

Series 3700A

Plug-in Cards for Series 3700A Mainframes



Plug-in cards for Series 3700A mainframes

SWITCHING AND CONTROL

1.888.KEITHLEY (U.S. only)
www.keithley.com

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

Series 3700A

- Multiplexer, matrix, and I/O cards
- Relay closures automatically counted and stored in each card's onboard memory
- Unlimited contact life with solid-state relay (Model 3724)
- Automatic CJC for temperature measurements when used with screw terminal accessory (Models 3720, 3721, 3724)

Ordering Information

3720	Dual 1×30 Multiplexer Card	4
3721	Dual 1×20 Multiplexer Card	6
3722	Dual 1×48, High Density, Multiplexer Card	8
3723	Dual 1×30, High Speed, Reed Relay, Multiplexer Card	10
3724	Dual 1×30 FET Multiplexer Card	12
3730	6×16, High Density, Matrix Card	15
3731	6×16, High Speed, Reed Relay, Matrix Card	17
3732	Quad 4×28, Ultra-High Density, Reed Relay, Matrix Card	19
3740	General Purpose Card with 32 Independent Channels	23
3750	Multifunction Control Card	25

Plug-in Cards for Series 3700A Mainframes

Specifications for Plug-In Cards

Additional Series 3700A cards are currently in development. For a current list of cards and specifications, visit www.keithley.com.

	3720	3721	3722
Page	4	6	8
No. of Channels	60 (Dual 1×30)	40 (dual 1×20)	96 (dual 1×48)
Card Config.	Multiplexer	Multiplexer	Multiplexer
Type of Relay	Latching electromechanical	Latching electromechanical	Latching electromechanical
Contact Configuration	2 Form A	2 Form A	2 Form A
Max. Voltage	300 V	300 V (ch 1–40), 60 V (ch 41–42)	300 V
Max. Current Switched	1 A	2 A (ch 1–40), 3 A (ch 41–42)	1 A
Comments	2 independent 1×30 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3720-ST)	2 independent 1×20 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3721-ST)	2 independent 1×48 multiplexers

Plug-in Card Accessories

	3720	3721	3722
Cables	3720-MTC-1.5, 3720-MTC-3	3721-MTC-1.5, 3721-MTC-3	3722-MTC-1.5, 3722-MTC-1.5/MM, 3722-MTC-3, 3722-MTC-3/MM
Screw Terminal Block	3720-ST	3721-ST	
Connector Kits	3791-KIT78-R	3790-KIT50-R	3792-KIT104-R, 3792-KIT104-R/F
Tools	3791-CIT		3791-CIT

1.888.KEITHLEY (U.S. only)

www.keithley.com



A GREATER MEASURE OF CONFIDENCE

Series 3700A

Plug-in Cards for Series 3700A Mainframes

3723	3724	3730	3731	3732	3740	3750
10	12	15	17	19	23	25
60 (dual 1×30) or 120 single pole (dual 1×60)	60 (dual 1×30)	6×16	6×16	448 crosspoints (Quad 4×28)	32	40 digital I/O, 4 counter/totalizers, and 2 isolated analog outputs
Multiplexer	Multiplexer	Matrix	Matrix	Matrix	Independent	Independent
Dry reed	FET solid-state	Latching electromechanical	Dry reed	Dry reed	Latching electromechanical	N/A
1 Form A	2 Form A	2 Form A	2 Form A	1 Form A	28 Form C, 4 Form A	N/A
200 V	200 V	300 V	200 V	200 V	300 VDC/250 VAC (Form A)	N/A
1 A	0.1 A	1 A	1 A	0.75 A	2 A (Form C), 7 A (Form A)	N/A
2 independent 1×30 multiplexers	2 independent 1×30 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3724-ST)	Columns can be expanded through the backplane or isolated by relays	Relay actuation time of 0.5ms. Columns can be expanded through the backplane or isolated by relays	Banks can be connected together via bank configuration relays to create a single 4×112 or dual 4×56 matrix. Analog backplane relays also included for card to card expansion. Row expansion with 3732-ST-R accessory to create a dual 8×28 or single 16×28 matrix.	32 general purpose independent channels.	All-in-one card design. 40 bidirectional I/O. Four 32-bit counter/totalizers. 2 programmable analog (V or I) outputs.

3723	3724	3730	3731	3732	3740	3750
3720-MTC-1.5, 3720-MTC-3	3720-MTC-1.5, 3720-MTC-3	3721-MTC-1.5, 3721-MTC-3	3721-MTC-1.5, 3721-MTC-3	3732-MTC-1.5, 3732-MTC-3	3721-MTC-1.5, 3721-MTC-3	3721-MTC-1.5, 3721-MTC-3
3723-ST, 3723-ST-1	3724-ST	3730-ST	3731-ST	3732-ST-C, 3732-ST-R	3740-ST	3750-ST
3791-KIT78-R	3791-KIT78-R	3790-KIT50-R	3790-KIT50-R	3791-KIT78-R	3790-KIT50-R	3790-KIT50-R
3791-CIT	3791-CIT			3791-CIT		

Plug-in cards for Series 3700A mainframes

SWITCHING AND CONTROL

1.888.KEITHLEY (U.S. only)
www.keithley.com



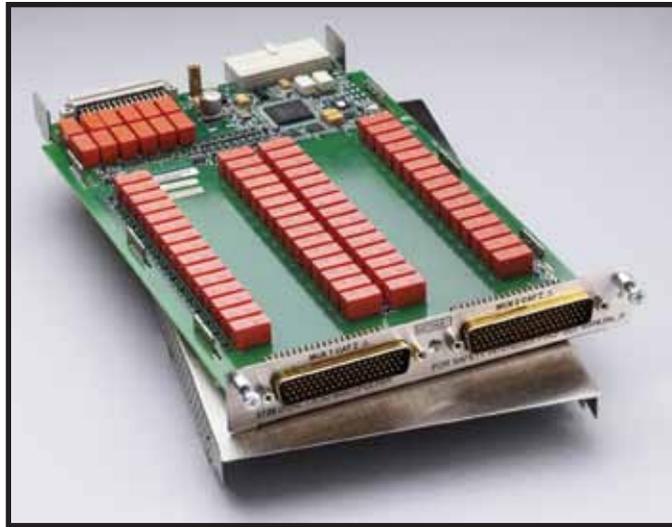
A GREATER MEASURE OF CONFIDENCE

3720

Dual 1×30 Multiplexer Card

60 differential channels, automatic CJC w/3720-ST accessory

- 60 two-pole channels or 30 four-pole channels for general purpose switching
- Automatic CJC for temperature measurements when used with 3720-ST accessory
- Analog backplane connection relays provide easy bank and card interconnections
- 300V, 1A switched or 2A carry signal capacity; 60W, 125VA
- Screw terminal connections provided with removable 3720-ST accessory
- Relay closures stored in onboard memory
- Latching electromechanical relays



The Model 3720 offers two independent banks of 1×30 two-pole multiplexers. It is ideal for general purpose switching, including temperature measurements. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the card to a single 1×60 two-pole multiplexer or to enable card-to-card expansion for even larger configurations.

Other features of the Model 3720 include its ability to be reconfigured to coordinated four-pole operation for additional measurement flexibility. Furthermore, the Model 3720 supports thermocouple-type temperature measurements when used with the Model 3720-ST (screw terminal) accessory providing automatic cold junction compensation (CJC).

The Model 3720 uses two 78-pin male D-sub connectors for signal connections. For screw terminal or automatic CJC, use the detachable Model 3720-ST accessory.

Ordering Information

3720 **Dual 1×30
Multiplexer Card**

ACCESSORIES AVAILABLE

3720-MTC-1.5	78 Pin D-sub Female to Male Cable, 1.5m (5 ft.)
3720-MTC-3	78 Pin D-sub Female to Male Cable, 3m (10 ft.)
3720-ST	Screw Terminal Block (required for auto CJC thermocouple measurements)
3791-CIT	Contact Insertion and Extraction Tool
3791-KIT78-R	78 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 156 solder-cup contacts)
7401	Type K Thermocouple Wire (100 ft.)

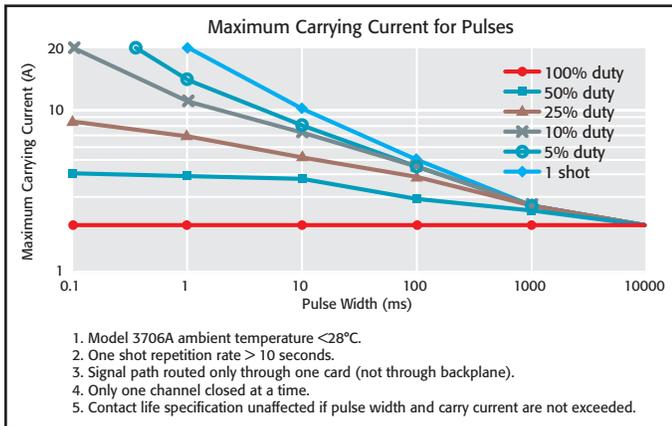
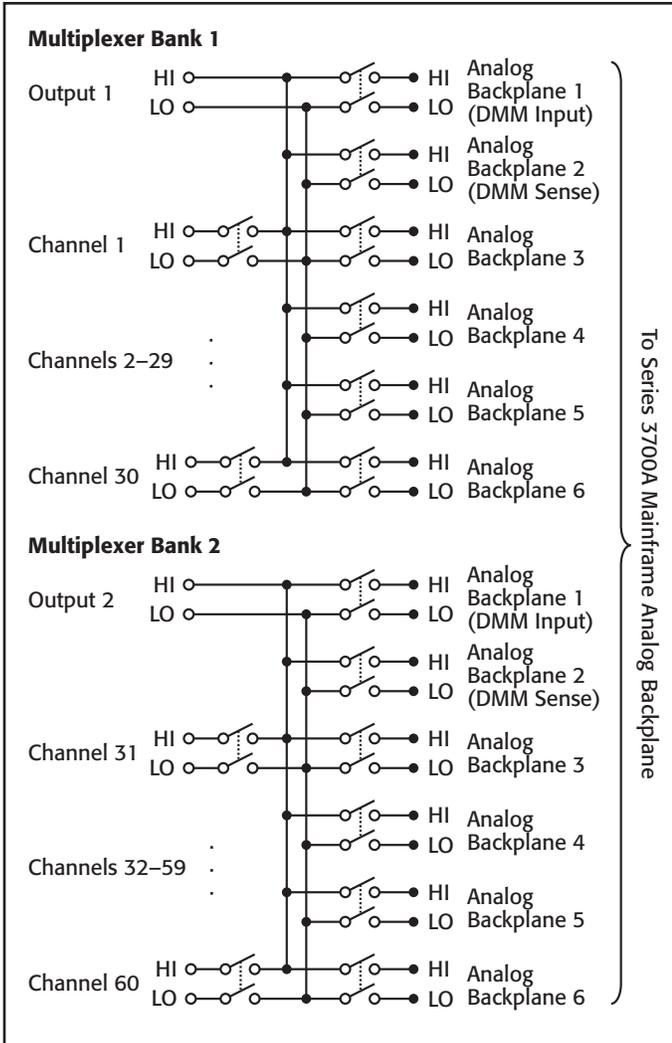
SERVICES AVAILABLE

3720-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3720-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3720-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries

Dual 1×30 Multiplexer Card

60 differential channels, automatic CJC w/3720-ST accessory



MULTIPLEXER CONFIGURATION: Two independent 1×30 2-pole multiplexers. Banks can be isolated from the backplane by relays. Card can be configured for 2 and 4 wire.

CONTACT CONFIGURATION: 2 pole form A.

CONNECTOR TYPE: Two 78 pin male D-shells.

MODEL 3720-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 124 conductors maximum. #16 AWG maximum wire size with 0.092 inch O.D. 36 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: Channels 1–60: 300V DC or RMS, 1A switched (2A carry), 60W, 125VA.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: >10⁵ operations at maximum signal level. >10⁸ operations no load.¹

	Dual 1×30 ³	Single 1×60 ^{2,3}
Channel Resistance (end of contact life)	<1.0 Ω	<1.5 Ω
Contact Potential (differential)	<±1 μV	<±3 μV
Offset Current	<±250 pA	<±250 pA
Isolation		
Differential Bank-Bank	10 ⁹ Ω, 250 pF	10 ⁹ Ω, 450 pF
Channel-channel	10 ¹⁰ Ω, 75 pF	—
Common Mode	10 ⁹ Ω, 75 pF	10 ⁹ Ω, 75 pF
Common Mode	10 ⁹ Ω, 200 pF	10 ⁹ Ω, 400 pF
Crosstalk Channel-channel		
300kHz	<-60 dB	<-55 dB
1MHz	<-50 dB	<-50 dB
20MHz:	<-25 dB	<-20 dB
Bandwidth	30 MHz	10 MHz

TYPICAL SCANNING SPEEDS:

Switch Only⁴: Sequential scanning, single channel, immediate trigger advance: >120 ch/s.

With Measurements Into Memory⁵:

DCV (10V range) or 2W Ohms (1kΩ range): >110 ch/s.

Thermocouple: >110 ch/s.

3- or 4-Wire RTD: >100 ch/s.

4-Wire Ohms (1kΩ range): >100 ch/s.

ACV (10V range): >110 ch/s.

GENERAL

ACTUATION TIME: 4ms.

TEMPERATURE ACCURACY using Automatic CJC with 3720-ST accessory: 1°C for J, K, T and E types (see mainframe specification for details).

