

MeasureReady™ M81-SSM

Synchronous Source Measure System

Adapter M81-BNC-DB25 Breakout Box for PPMS Connections

The M81-BNC-DB25 breakout box is used to connect various module configurations of the MeasureReady™ M81-SSM to the Quantum Design PPMS® Dynacool sample puck device, using connections A, B, and C for 4-wire I-V and resistance measurements. The breakout box routes BNC-connected source and measure modules to the Quantum Design standard LEMO connection at the cryostat feedthrough using one of two wiring mapping configurations. The standard Quantum Design LEMO to DB25 cable can be used (see [Connection Guidance](#) below); however, the preferred option is to use the optional Lake Shore provided DB25 to LEMO cable.

When used in conjunction with source and measure modules, the Lake Shore DB25 to LEMO cable (P/N 112-819) simplifies the establishment of cryogenic low-noise connections from an M81 to a PPMS (Physical Property Measurement System) system. This breakout box can also be used with a standard Quantum Design PPMS DB25 to LEMO cable (P/N 3084-003). However, in some sample and test setup conditions, the use of this standard cable can create source to measure AC signals cross-coupling between source and measure connections due to the adjacent BNC source/measure connectors at the breakout box front panel. Cross-coupling effects can create noticeable measurement offsets/errors for combinations of higher lock-in reference frequencies (>100Hz), higher stimulus currents (>100uA), and higher device impedances (>100KΩ) levels.

The breakout box adapts the M81's BNC/triaxial connections to a DB25 connector, enabling seamless integration with the PPMS insert.

NOTE: There are no RF or DC blocking filters or over voltage/current limiters in this device. Sensitive device protection and any needed wide band RF filtering or DC blocking measures, if needed, are the responsibility of the user.

Features and Benefits

- **Simplified connections:** Adapts up to 24 BNC connections to a standard PPMS type DB25 for straightforward integration with Quantum Design Dynacool (select Opticool setups) and other non-guarded type (twisted pair) cryostats, etc. See pin map tables, [below](#).
- **High signal integrity:** High signal integrity when used with the optional Lake Shore DB25 to LEMO, which features fully-shielded construction with braided/foil shielding surrounding insulated twisted pair wires. This cable separates up to three source and three measure module wiring pairs to minimize AC crosstalk at the front panel while also minimizing the effects of dielectric absorption and vibration-induced noise pickup.
- **Flexible grounding configurations:** Provides the ability to reconfigure grounding connections, enabling various methods of linking the M81's measure common (output low) to the PPMS cryostat (earth ground).
NOTE: Refer to the M81 user manual for comprehensive grounding suggestions.
- **Manual device protections:** The breakout box allows users to safeguard sensitive test materials by providing the option to manually connect the BNC center and shell by selectively closing both BNC switches. Also, as illustrated below, it allows the flexibility for selectively connecting M81 measure common (BNC shells) together and/or to low noise earth ground potentials for lowest system noise performance while avoiding ground loop conditions.

Connection Guidance

Refer to the information below for detailed instructions on connecting the M81 to Quantum Design's PPMS® Dynacool sample mount puck connections. Lake Shore offers a LEMO to DB25 cable option that separates source and measure BNC connections (noted in pin map tables below).

NOTE: Quantum Design offers various probes, sample pucks, and sample accessories. Please consult the Quantum Design documentation for sample wiring and interconnection details not covered here.

For specific guidance for your application or setup, please contact [Lake Shore](#).

Front Panel BNC, Banana Connections and Connection Float/Short Switches

BNC Signal (center pin)

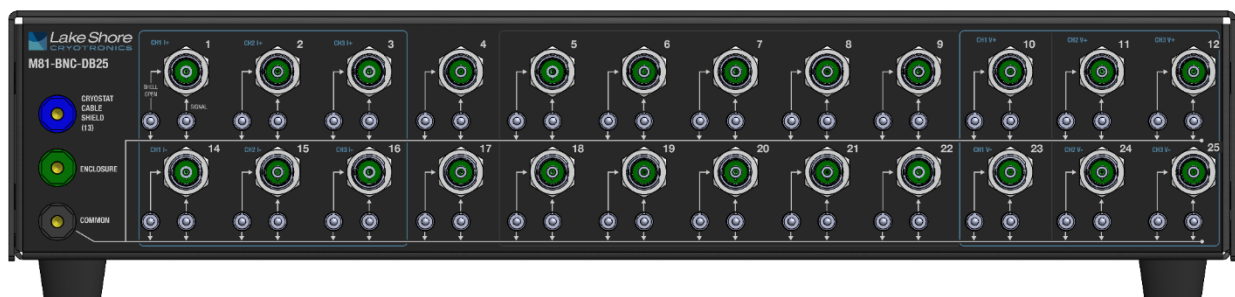
UP: Signal to DB25 (normal operation)

