVel][:DEFault] <NRf>   <NDN>	Set output pattern
:SOURce2:TTL[:LEVel][:DEFault]?	Query default output pattern
:SOURce2:TTL[:LEVel]:ACTual?	Query actual output pattern

See "Output pattern formats" for information on value ranges for the <NRf> and <NDN> parameters, and format selection for the query commands.

## Input/output limits

**CAUTION** When not using the Model 2499 (3-bit/4-bit operation), the maximum sink current for an output line is 500mA. This maximum sink current is NOT valid with the Model 2499 connected to the SourceMeter. To prevent damage to the SourceMeter, do not exceed the maximum sink current and maximum input voltage for the I/O port.

### Maximum sink current

- **16 output lines** — The 16 output lines are divided into two banks. Bank A consists of outputs 1 through 8, and Bank B consists of outputs 9 through 16.
  - The maximum allowable total sink current for each bank is 300mA.
  - The maximum allowable sink current for any individual output line is 100mA.
  - If, for example, each external device causes maximum sink current (100mA), you can connect six of those devices to the output lines: three to Bank A and three to Bank B.
- **EOT, /EOT, BUSY, /BUSY line** — Maximum allowable sink current is 500mA.

### Maximum input voltage

- The absolute maximum allowable input voltage on any line of the digital I/O is 42V.

### Source current limits

- **16 Output lines** - The source current for each output line is limited to approximately 2mA at TTL high levels.
- **+5V line** - The source current for this +5V output is limited to approximately 300mA.

### Output voltage

- **16 output lines and EOT, /EOT, BUSY, /BUSY line** — The maximum working output voltage for these lines 30V.