RELAY TYPE: Latching electromechanical.

RELAY DRIVE SCHEME: Matrix.

INTERLOCK: Backplane relays disabled when interlock connection is removed.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 2.5 lbs.

SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.

EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

NOTES

- Open detector enabled during thermocouple measurements. Minimum signal level 10mV, 10μA.
- 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
- Connections made using 3720-ST accessory.
- Scanning script local to 3706A mainframe, within same bank, and break before make switching.
- 3706A mainframe with autorange off, limits off, dmm.autozero=0, dmm.autodelay=0, 4½ digits (NPLC=0.006), for ACV dmm.detectorbandwidth=300, for OHMS dmm.offsetcompensation=off, dmm.opendetector=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

Model 3720 specifications

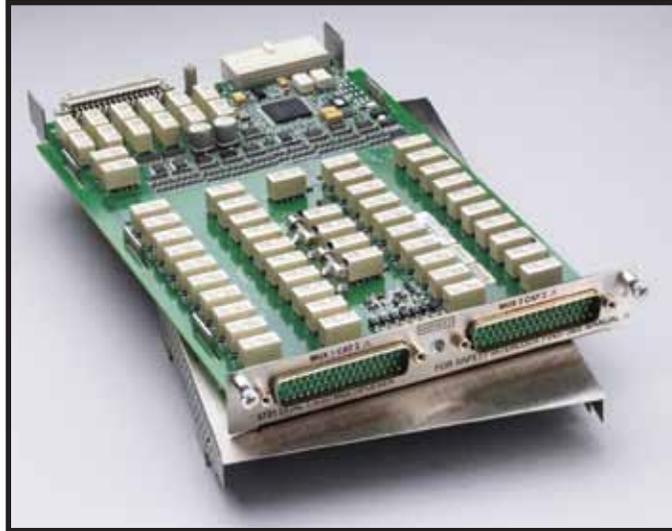
SWITCHING AND CONTROL

3721

Dual 1x20 Multiplexer Card

40 differential channels, automatic CJC w/3721-ST accessory

- 40 two-pole or 20 four-pole channels for general purpose switching
- 2 dedicated channels for current measurements, 3A capacity
- Automatic CJC for temperature measurements when used with 3721-ST accessory
- 4-wire common side ohms input supports 40 channels of 4-wire ohms measurements
- Analog backplane connection relays provide easy bank and card interconnections
- 300V, 2A switched or 3A carry signal capacity; 60W, 125VA
- Latching electromechanical relays



The Model 3721 offers two independent banks of 1x20 two-pole multiplexers that are ideal for general purpose switching, including temperature measurements. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the Model 3721 as a single 1x40 two-pole multiplexer or to enable card-to-card expansion for even larger configurations.

The Model 3721 provides a number of other features. In addition to the 40 channels, two fused channels are supplied for current measurements. Also, the Model 3721 includes dedicated inputs that enable 40 channels of four-wire common side ohms measurements. For thermocouple type measurements, automatic cold junction compensation (CJC) is supported when used with the Model 3721-ST (screw terminal) accessory.

The Model 3721 uses two 50-pin male D-sub connectors for signal connections. For screw terminal or automatic CJC, use the detachable Model 3721-ST accessory.

Ordering Information

3721 **Dual 1x20
Multiplexer Card**

ACCESSORIES AVAILABLE

3721-MTC-1.5	50 Pin D-sub Female to Male Cable, 1.5m (5 ft.)
3721-MTC-3	50 Pin D-sub Female to Male Cable, 3m (10 ft.)
3721-ST	Screw Terminal Block (required for auto CJC thermocouple measurements)
3790-KIT50-R	50 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder-cup contacts)
7401	Type K Thermocouple Wire (100 ft.)

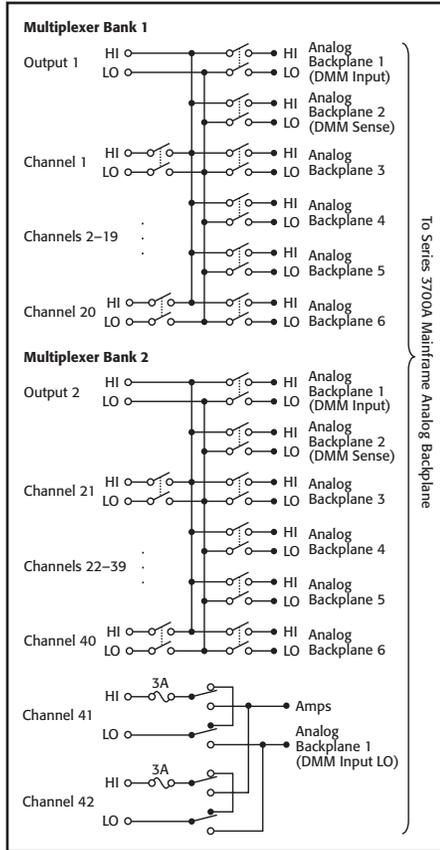
SERVICES AVAILABLE

3721-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3721-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3721-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

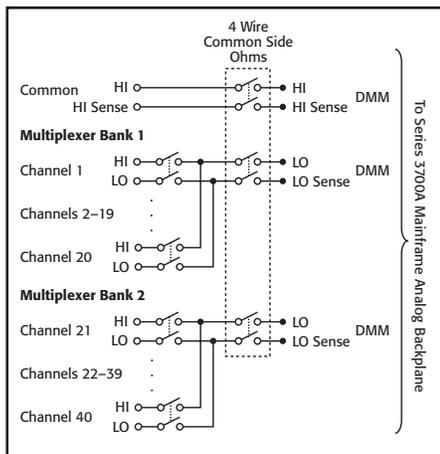
*Not available in all countries

Dual 1×20 Multiplexer Card

40 differential channels, automatic CJC w/3721-ST accessory



Two pole mode



Four-wire common side ohm mode

MULTIPLEXER CONFIGURATION: Two independent 1×20 2-pole multiplexers. Banks can be connected together via relay creating a single 1×40 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for common side Ohms measurement via backplane relays. **Channel 41–42:** Multiplex one of two 2-pole current signals into DMM.

CONTACT CONFIGURATION: 2 pole form A.

CONNECTOR TYPE: Two 50 pin male D-shells. Removable screw terminal option.

MAXIMUM SIGNAL LEVEL: **Channels 1–40:** 300V DC or RMS, 2A switched (3A carry), 60W, 125VA maximum. **Channels 41–42:** 60V DC or 30V RMS, 3A switched, 60W, 125VA maximum. Fused 3A, 250V RMS.

COMMON MODE VOLTAGE: **Channels 1–40:** 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: >10⁵ operations at maximum signal level. >10⁶ operations no load.¹

TYPICAL SCANNING SPEEDS:

Switch Only⁴: Sequential scanning, single channel, immediate trigger advance: >120 ch/s.

With Measurements Into Memory⁵:

DCV (10V range) or 2W Ohms (1kΩ range): >110 ch/s

Thermocouple: >110 ch/s.

3- or 4-Wire RTD: >100 ch/s.

4-Wire Ohms (1kΩ range): >100 ch/s.

ACV (10V, 400Hz range) or ACI (1A, 400Hz range): >110 ch/s.

NOTES

- Open detector enabled during thermocouple measurements. Minimum signal level 10mV, 10μA.
- 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
- Connections made using 3721-ST accessory.
- Scanning script local to 3706A mainframe, within same bank, and break before make switching.
- 3706A mainframe with autorange off, limits off, dmm.autozero=0, dmm.autodelay=0, 4½ digits (NPLC=0.006), for ACV dmm.detectorbandwidth=300, for OHMS dmm.offsetcompensation=off, dmm.opendetector=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

	Dual 1×20 ³	Single 1×40 ^{2,3}
Channel Resistance (end of contact life)	<1.0 Ω	<1.5 Ω
Contact Potential (differential)	<±1 μV	<±3 μV
Offset Current	<±250 pA	<±250 pA
Isolation		
Differential	10 ⁹ Ω, 280 pF	10 ⁹ Ω, 530 pF
Bank-Bank	10 ¹¹ Ω, 60 pF	—
Channel-channel	10 ⁹ Ω, 50 pF	10 ⁹ Ω, 50 pF
Common Mode	10 ⁹ Ω, 180 pF	10 ⁹ Ω, 480 pF
Crosstalk Channel-channel		
300kHz	<-60 dB	<-60 dB
1MHz	<-50 dB	<-50 dB
20MHz:	<-25 dB	<-15 dB
Bandwidth	28 MHz	9 MHz

GENERAL

ACTUATION TIME: 4ms.

TEMPERATURE ACCURACY using Automatic CJC with 3721-ST accessory: 1°C for J, K, T, and E types (see mainframe specification for details).

RELAY TYPE: Latching electromechanical.

RELAY DRIVE SCHEME: Direct.

INTERLOCK: Backplane relays disabled when interlock connection is removed.

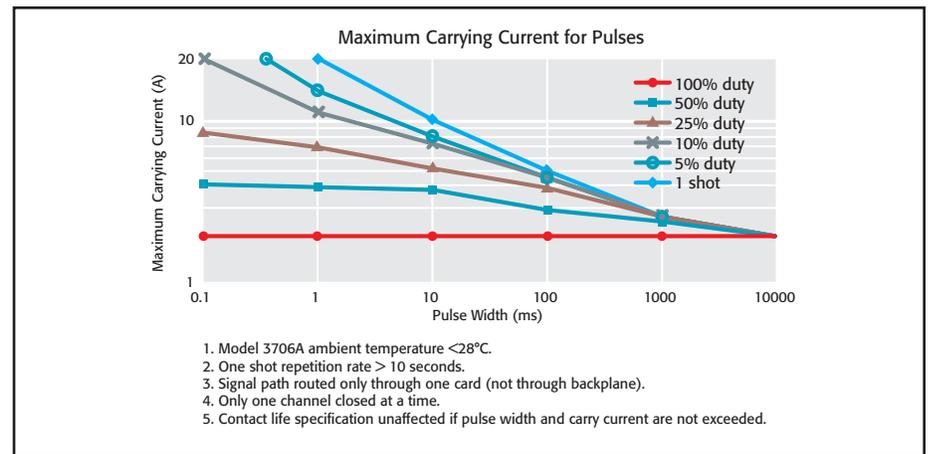
OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 2.25 lbs.

SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.

EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

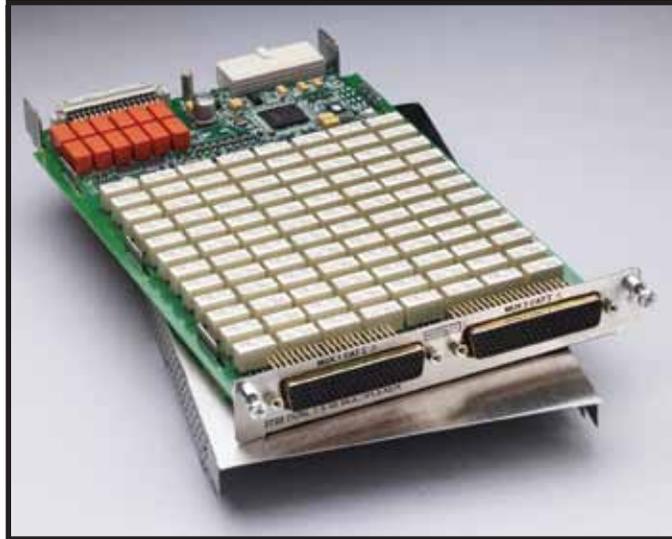


- Model 3706A ambient temperature <28°C.
- One shot repetition rate > 10 seconds.
- Signal path routed only through one card (not through backplane).
- Only one channel closed at a time.
- Contact life specification unaffected if pulse width and carry current are not exceeded.

3722

Dual 1x48, High Density, Multiplexer Card 96 differential channels, 300 Volts/1 Amp

- 96 two-pole or 48 four-pole channels for general purpose measurements
- Analog backplane connection relays provide easy bank and card interconnections
- 300V, 1A switched or 2A carry signal capacity; 60W, 125VA
- 1 μ V and 100pA offsets
- 25MHz bandwidth
- Relay closures stored in onboard memory
- Latching electromechanical relays
- Scan and measure over 110 channels/second



The Model 3722 offers two independent banks of 1x48 two-pole multiplexers, which is ideal for applications that require a high channel count. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the card as a single 1x96 two-pole multiplexer or to enable card-to-card expansion for even larger configurations. Another feature of this card is the latching electromechanical relays. They can accommodate 300V, 1A switched signal levels.

The Model 3722 uses two 104-pin D-sub connectors for signal connections. A solder style connector kit (Model 3792-KIT104-R) and pre-assembled cables (Model 3722-MTC-1.5 and 3722-MTC-3) are available for card connections.

Ordering Information

3722 Dual 1x48, High Density, Multiplexer Card

ACCESSORIES AVAILABLE

3722-MTC-1.5	104-pin D-sub Male to Female Cable, 1.5m (5 ft.)
3722-MTC-1.5/MM	104-pin D-sub Male to Male Cable, 1.5m (5 ft.)
3722-MTC-3	104-pin D-sub Male to Female Cable, 3m (10 ft.)
3722-MTC-3/MM	104-pin D-sub Male to Male Cable, 3m (10 ft.)
3791-CIT	Contact Insertion and Extraction Tool
3792-KIT104-R	104-pin Male D-sub Connector kit (contains 2 male D-sub connectors with housings and 208 solder-cup contacts)
3792-KIT104-R/F	104-pin Female D-sub Connector kit (contains 2 female D-sub connectors with housings and 208 solder-cup contacts)

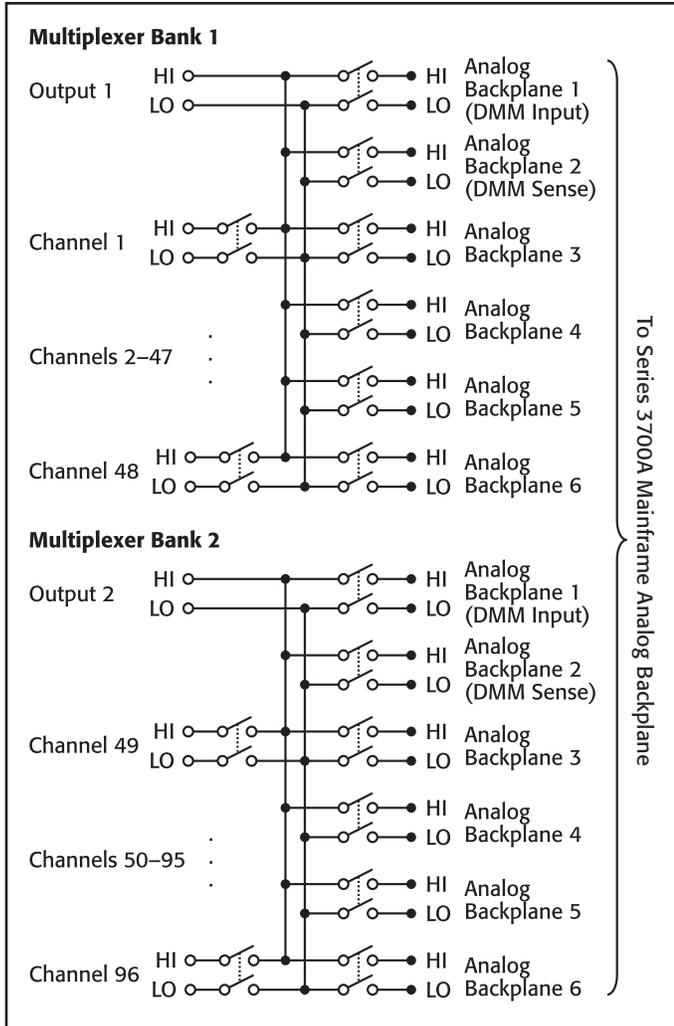
SERVICES AVAILABLE

3722-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3722-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3722-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries

Dual 1×48, High Density, Multiplexer Card

96 differential channels, 300 Volts/1 Amp



MULTIPLEXER CONFIGURATION: Two independent 1×48 2-pole multiplexers. Banks can be connected together via relays creating a single 1×96 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for 2- and 4-wire mode.

CONTACT CONFIGURATION: 2 pole form A.

CONNECTOR TYPE: Two 104 pin female D-shells.

MAXIMUM SIGNAL LEVEL: 300V DC or RMS, 1A switched (2A carry), 60W, 125VA.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: >10⁵ operations at maximum signal level. >10⁸ operations no load.¹

	Dual 1×48 ²	Single 1×96
Channel Resistance (end of contact life)	<1.5 Ω	<2.5 Ω
Contact Potential (differential)	<±1 μV	<±2 μV
Offset Current	<100 pA	<100 pA
Isolation		
Differential	5×10 ⁹ Ω, 200 pF	5×10 ⁹ Ω, 400 pF
Bank-Bank	10 ⁹ Ω, 50 pF	—
Channel-channel	10 ⁹ Ω, 50 pF	10 ⁹ Ω, 50 pF
Common Mode	10 ¹⁰ Ω, 200 pF	10 ¹⁰ Ω, 400 pF
Crosstalk Channel-channel		
300kHz	<-65 dB	<-65 dB
1MHz	<-55 dB	<-55 dB
20MHz	<-30 dB	<-30 dB
Bandwidth	25 MHz	15 MHz

TYPICAL SCANNING SPEEDS:

Switch Only³: Sequential scanning, single channel, immediate trigger advance: >120 ch/s.

With Measurements Into Memory⁴:

DCV (10V range) or 2W Ohms (1kΩ range): >110 ch/s.

3- or 4-Wire RTD: >100 ch/s.

4-Wire Ohms (1kΩ range): >100 ch/s.

ACV (10V, 400Hz range): >110 ch/s.

GENERAL

ACTUATION TIME: 4ms.

RELAY TYPE: Latching electromechanical.

RELAY DRIVE SCHEME: Matrix.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 2.5 lbs.

SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.

EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

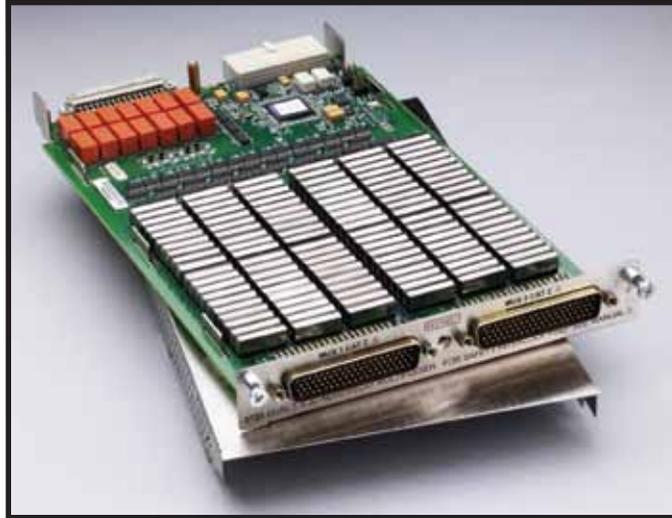
NOTES

- Minimum signal level 10mV, 10μA.
- 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
- Scanning script local to 3706A mainframe, within same bank, and break before make switching.
- 3706A mainframe with autorange off, limits off, dmm.autozero=0, dmm.autodelay=0, 4½ digits (NPLC=.006), for ACV dmm.detectorbandwidth=300, for OHMs dmm.offsetcompensation=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

3723

Dual 1×30, High Speed, Multiplexer Card 60 differential channels, long life reed relays

- 60 two-pole or 30 four-pole channels for high speed scanning
- 120 channel single-pole mode for one-wire (common side) measurements
- Analog backplane connection relays provide easy bank and card interconnections
- 200V, 1A switched or 1.25A carry signal capacity; 15W
- Relay actuation time <0.5ms
- 20MHz bandwidth
- Ideal for multi-channel I-V testing with Series 2600A SourceMeter® instruments
- Long life dry reed relays (>10⁹ operations)



The Model 3723 offers two independent banks of high speed 1×30 two-pole multiplexers that are ideal for high speed scanning applications. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the Model 3723 as a single 1×60 two-pole multiplexer or as a single 1×120 single-pole multiplexer. It also enables card-to-card expansion for even larger configurations.

By using high speed reed relays with actuation times of less than 0.5ms, this card can meet demanding throughput applications. Another feature of the Model 3723 is its single-ended, one-pole mode, which supports up to 120 channels of single-wire measurements.

The Model 3723 uses two 78-pin D-sub connectors for signal connections. For screw terminal connections, use the Model 3723-ST for two- and four-pole configurations or the Model 3723-ST-1 for single-wire applications.

Ordering Information

3723 Dual 1×30, High Speed, Reed Relay, Multiplexer Card

ACCESSORIES AVAILABLE

3720-MTC-1.5	78 Pin D-sub Female to Male Cable, 1.5m (5 ft.)
3720-MTC-3	78 Pin D-sub Female to Male Cable, 3m (10 ft.)
3723-ST	Screw Terminal Block
3723-ST-1	Screw Terminal Block for single-pole applications
3791-CIT	Contact Insertion and Extraction Tool
3791-KIT78-R	78 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 156 solder-cup contacts)

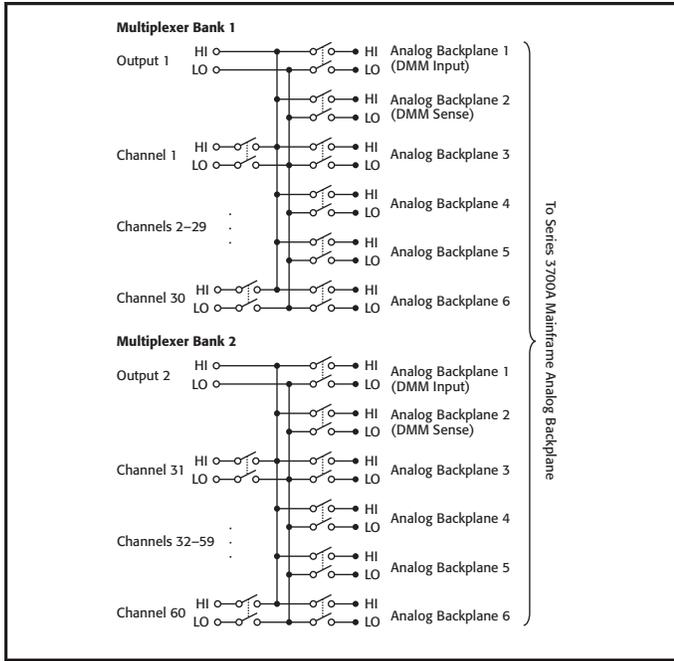
SERVICES AVAILABLE

3723-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3723-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3723-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

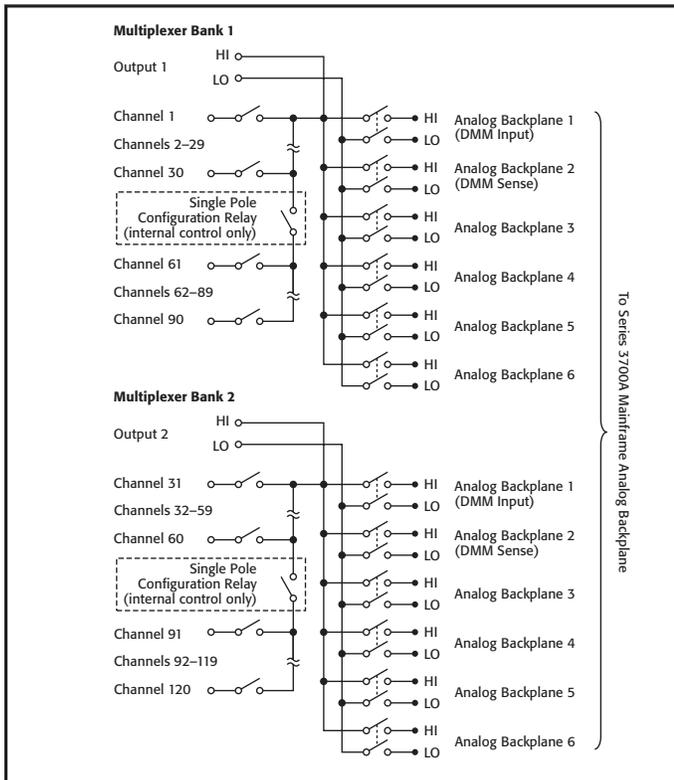
*Not available in all countries

Dual 1×30, High Speed, Multiplexer Card

60 differential channels, long life reed relays



Two-pole mode



Single-pole mode

MULTIPLEXER CONFIGURATION: Two independent 1×30 2-pole multiplexers. Banks can be connected together via relay creating a single 1×60 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for 1-, 2-, and 4-wire.

CONTACT CONFIGURATION: 2 pole form A.

CONNECTOR TYPE: Two 78-pin male D-shells.

MODEL 3723-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 124 conductors maximum. #16 AWG maximum wire size with 0.092 inch O.D. 36 conductor per card maximum.

MAXIMUM SIGNAL LEVEL: 200V DC or RMS, 1A switched (1.25A carry), 15W.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: Reed: >10⁹ operations, no load. 10⁷ operations @ 100V, 10mA.

EMR: >10⁸ operations @ 5V, 10mA. 10⁵ operations @ maximum signal level.

	Dual 1×30 ¹	Single 1×60 ^{1, 2}
Channel Resistance (end of contact life)	<1.5 Ω	<2.0 Ω
Contact Potential: Differential	<±6 μV	<±6 μV
Single-Ended	<±12 μV	<±12 μV
Offset Current	<250 pA	<250 pA
Isolation		
Differential	10 ¹⁰ Ω, 260 pF	10 ¹⁰ Ω, 500 pF
Bank-Bank	10 ¹⁰ Ω, 75 pF	—
Channel-channel	10 ¹⁰ Ω, 75 pF	10 ¹⁰ Ω, 75 pF
Common Mode	10 ¹⁰ Ω, 280 pF	10 ⁹ Ω, 625 pF
Crosstalk Channel-channel		
300kHz	<-55 dB	<-55 dB
1MHz	<-50 dB	<-45 dB
20MHz	<-20 dB	<-20 dB
Bandwidth	20 MHz	10 MHz

TYPICAL SCANNING SPEEDS:

Switch Only³: Sequential scanning, single channel, immediate trigger advance: >1000 ch/s.

With Measurements Into Memory⁴:

DCV (10V range) or 2W Ohms (1kΩ range): >800 ch/s.

3- or 4-Wire RTD: >450 ch/s.

4-Wire Ohms (1kΩ range): >450 ch/s.

ACV (10V, 400Hz range): >800 ch/s.

GENERAL

ACTUATION TIME: <0.5ms.

RELAY TYPE: Dry reed.

RELAY DRIVE SCHEME: Direct.

RELAY DRIVE CURRENT: 10mA.

INTERLOCK: Backplane relays disabled when interlock connection is removed.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 3.0 lbs.

SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.

EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

NOTES

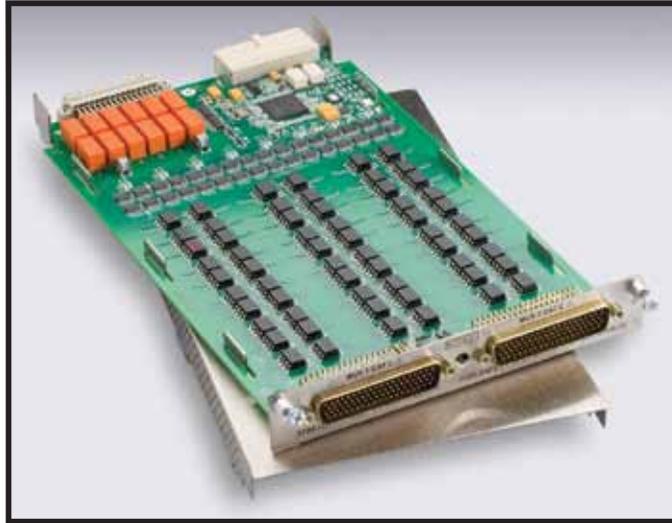
- Connections made using 3723-ST accessory.
- 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
- Scanning script local to 3706A mainframe, within same bank, and break before make switching.
- 3706A mainframe with autorange off, limits off, dmm.autozero=0, dmm.autodelay=0, 4½ digits (NPLC=0.006), for ACV dmm.detectorbandwidth=300, for OHMs dmm.offsetcompensation=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

3724

Dual 1×30 FET Multiplexer Card

60 differential channels, automatic CJC with 3724-ST accessory

- 60 two-pole or 30 four-pole solid-state channels
- Scanning speeds greater than 1250 channels/second (switch only)
- Optically isolated, solid-state FET relays provide unlimited contact life
- 200V, 0.1A switch/carry signal capacity; 800mW
- Automatic CJC for temperature measurements when used with 3724-ST accessory
- Analog backplane connection relays provide easy bank and card interconnections
- Screw terminal connections provided with removable 3724-ST accessory
- Ideal for maintenance-free, long-life thermocouple temperature measurements



The Model 3724 provides two independent banks of solid-state relays arranged as 1×30 two-pole multiplexers that are ideal for high reliability, high speed multipoint measurement applications including temperature. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the card to a single 1×60 two-pole multiplexer or to enable card-to-card expansion for even larger configurations.

The solid-state FET relay technology supports fast switching times with scanning rates of greater than 1250 channels/second and provides unlimited contact life. In addition, the Model 3724 supports thermocouple temperature measurements when used with the Model 3724-ST (screw terminal) accessory providing automatic cold junction compensation (CJC).

The Model 3724 uses two 78-pin male D-sub connectors for signal connections. For screw terminal or automatic CJC, use the detachable Model 3724-ST accessory.

ACCESSORIES AVAILABLE

3720-MTC-1.5	78-pin female-to-male D-sub Cable Assembly, 1.5m (4.9 ft)
3720-MTC-3	78-pin female-to-male D-sub Cable Assembly, 3m (9.8 ft)
3724-ST	Screw Terminal Block (required for auto CJC thermocouple measurements)
3791-CIT	Contact Insertion and Extraction Tool
3791-KIT78-R	78-pin female D-sub Connector Kit (contains 2 female D-sub connectors and 156 solder-cup contacts)

SERVICES AVAILABLE

3724-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3724-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3724-3Y-DATA	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries

Ordering Information

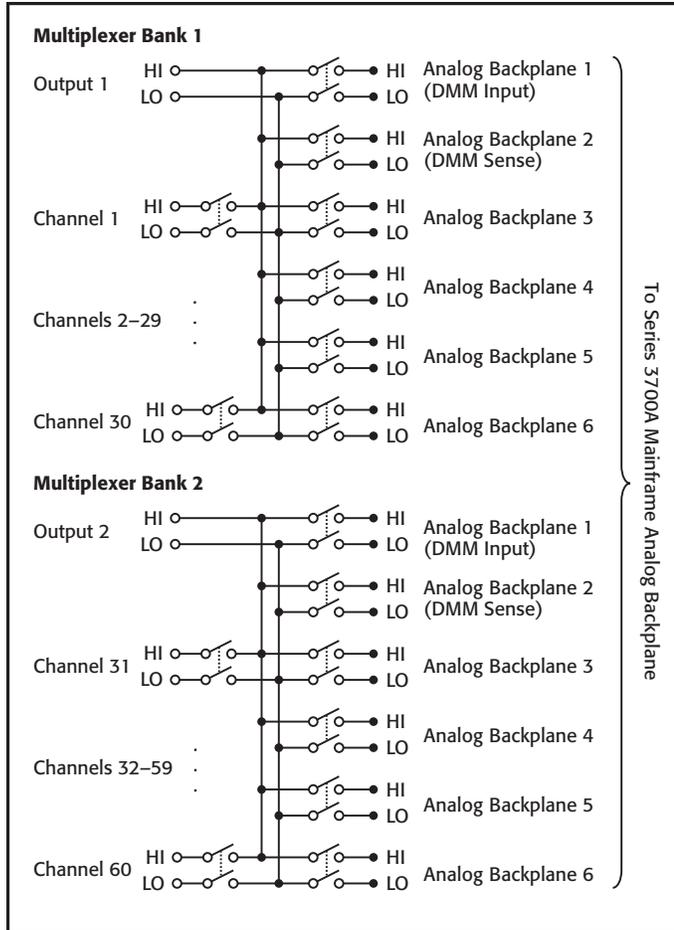
3724 Dual 1×30 FET Multiplexer Card

1.888.KEITHLEY (U.S. only)

www.keithley.com

KEITHLEY

A GREATER MEASURE OF CONFIDENCE



Model 3724 Specifications

MULTIPLEXER CONFIGURATION: Two independent 1×30, 2-pole multiplexers. Banks can be connected together via relay creating a single 1×60 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for 2- and 4-wire.

CONTACT CONFIGURATION: 2-pole form A.

CONNECTOR TYPE: Two 78-pin male D-shells.

MODEL 3724-ST SCREW TERMINAL OPTION: #22AWG typical wire size with 0.062 inch O.D. 124 conductors maximum. 16 AWG maximum wire size with 0.092 inch O.D. 36 conductor per card maximum.

MAXIMUM SIGNAL LEVEL: 200V DC or 141V RMS between any terminal, 0.1A switched (0.1A carry), 800mW.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 10⁷.

CONTACT LIFE:

Solid State: > unlimited.

EMR (Backplane): >1×10⁸ operations @ 5V, 10mA.

1×10⁵ operations @ max. signal level.

	Dual 1×30 ¹	Single 1×60 ^{1,2}
Channel Resistance	<62Ω (54Ω @ 23°C)	<64Ω (58Ω @ 23°C)
Contact Potential (differential)	<±2 μV	<±2.5 μV
Offset Current	<10 nA (<±100 pA @ 23°C/60% R.H.)	<10 nA (<±100 pA @ 23°C/60% R.H.)
Isolation		
Differential	10 ⁹ Ω, 500 pF	10 ⁹ Ω, 1100 pF
Bank-Bank	10 ⁹ Ω, 100 pF	—
CH-CH	10 ⁹ Ω, 125 pF	10 ⁹ Ω, 125 pF
Common Mode	10 ⁹ Ω, 150 pF	10 ⁹ Ω, 700 pF
Crosstalk CH-CH		
300 kHz	-40 dB	-40 dB
1 MHz	-30 dB	-30 dB
Bandwidth	2 MHz	1 MHz

NOTES

1. Connections made using 3724-ST.

2. 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.

3724 Card/3706A Multimeter Condensed Specifications

TEMPERATURE

Displayed in °C, °F, or K. Exclusive of probe errors.

THERMOCOUPLES (accuracy based on ITS-90)

Type	Range	Resolution	90 Day/1 Year 23°C ± 5°
J	-150 to +760°C	0.001°C	1.0°C
K	-150 to +1372°C	0.001°C	1.0°C
N	-100 to +1300°C	0.001°C	1.0°C
T	-100 to +400°C	0.001°C	1.0°C
E	-150 to +1000°C	0.001°C	1.0°C
R	+400 to +1768°C	0.1°C	1.8°C
S	+400 to +1768°C	0.1°C	1.8°C
B	+1100 to +1820°C	0.1°C	1.8°C

DC SPECIFICATIONS

3724 CARD/3706A MULTIMETER UNCERTAINTY SPECIFICATIONS:

Function	Range	Notes
Voltage	All	Add 4.5 μV to PPM "of range"
Resistance	100 kΩ	Add 8 PPM to "of reading"
Resistance	1 MΩ	Add 80 PPM to "of reading"
Resistance	10 MΩ	Add 250 PPM to "of reading"
Resistance	100 MΩ	Add 5000 PPM to "of reading"
Resistance 2-wire	1 kΩ through 100 MΩ	Add 1.2 Ω (with REL) to PPM "of range" Add 64Ω (without REL) to PPM "of range"
Resistance 4-wire and Dry Circuit	1 Ω, 10 Ω, and 100 Ω	Ranges Not Available (maximum lead resistance exceeded, see manual for measurement considerations)

CONDITIONS: 1 PLC or 5 PLC.

ACCURACY: ±(ppm of reading + ppm of range) (ppm = parts per million; e.g., 10ppm = 0.001%).

GENERAL

ACTUATION TIME: <0.2ms.

TEMPERATURE ACCURACY USING AUTOMATIC CJC WITH 3724-ST ACCESSORY: 1°C for J, K, T, and E type (see mainframe specification for details).

RELAY TYPE: Optically isolated FET.

RELAY DRIVE SCHEME: Direct.

INTERLOCK: Backplane relays disabled when interlock connection removed.

RELAY DRIVE CURRENT: 4mA.

OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25°C to 65°C.

WEIGHT: 1.13 kg (2.5 lbs.).

SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.

EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

TYPICAL SCANNING SPEEDS, SWITCH ONLY¹:

Sequential scanning, single channel, immediate trigger advance: >1250 ch/s.

TYPICAL SCANNING SPEEDS, WITH MEASUREMENTS INTO MEMORY²:

DCV (10V range) or 2WΩ (1kΩ range): >1000 ch/s.

Thermocouple: >1000 ch/s.

3- or 4-Wire RTD: >450 ch/s.

4-Wire Ω (1kΩ range): >450 ch/s.

ACV (10V, 400Hz range): >1000 ch/s.

POWER BUDGET INFORMATION:

Quiescent Power (mW): 1150.

Channel Relay Power (mW) Each: 20.

Backplane Relay Power Consumption (mW) Each: 100.

See Chapter 8 of the Series 3700A user's manual for more detailed information.

NOTES

- Scanning script local to mainframe, within same bank, break before make.
- 3706A mainframe with autorange off, limits off, dmm.autodelay=0, dmm.autozero=0, 4½ digits (NPLC=.006), for ACV dmm.detectorbandwidth=300, for OHMs dmm.offsetcompensation=off, dmm.opendetector=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

1.888.KEITHLEY (U.S. only)

www.keithley.com

KEITHLEY

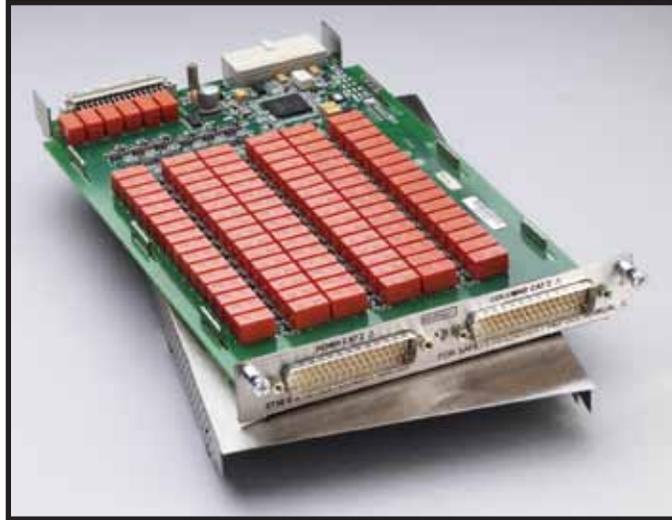
A GREATER MEASURE OF CONFIDENCE

3730

6×16, High Density, Matrix Card

96 two-pole crosspoints with column expansion relays

- 6 row by 16 column matrix (2-pole)
- Analog backplane connection relays provide easy column expansion
- 300V, 1A switched or 2A carry signal capacity; 60W, 125VA
- Screw terminal connections provided on removable 3730-ST accessory
- 2μV and 100pA offsets
- Relay closures stored in onboard memory
- Latching electromechanical relays



The Model 3730 is a two-pole, 6 row by 16 column matrix card. It can connect up to six differential instrument channels to any combination of 16 DUTs (devices under test). Any row can be connected to the Series 3700A mainframe backplane by using the analog backplane connection relays. This allows for easy matrix column expansion. A matrix of up to 6 rows by 96 columns can be supported within a single Model 3706A mainframe (with six Model 3730 cards).

The Model 3730 uses two 50-pin male D-sub connectors for signal connections. For screw terminal connections, use the detachable Model 3730-ST accessory.

ACCESSORIES AVAILABLE

3721-MTC-1.5	50 Pin D-sub Female to Male Cable, 1.5m (5 ft.)
3721-MTC-3	50 Pin D-sub Female to Male Cable, 3m (10 ft.)
3730-ST	Screw Terminal Block
3790-KIT50-R	50 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder-cup contacts)

SERVICES AVAILABLE

3730-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3730-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3730-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries

Ordering Information

3730 **6×16, High Density,
Matrix Card**

1.888.KEITHLEY (U.S. only)

www.keithley.com

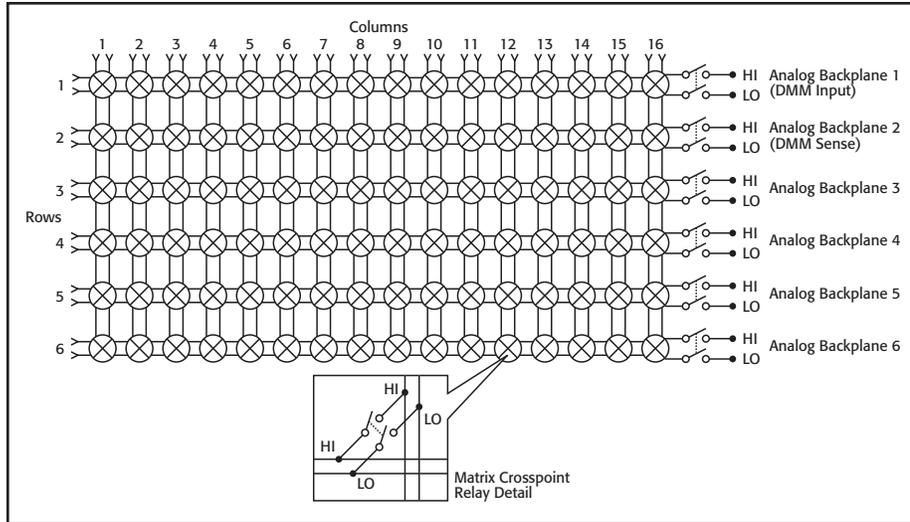
KEITHLEY

A GREATER MEASURE OF CONFIDENCE

3730

6×16, High Density, Matrix Card

96 two-pole crosspoints with column expansion relays



MATRIX CONFIGURATION: 6 row by 16 column matrix. Columns can be expanded using the backplane or isolated by relays.

CONTACT CONFIGURATION: 2 pole form A.
CONNECTOR TYPE: Two 50 pin male D-shells.

MODEL 3730-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 88 conductors maximum. #16 AWG maximum wire size with 0.092 inch O.D. 44 conductor per card maximum.

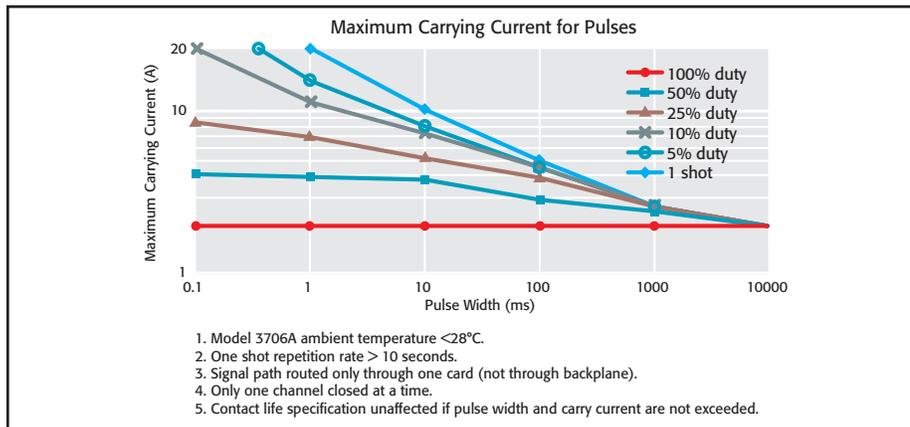
MAXIMUM SIGNAL LEVEL: 300V DC or RMS, 1A switched (2A carry), 60W, 125VA.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10^7 .

CONTACT LIFE: $>10^5$ operations @ maximum signal level. $>10^8$ operations no load.¹

	$6 \times 16^{2,3}$
Channel Resistance (end of contact life)	$<1.0 \Omega$
Contact Potential (differential)	$<\pm 2 \mu V$
Offset Current	$<\pm 100 \text{ pA}$
Isolation	
Differential	$10^{10} \Omega, 250 \text{ pF}$
Channel-channel	$10^{10} \Omega, 75 \text{ pF}$
Common Mode	$10^{10} \Omega, 150 \text{ pF}$
Crosstalk Channel-channel	
300kHz	$<-65 \text{ dB}$
1MHz	$<-55 \text{ dB}$
20MHz	$<-30 \text{ dB}$
Bandwidth	27 MHz



GENERAL

ACTUATION TIME: 4ms.
RELAY TYPE: Latching electromechanical.
RELAY DRIVE SCHEME: Hybrid Matrix.
INTERLOCK: Backplane relays disabled when terminal assembly is removed.
OPERATING ENVIRONMENT: Specified for 0° to 50°C . Specified to 70% R.H. at 35°C .
STORAGE ENVIRONMENT: -25° to 65°C .
WEIGHT: 2.5 lbs.
SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.
EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

NOTES

- Minimum signal level 10mV, $10 \mu\text{A}$.
- Connections made using 3730-ST accessory.
- 3706A mainframe with all DMM backplane relays disconnected.

1.888.KEITHLEY (U.S. only)

www.keithley.com

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

3731

- 6 row by 16 column matrix (2-pole) using high speed, long life reed relays
- Analog backplane connection relays provide easy column expansion
- 200V, 1A switched or 2A carry signal capacity; 10W, 10VA
- Screw terminal connections provided on removable 3731-ST accessory
- Relay actuation time of 0.5ms
- Ideal for multi-channel I-V testing with Series 2600A System SourceMeter® Instruments
- Long life dry reed relays (>10⁹ operations)

Ordering Information

3731 **6×16 High Speed, Reed Relay, Matrix Card**

6×16 High Speed, Reed Relay, Matrix Card

96 two-pole crosspoints with column expansion relays



The Model 3731 is a two-pole, 6 row by 16 column reed relay matrix card. By using high speed reed relays with actuation times of 0.5ms, this card meets the requirements of demanding throughput applications while offering users the additional benefit of long life, exceeding one billion operations. The card can connect up to six differential instrument channels to any combination of 16 DUTs (devices under test). Any row can be connected to the Series 3700A mainframe backplane by using the analog backplane connection relays. This allows for easy matrix column expansion. A matrix of up to 6 rows by 96 columns can be supported within a single 3706A mainframe (with six Model 3731 cards).

The Model 3731 uses two 50-pin male D-sub connectors for signal connections. For screw terminal connections, use the detachable Model 3731-ST accessory.

ACCESSORIES AVAILABLE

3721-MTC-1.5	50-pin D-sub Female to Male Cable, 1.5m (5 ft.)
3721-MTC-3	50-pin D-sub Female to Male Cable, 3m (10 ft.)
3731-ST	Screw Terminal Block
3790-KIT50-R	50-pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder-cup contacts)

SERVICES AVAILABLE

3731-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3731-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3731-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

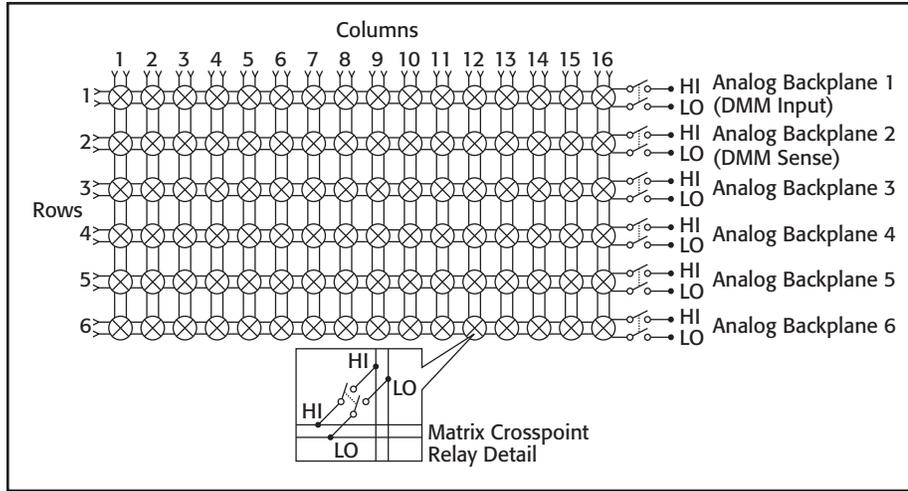
*Not available in all countries

3731

6×16 High Speed, Reed Relay, Matrix Card

96 two-pole crosspoints with column expansion relays

Model 3731 specifications



96 Two-Pole Crosspoints with Column Expansion Relays

MATRIX CONFIGURATION: 6 row by 16 column matrix. Columns can be expanded using the backplane or isolated by relays.

CONTACT CONFIGURATION: 2-pole form A.

CONNECTOR TYPE: Two 50-pin male D-shells.

MODEL 3731-ST SCREW TERMINAL OPTION:

Typical wire size: #22 AWG with .062 inch O.D.;

88 conductors maximum

Maximum wire size: #16 AWG with .092 inch O.D.;

44 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: 200V DC or peak AC, 1A switched (2A carry), 10W, 10VA.

COMMON MODE VOLTAGE: 200V DC or peak AC between any signal path to a signal path or ground.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE:

Reed: >10⁹ operations no load. >8×10⁶ operations @ 100V, 10mA.

EMR (Backplane): >10⁸ operations @ 5V, 10mA and 10⁵ operations @ maximum signal level.

6×16^{1,2}

Channel Resistance (end of contact life)	<1.5 Ω
Contact Potential (differential)	<±80 μV
Offset Current	<±500 pA
Isolation	
Differential	3×10 ⁹ Ω, 300 pF
Channel-channel	3×10 ⁹ Ω, 100 pF
Common Mode	3×10 ⁹ Ω, 150 pF
Crosstalk Channel-channel	
300kHz	<-60 dB
1MHz	<-50 dB
15MHz	<-20 dB
Bandwidth	19 MHz

GENERAL

ACTUATION TIME: 0.5ms.

RELAY TYPE: Reed.

RELAY DRIVE SCHEME: Direct drive.

INTERLOCK: Backplane relays disabled when terminal assembly is removed.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 2.2 lbs.

SAFETY: Compliant with European Union Low Voltage Directive

EMC: Compliant with European Union EMC Directive 2004/108/EC, EN61326-1.

NOTES

1. Connections made using 3731-ST.

2. 3706A mainframe with all DMM backplane relays disconnected.

SWITCHING AND CONTROL

1.888.KEITHLEY (U.S. only)

www.keithley.com

KEITHLEY

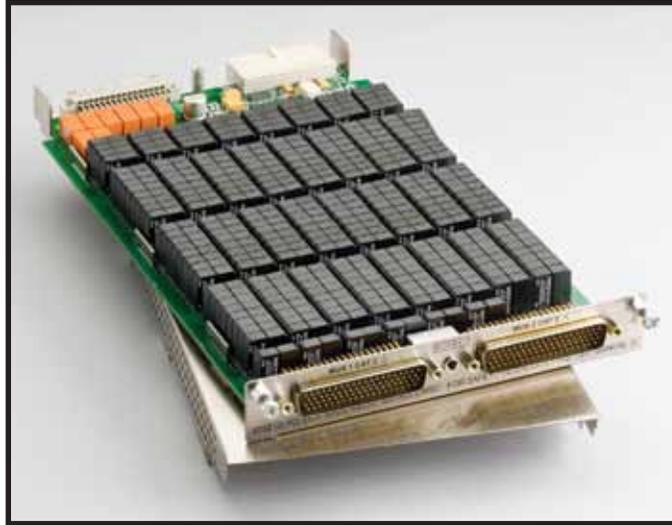
A GREATER MEASURE OF CONFIDENCE

3732

Quad 4×28, Ultra-High Density, Reed Relay Matrix Card

448 one-pole crosspoints with bank configuration and backplane connection relays

- Four independent banks of 4×28 single pole matrices
- 200V, 1.2A carry or 0.75A switched signal capacity; 15W, 15VA
- Bank configuration relays enable alternative matrix sizes, including:
 - Dual 4×56 (1 wire)
 - Single 4×112 (1 wire)
 - Single 4×56 (2 wire)
- Optional accessory, Model 3732-ST-R, enables screw terminal access and additional matrix sizes including:
 - Dual 8×28 (1 wire)
 - Single 16×28 (1 wire)
 - Single 8×28 (2 wire)
- Analog backplane connection relays provide easy card-to-card column expansion
- Long life dry reed relays (>10⁹ operations)
- Ideal for high channel count I-V testing with Series 2600A System SourceMeter® Instruments



The ultra-high density Model 3732 matrix card is comprised of four banks, each with 4 rows by 28 columns of reed relays. This provides 448 single-pole crosspoints for maximum connection versatility in high channel count applications. For even greater flexibility, bank configuration relays are mounted on the card. They offer an automated method of connecting banks to enable two additional matrix configurations: single 4×112 and dual 4×56. This feature allows the matrix size to be easily adapted to existing or future applications. For differential (2-wire) measurements, a two-pole mode can be selected that enables automatic pairing of crosspoints to create a dual 4×28 or single 4×56 configuration. For larger matrix sizes, analog backplane relays are provided that enable rows to connect to the Series 3700A mainframe backplane. This allows, for example, a matrix of up to 4 rows by 672 columns within a single 3706A mainframe using six Model 3732 cards.

The card uses optimized reed relays that offer both low contact potential and low current offset to minimize the switching errors that often accompany this relay technology. Additionally, these relays provide greater signal voltage (200V) and current (1.2A carry) dynamic range while supporting the long life and fast actuation times necessary in many automated test applications.

The Model 3732 uses two 78-pin male D-sub connectors for signal and configuration connections. For screw terminal connections, two accessories are offered. Use the 3732-ST-R for the 16×28 or dual 8×28 matrix configurations. Use the 3732-ST-C for the 4×112, dual 4×56, or base quad 4×28 matrix configurations.

Ordering Information

3732 Quad 4×28, Ultra-High Density, Reed Relay Matrix Card

ACCESSORIES AVAILABLE

3732-ST-C	Screw Terminal Block for matrix configurations: Quad 4×28 (1 wire) Dual 4×28 (2 wire) Single 4×56 (2 wire) Dual 4×56 (1 wire) Single 4×112 (1 wire)
3732-ST-R	Screw Terminal Block for matrix configurations: Dual 8×28 (1 wire) Single 8×28 (2 wire) Single 16×28 (1 wire)
3732-MTC-1.5	78-pin, D-sub Female-to-Male Cable, 1.5m (5 ft.)
3732-MTC-3	78-pin, D-sub Female-to-Male Cable, 3m (10 ft.)
3791-CIT	Contact Insertion and Extraction Tool
3791-KIT78-R	78-pin, Female D-sub Connector Kit (contains 2 female D-sub connectors and 156 solder-cup contacts)

SERVICES AVAILABLE

3732-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3732-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3732-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*
*Not available in all countries	

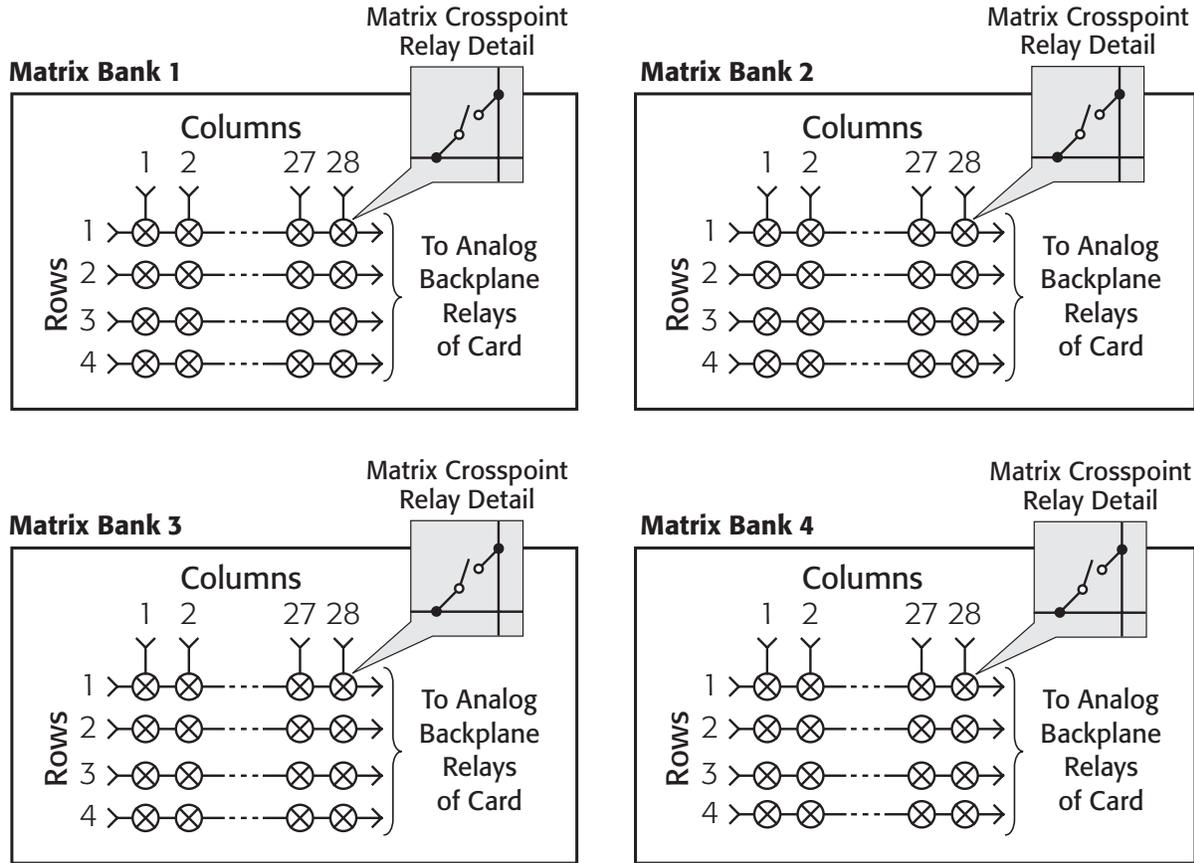
Quad 4×28, ultra-high density, reed relay matrix card

SWITCHING AND CONTROL

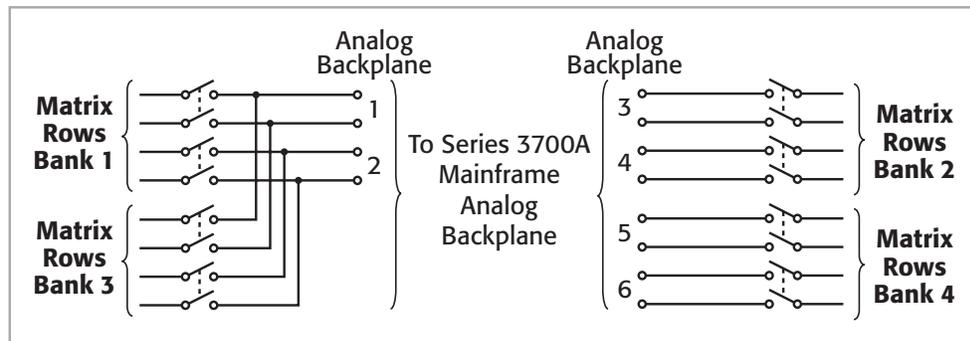
Quad 4x28, Ultra-High Density, Reed Relay Matrix Card

448 one-pole crosspoints with bank configuration and backplane connection relays

Quad 4x28 (1-wire) or Dual 4x28 (2-wire) Matrix Configuration



Analog Backplane Connection Relays

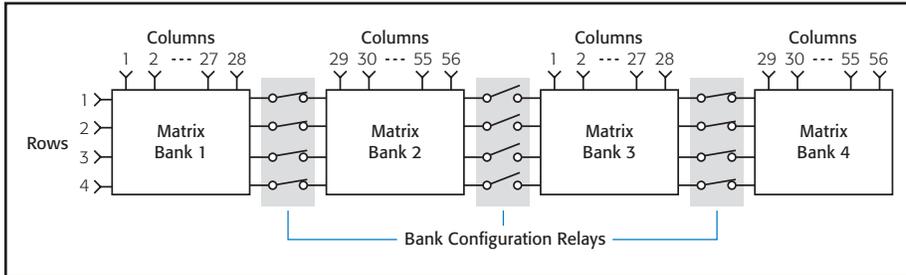


3732

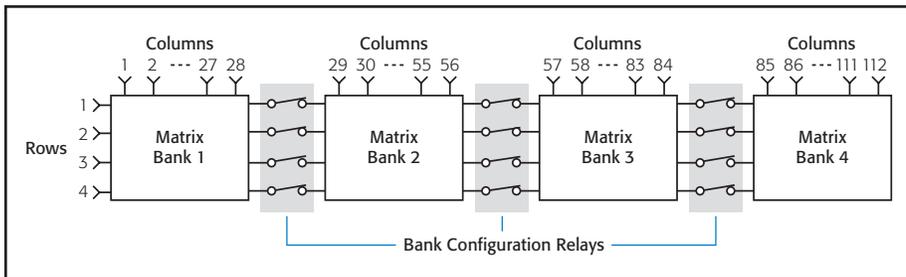
Quad 4x28, Ultra-High Density, Reed Relay Matrix Card

448 one-pole crosspoints with bank configuration and backplane connection relays

Additional Matrix Configurations Using Bank Configuration Relays

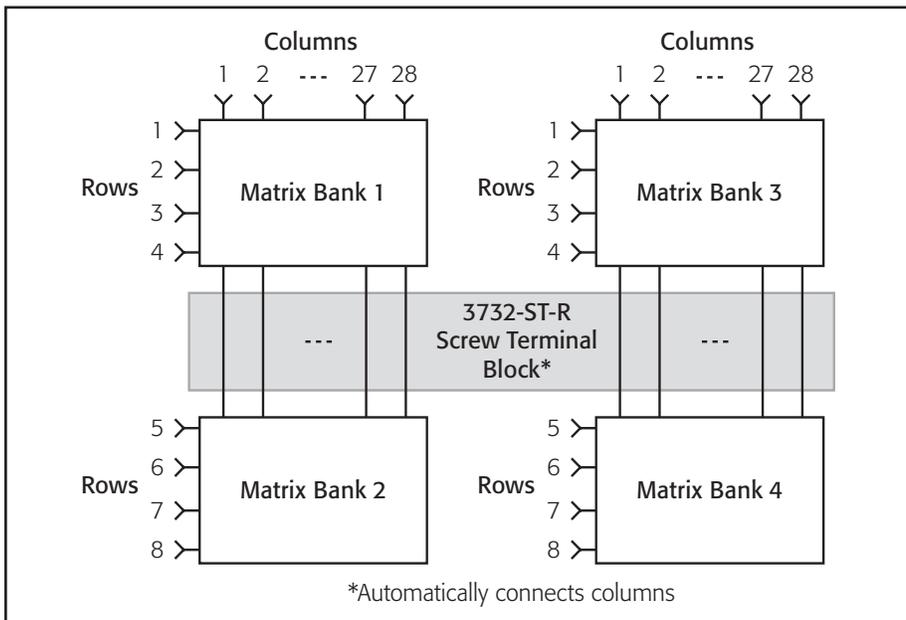


Dual 4x56 (1-wire) or single 4x56 (2-wire) matrix configuration using bank configuration relays

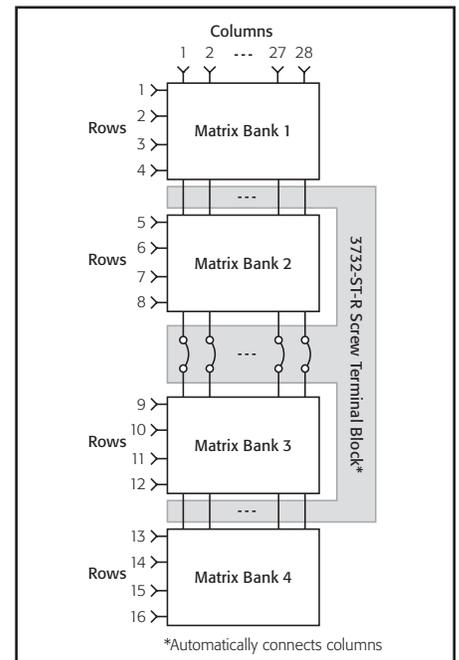


Single 4x112 (1-wire) matrix configuration using bank configuration relays

Additional Matrix Configurations Using the Model 3732-ST-R Screw Terminal Block



Dual 8x28 (1-wire) or single 8x28 (2-wire) matrix configuration using one Model 3732-ST-R screw terminal block



Single 16x28 (1-wire) matrix configuration using one Model 3732-ST-R screw terminal block

1.888.KEITHLEY (U.S. only)
www.keithley.com

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

3732

Quad 4×28, Ultra-High Density, Reed Relay Matrix Card

448 one-pole crosspoints with bank configuration and backplane connection relays

MATRIX CONFIGURATION: Four banks, each with 4 rows by 28 columns of reed relays. Bank configuration and analog backplane relays are included for additional matrix configurations. Banks can be connected together via relays creating dual 4×56 matrices or a single 4×112 matrix. Row expansion is available using optional screw terminal accessories.

CONTACT CONFIGURATION: Single-pole form A.

CONNECTOR TYPE: Two 78-pin male D-shells.

MODEL 3732-ST-R SCREW TERMINAL OPTION: Provides terminal block access and column jumper blocks for extended row configurations including Dual 8×28 (1W), Single 8×28 (2W), and Single 16×28 (1W).

Typical Wire Size: #22 AWG with 0.062 inch O.D.; 88 conductors per card maximum.

Maximum Wire Size: #16 AWG with 0.092 inch O.D.; 44 conductors per card maximum.

MODEL 3732-ST-C SCREW TERMINAL OPTION: Provides terminal block access for Quad 4×28 (1W), Dual 4×28 (2W), Dual 4×56 (1W), Single 4×56 (2W), and Single 4×112 (1W) matrix configurations.

Typical Wire Size: #22 AWG with 0.062 inch O.D.; 88 conductors per card maximum.

Maximum Wire Size: #16 AWG with 0.092 inch O.D.; 44 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: 200VDC or peak AC, 0.75A switched (1.2A carry), 15W/15VA max. switch power.

COMMON MODE VOLTAGE: 200VDC or peak AC between any signal path to a signal path or ground.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: Reed: >10⁹ operations no load, >8×10⁶ operations @ 100V, 10mA.

EMR (Backplane): >10⁸ operations @ 5V, 10mA and 10⁵ operations at maximum signal level.

MODEL 3732 PARAMETERS

Parameter	Quad 4×28 ^{1,2}	Dual 4×56 ^{1,2}	Single 4×112 ^{1,2}	Dual 8×28 ^{2,3}	Single 16×28 ^{2,3}
Channel Resistance (end of life)	<1.5 Ω	<2.0 Ω	<2.5 Ω	<1.6 Ω	<2.0 Ω
Contact Potential (differential)	<±10 μV	<±20 μV	N/A	<±15 μV	N/A
Contact Potential (single ended)	<±20 μV	<±40 μV	<±65 μV	<±20 μV	<±20 μV
Offset Current	<±0.5 nA	<±1.0 nA	<±2.0 nA	<±1.0 nA	<±2.0 nA
Isolation					
CH-CH	3×10 ⁹ Ω/150 pF	1.5×10 ⁹ Ω/300 pF	7.5×10 ⁸ Ω/600 pF	2×10 ⁹ Ω/200 pF	1.5×10 ⁹ Ω/300 pF
Common mode	1.5×10 ⁹ Ω/300 pF	1.5×10 ⁹ Ω/300 pF	7.5×10 ⁸ Ω/600 pF	2×10 ⁹ Ω/200 pF	1.5×10 ⁹ Ω/300 pF
Crosstalk Ch-Ch					
300 kHz	<-37 dB	<-37 dB	<-37 dB	<-37 dB	<-37 dB
1 MHz	<-26 dB	<-26 dB	<-26 dB	<-26 dB	<-26 dB
15 MHz	<-7 dB	<-7 dB	<-7 dB	<-7 dB	<-7 dB
Bandwidth	15 MHz	15 MHz	10 MHz	15 MHz	15 MHz

1. Connections made using Model 3732-ST-C.
2. Model 3706A mainframe with all DMM backplane relays disconnected.
3. Connections made using Model 3732-ST-R.

GENERAL SPECIFICATIONS

POWER BUDGET INFORMATION:

Quiescent Power Usage:

Mode	Quiescent Power
Quad 4×28	780 mW
Dual 4×56	916 mW
Single 4×112	984 mW
Dual 8×28	780 mW
Single 16×28	780 mW

Channel Relay Power Consumption (each): 17mW.

Backplane Relay Power Consumption (each): 100mW.

For additional power-budgeting information, refer to the Series 3700A Module Schematics and Connections section in the Series 3700A User's Manual (part no. 3700S-900-01).
ACTUATION TIME: 0.6ms.

RELAY TYPE: Reed (signal relays); EMR (backplane relays)

RELAY DRIVE SCHEME: Direct drive.

RELAY DRIVE CURRENT: 3.2mA.

INTERLOCK: Backplane relays disabled when terminal assembly interlock signal removed. When asserted allows system to read and save ID configuration bits.

EMC: Compliant with European Union EMC Directive.

SAFETY: Compliant with European Union Low Voltage Directive.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% relative humidity at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 3.40 lbs (1.54kg).

1.888.KEITHLEY (U.S. only)

www.keithley.com

KEITHLEY

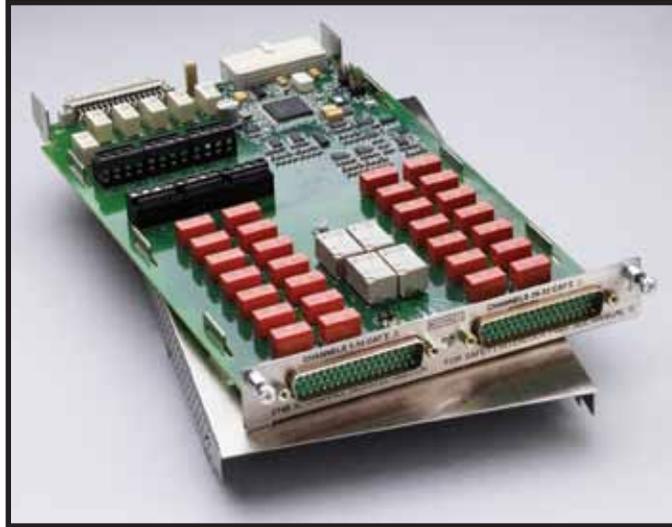
A GREATER MEASURE OF CONFIDENCE

3740

32-channel Isolated Switch Card

28 Form C relays and 4 high power Form A relays

- 28 general purpose Form C relays rated for 300V, 2A switched or 3A carry signal capacity; 60W, 125VA
- 4 high current Form A relays rated for 250VAC, 7A or 30VDC, 7A switched capacity; 210W
- Analog backplane connection relays provided for user interconnections
- Screw terminal connections provided on removable 3740-ST accessory
- Relay closures stored in onboard memory
- Latching electromechanical relays



The Model 3740 offers 28 general-purpose form C channels that are ideal for routing power or other control devices. For higher power applications of up to 7A, four additional high current form A channels are provided.

If any general purpose signal requires routing to the Series 3700A mainframe backplane, terminal blocks are located on the card, which are enabled with jumpers. Custom configurations can be created with the user accessible terminal blocks. For additional protection, an onboard temperature sensor will notify the mainframe when the card's operating temperature exceeds 70°C, compromising system specifications.

The Model 3740 uses two 50-pin male D-sub connectors for signal connections. For screw terminal connections, use the detachable Model 3740-ST accessory.

Ordering Information

3740 General Purpose Card with 32 Independent Channels

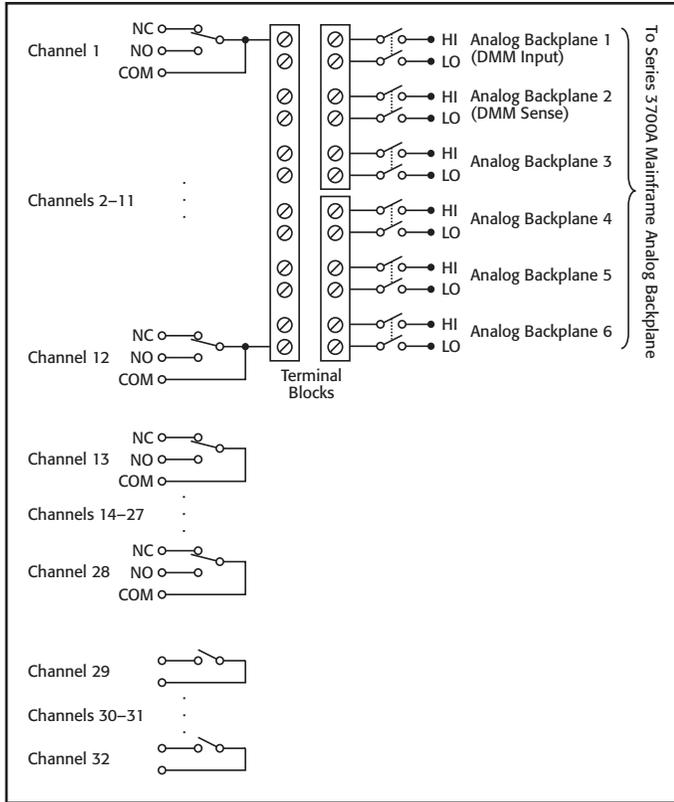
ACCESSORIES AVAILABLE

3721-MTC-1.5	50 Pin D-sub Female to Male Cable, 1.5m (5 ft.)
3721-MTC-3	50 Pin D-sub Female to Male Cable, 3m (10 ft.)
3740-ST	Screw Terminal Block
3790-KIT50-R	50 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder cup contacts)

SERVICES AVAILABLE

3740-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3740-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3740-3Y-STD	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries



RELAY SWITCH CONFIGURATION: 32 general purpose independent channels. 28 channels of Form C switching at 2A and 4 channels of Form A switching at 7A. Relays can be connected to each other and backplane via removable terminal blocks.

CONTACT CONFIGURATION: **General Purpose:** 1 pole Form C. **High Current:** 1 pole Form A. **CONNECTOR TYPE:** Two 50 pin male D-shells.

MODEL 3740-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 84 conductors maximum. #16 AWG maximum wire size with 0.092 inch O.D. 44 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: **Form C:** 300V DC or RMS, 2A switched (3A carry), 60W, 125VA. **Form A:** 250VAC 7A, 30VDC 7A, 210W.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: **Form C:** >10⁵ operations at maximum signal level. >10⁸ operations no load.¹ **Form A:** >10⁵ operations at maximum signal level, >5×10⁷ operations no load.¹

CHANNEL RESISTANCE (end of contact life): <0.5Ω

CONTACT POTENTIAL: <±3μV typical per contact.

ISOLATION: **Channel-channel:** 10⁹Ω, <200pF. **Common Mode:** >10¹⁰Ω, <150pF.

Crosstalk (Channel-channel, 50Ω load–50Ω source): **100kHz:** <–50dB. **1MHz:** <–35dB. **10MHz:** <–15dB.

BANDWIDTH: 30MHz.

GENERAL

OVER-TEMPERATURE: Temperature sensor indicates over temperature.

ACTUATION TIME: **Form C:** 4ms. **Form A:** 10ms.

RELAY TYPE: **Form C:** Latching electromechanical. **Form A:** Nonlatching electromechanical.

RELAY DRIVE SCHEME: Direct.

INTERLOCK: Backplane relays disabled when interlock connection is removed.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: –25° to 65°C.

WEIGHT: 2.5 lbs.

SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.

EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.

NOTES

1. Minimum signal level 10mV, 10μA.

3750

- 40 bidirectional digital input/output bits
- High current driver outputs for sinking (300mA)
- Internal 5V, 50mA logic supply for powering external logic circuits
- 2 isolated analog output channels, programmable to $\pm 12V$, 0–20mA, or 4–20mA
- 4 gated 32-bit counters with 1MHz input rate
- Screw terminal connections provided with removable 3750-ST accessory
- External supply voltage supported on digital I/O

Ordering Information

3750 **Multifunction
Control Card**

ACCESSORIES AVAILABLE

3721-MTC-1.5	50-pin female-to-male D-sub Cable Assembly, 1.5m (4.9 ft)
3721-MTC-3	50-pin female-to-male D-sub Cable Assembly, 3m (9.8 ft)
3750-ST	Screw Terminal Block
3790-KIT50-R	50-pin female D-sub Connector Kit (contains 2 D-sub connectors and 100 solder cup contacts)

SERVICES AVAILABLE

3750-3Y-EW-STD	1-year factory warranty extended to 3 years from date of shipment
3750-5Y-EW-STD	1-year factory warranty extended to 5 years from date of shipment
C/3750-3Y-DATA	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries

1.888.KEITHLEY (U.S. only)

www.keithley.com

Multifunction Control Card

40 digital I/O bits, 2 analog output channels, and 4 counters



Use the Model 3750 to monitor and control your automated test system. The flexibility and speed provided by the 40 digital I/O bits, four counters, and two analog outputs make it well-suited for a wide variety of system control applications.

Digital I/O

The Model 3750 offers 40 digital I/O bits arranged in five banks. Each bank is comprised of eight bits each, and each bank can be programmed as either input or output. Digital I/O is often used to control processes and monitor the status of switches, contacts, and other control points. Additional features include scanning capabilities, such as writing a unique output pattern or reading banks of inputs at rates up to 1000 rdgs/second. Also, pattern matching is available, making it ideal for complex event algorithms.

Further versatility is provided by supporting external voltage levels of up to 30V and output current sink levels of 300mA for control of external devices like RF/microwave relays.

Analog Outputs

The two analog outputs of the Model 3750 are designed for general purpose applications such as setpoint control or as bias supplies to your device under test. For maximum utility, these outputs are programmable as voltage ($\pm 12V$) or current (0–20mA or 4–20mA). A number of protection features are provided, including monitoring for current and/or voltage compliance and the ability to disconnect automatically during fault conditions. Output relays are supplied for each channel, ensuring mechanical isolation between your control device and the analog output.

Counters

Four 32-bit counters are provided with a maximum input rate of 1MHz. Each counter has a gate input that offers precise control of event counting and totalizing for a broad range of system components, such as: fixtures, limit switches, pass/fail indicators, revolutions, or time-related quantities. The counters, like the digital I/O, can be used in scanning operations and pattern matching as well as supporting reading rates of up to 1000 rdgs/second.

Self-calibration

When your Model 3706A mainframe is equipped with the high performance multimeter option, hardware and software is provided for self-calibration of analog outputs (voltage and current) and counter thresholds.

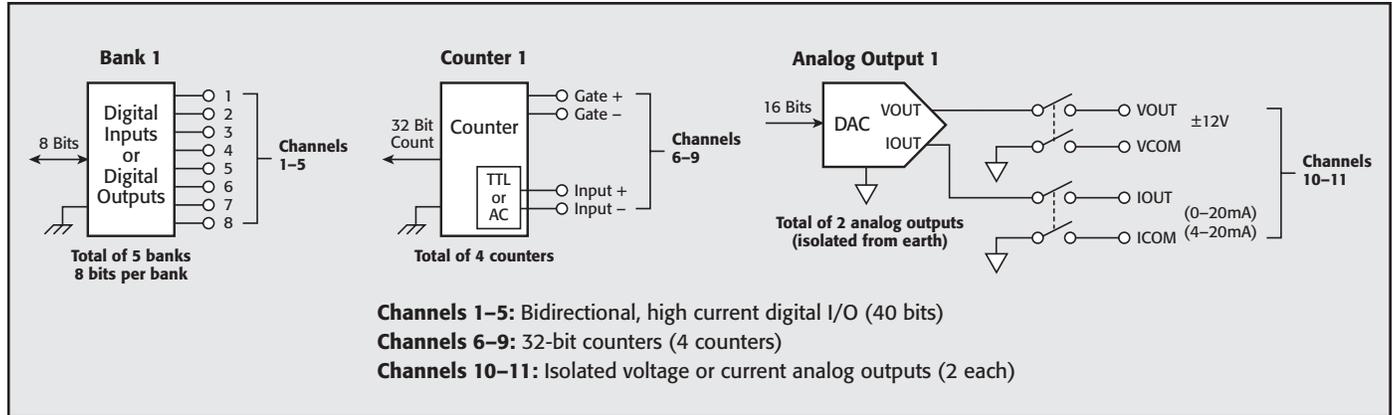


Figure 1. Block diagram

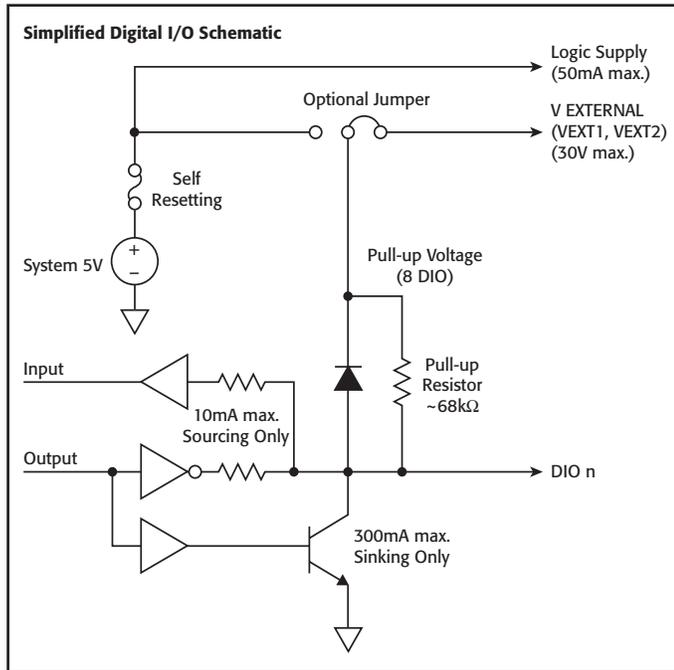


Figure 2. Simplified I/O schematic

Specifications

DIGITAL I/O¹

CONFIGURATION: 40 bidirectional digital I/O bits arranged in 5 banks of 8 bits each.

Each bank can be configured for either input or output capability. 1 bank of I/O is equivalent to 1 system channel.

DIGITAL INPUT SPECIFICATIONS

An internal weak pull-up resistor of approximately 68kΩ is provided on the card for each I/O. This pull-up resistor can be removed via onboard jumper on a channel (8 bit) basis. The pull-up voltage can either connect to the internally supplied 5V or an externally supplied voltage of up to 30V via onboard jumper. An internal 5V supply connection is separately available to run external logic circuits.

DIGITAL INPUT LOGIC LOW VOLTAGE: 0.8V max.

DIGITAL INPUT LOGIC HIGH VOLTAGE: 2V min.

DIGITAL INPUT LOGIC LOW CURRENT: -600μA max @ 0V.

DIGITAL INPUT LOGIC HIGH CURRENT: 50μA max @ 5V.

LOGIC: Positive true.

SYSTEM INPUT MINIMUM READ SPEED²: 1000 readings/second.

MAXIMUM EXTERNALLY SUPPLIED PULL-UP VOLTAGE: 30V.

MAXIMUM EXTERNALLY SUPPLIED VOLTAGE TO ANY DIGITAL I/O LINE: Pull-up voltage (5V internal or up to 30V external).

DIGITAL OUTPUT SPECIFICATIONS

Each output has an internal fly-back diode for driving inductive loads. Each output is protected against continuous short circuits and over temperature. An internal 5V supply connection is separately available to run external logic circuits.

DIGITAL OUTPUT LOGIC HIGH VOLTAGE: 2.4V minimum @ I_{out} = 10mA, sourcing only.

DIGITAL OUTPUT LOGIC LOW VOLTAGE: 0.5V maximum @ I_{out} = -300mA, sinking only.

MAXIMUM OUTPUT SINK CURRENT: 300mA per output, 3.0A total per card.

LOGIC: Positive true.

SYSTEM OUTPUT MINIMUM WRITE SPEED³: 1000 readings/second.

MAXIMUM EXTERNALLY SUPPLIED VOLTAGE TO ANY DIGITAL I/O LINE: Pull-up voltage (5V internal or up to 30V external).

ALARM: Trigger generation is supported for a maskable pattern match or state change on any of channels 1 through 5.

PROTECTION: Optional disconnect (set to inputs) during output fault conditions.

INTERNAL 5V LOGIC SUPPLY: The internal logic supply is designed for powering external logic circuits of up to 50mA maximum. The logic supply is internally protected with a self-resetting fuse. Fuse reset time < 1 hour.

NOTES

- All channels power up configured as inputs.
- All channels configured as inputs.
- All channels configured as outputs.

COUNTER/TOTALIZER INPUT

MAXIMUM COUNT: $2^{32} - 1$.
MAXIMUM INPUT RATE: 1MHz, rising or falling edge, programmable.
MINIMUM INPUT PULSE WIDTH: 500ns.
INPUT SIGNAL LEVEL: 200mV p-p (minimum), 42V peak (maximum).
THRESHOLD: AC (0V) or TTL logic level.
GATE INPUT: TTL-HI (Gate+), TTL-LO (Gate-) or NONE.
MINIMUM GATE INPUT SETUP TIME: 1 μ s.
COUNT RESET: Manual or Read + Reset.
SYSTEM INPUT MINIMUM READ SPEED: 1000 readings/second.
ALARM: Trigger generation is supported for a count match or counter overflow on any of channels 6 through 9.

ANALOG VOLTAGE OUTPUT

The isolated analog voltage output is designed for general purpose, low power applications.
OUTPUT AMPLITUDE: ± 12 V up to 10mA.
OVERLOAD CURRENT: 21mA minimum.
RESOLUTION: 1mV.
FULL SCALE SETTling TIME: 1ms to 0.1% of output.
DC ACCURACY: \pm (% of output + mV):
 1 Year 23° $\pm 5^{\circ}$ C: 0.15% + 16mV.
 90 Day 23° $\pm 5^{\circ}$ C: 0.1% + 16mV.
 24 Hour 23° $\pm 5^{\circ}$ C: 0.04% + 16mV.
TEMPERATURE COEFFICIENT: \pm (0.02% + 1.2mV)/ $^{\circ}$ C.
10mV MAXIMUM UPDATE RATE: 350 μ s to 1% accuracy. System limited.
OUTPUT FAULT DETECTION: System fault detection is available for short circuit output/current compliance.
ISOLATION: 300V peak channel to channel or channel to chassis.
PROTECTION: Optional disconnect during output fault conditions.
MINIMUM GUARANTEED STABLE CAPACITIVE LOAD: 10nF.

NOTES

- Programming up to 1% over full scale range is supported.
- Measured with standard load shown in Figure 3.
- Measured with >10M Ω input DMM (DCV, filter, 1 PLC rate). Warm-up time is 1 hour @ 10mA load with 3750-ST.

ANALOG CURRENT OUTPUT

The isolated analog current output is designed for 0–20mA or 4–20mA unipolar modes of operation.
OUTPUT AMPLITUDE: 0 to 20mA or 4 to 20mA.
COMPLIANCE VOLTAGE: 11V minimum.
MAXIMUM OPEN CIRCUIT VOLTAGE: 16V.
RESOLUTION: 1 μ A.
FULL SCALE SETTling TIME: 1ms to 0.1% of output.
DC ACCURACY: \pm (% of output + μ A):
 1 Year 23° $\pm 5^{\circ}$ C: 0.15% + 18 μ A.
 90 Day 23° $\pm 5^{\circ}$ C: 0.1% + 18 μ A.
 24 Hour 23° $\pm 5^{\circ}$ C: 0.04% + 18 μ A.
TEMPERATURE COEFFICIENT: \pm (0.02% + 1.6 μ A)/ $^{\circ}$ C.
OUTPUT FAULT DETECTION: System fault detection is available for open circuit output/voltage compliance.
ISOLATION: 300V peak channel to channel or channel to chassis.
PROTECTION: Optional disconnect during output fault conditions.

NOTES

- Measured with standard load shown in Figure 3.
- Measured with <2 Ω shunt DMM (DCI, filter, 1 PLC rate). Warm-up time is 1 hour with 3750-ST.

GENERAL

CONNECTOR TYPE: Two 50-pin male D-shells.
OPERATING ENVIRONMENT: Specified for 0 $^{\circ}$ C to 50 $^{\circ}$ C. Specified to 70% R.H. at 35 $^{\circ}$ C.
STORAGE ENVIRONMENT: –25 $^{\circ}$ C to 65 $^{\circ}$ C.
WEIGHT: 1.27kg (2.80 lbs.).
SAFETY: Conforms to European Union Directive 73/23/EEC, EN61010-1.
EMC: Conforms to European Union Directive 2004/108/EC, EN61326-1.
POWER BUDGET INFORMATION:
Quiescent Power: 3300mW.
Digital Outputs Each Channel (1 through 5): 325mW.
Analog Channel Each (10 and 11): 820mW.
Totalizer Channel All (6 through 9): 730mW.
 Analog channels and counter channels may optionally be turned off to conserve system power.
 See Chapter 8 of the Series 3700A user's manual for more detailed information.

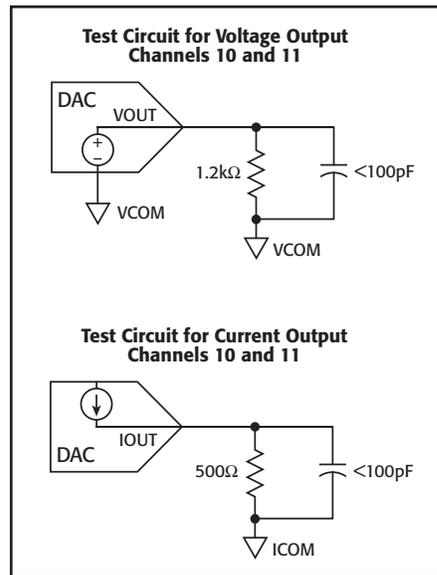


Figure 3. Standard load test circuits

Specifications are subject to change without notice.
All Keithley trademarks and trade names are the property of Keithley Instruments, Inc.
All other trademarks and trade names are the property of their respective companies.

KEITHLEY

A G R E A T E R M E A S U R E O F C O N F I D E N C E

KEITHLEY INSTRUMENTS, INC. ■ 28775 AURORA RD. ■ CLEVELAND, OH 44139-1891 ■ 440-248-0400 ■ Fax: 440-248-6168 ■ 1-888-KEITHLEY ■ www.keithley.com

BELGIUM

Sint-Pieters-Leeuw
Ph: 02-3630040
Fax: 02-3630064
info@keithley.nl
www.keithley.nl

CHINA

Beijing
Ph: 86-10-8447-5556
Fax: 86-10-8225-5018
china@keithley.com
www.keithley.com.cn

FRANCE

Saint-Aubin
Ph: 01-64532020
Fax: 01-60117726
info@keithley.fr
www.keithley.fr

GERMANY

Germering
Ph: 089-84930740
Fax: 089-84930734
info@keithley.de
www.keithley.de

INDIA

Bangalore
Ph: 080-26771071, -72, -73
Fax: 080-26771076
support_india@keithley.com
www.keithley.com

ITALY

Peschiera Borromeo (Mi)
Ph: 02-5538421
Fax: 02-55384228
info@keithley.it
www.keithley.it

JAPAN

Tokyo
Ph: 81-3-5733-7555
Fax: 81-3-5733-7556
info.jp@keithley.com
www.keithley.jp

KOREA

Seoul
Ph: 82-2-574-7778
Fax: 82-2-574-7838
keithley@keithley.co.kr
www.keithley.co.kr

MALAYSIA

Penang
Ph: 60-4-643-9679
Fax: 60-4-643-3794
sea@keithley.com
www.keithley.com

NETHERLANDS

Gorinchem
Ph: 0183-635333
Fax: 0183-630821
info@keithley.nl
www.keithley.nl

SINGAPORE

Singapore
Ph: 65-6747-9077
Fax: 65-6747-2991
sea@keithley.com
www.keithley.com

SWITZERLAND

Zürich
Ph: 044-8219444
Fax: 044-8203081
info@keithley.ch
www.keithley.ch

TAIWAN

Hsinchu
Ph: 886-3-572-9077
Fax: 886-3-572-9031
info_tw@keithley.com
www.keithley.com.tw

UNITED KINGDOM

Theale
Ph: 0118-9297500
Fax: 0118-9297519
info@keithley.co.uk
www.keithley.co.uk