DOWN: Signal to "COMMON" and DB25

BNC Shell (shield)

UP: Shell open (normal operation)

DOWN: Shell(s) connected to "COMMON"



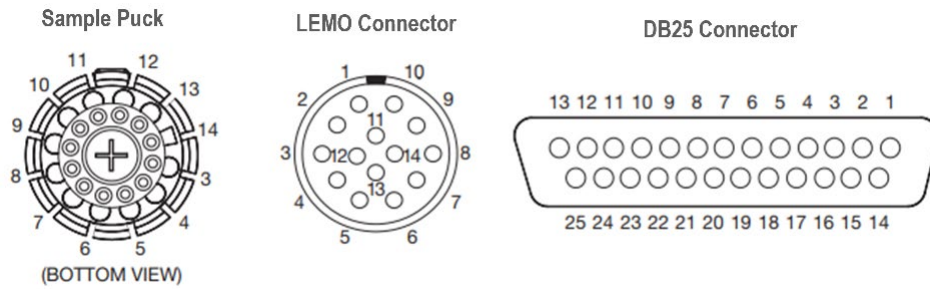
**When using the optional Lake Shore DB25 to LEMO cable (P/N 112-819)
(see left pin map table, [below](#)):**

- Source module(s) (BCS) connections to puck on left side BNCs 1 to 3 (+) and 14 to 16 (-):
BCS differential source module connections use pairs 1 & 14, 2 & 15, 3 & 16
 - BCS triaxial connections must be converted to unguarded BNC using included (with each BCS) triaxial to BNC adapters to work with this breakout box.
 - The supplied adapters place earth common (BCS panel) on BCS BNC shells, so close BCS connected breakout shell switches to down position to tie common to earth ground.
- Measure module(s) (VM) connections to puck on right side BNCs 10 to 12 (+) and 23 to 25 (-):
VM differential (A-B) measure module connections mirror those for the BCS above, using the right side BNCs 10 & 23, 11 & 24, and 12 & 25, but without the need for triaxial to BNC adapters. VM (and VS, CM) modules are BNC by default.
- When using VS and CM module pairs:
These modules are not differential as are the above BCS and VM connections. These modules each use a single BNC connection to the sample pins and require careful configuration of the shell connection switches to ensure proper measure common connections between all connected single-ended BNC modules. All modules except BCS are, or can be, used in single-ended mode).
NOTE: Please refer to the example module setup diagrams below for best practice connections and shorting switch settings for best measurement performance and results.

**When using Quantum Design supplied PPMS DB25 to LEMO cable (3084-003)
(see right pin map table, [below](#))**

Shift the BNC connections at the front panel of the breakout box to adjacent source measure pairs as shown by the light gray box surrounding BNCs 5 to 10 and 18 to 23. With source and measure module pair connections being directly adjacent to each other, the crosstalk issue should be considered for setups as noted above, under [High signal integrity](#).

M81 to PPMS DB25 Connections



Lake Shore DB25 to LEMO cable (PN 112-819) with separated source to measure connections (left table pin map, below)

M81/PPMS LEMO Cable (112-819)			
LEMO and (Puck) Pins	User Function	DB25 Pins (Cable)	Front Panel (M81)
3	Channel 1 I+	1	BNC 1
4	Channel 1 I-	14	BNC 14
7	Channel 2 I+	2	BNC 2
8	Channel 2 I-	15	BNC 15
11	Channel 3 I+	3	BNC 3
12	Channel 3 I-	16	BNC 16
-	-	4	BNC 4
-	-	17	BNC 17
-	-	5	BNC 5
-	-	18	BNC 18
-	-	6	BNC 6
-	-	19	BNC 19
-	-	7	BNC 7
-	-	20	BNC 20
-	-	8	BNC 8
-	-	21	BNC 21
-	-	9	BNC 9
-	-	22	BNC 22
5	Channel 1 V+	10	BNC 10
6	Channel 1 V-	23	BNC 23
9	Channel 2 V+	11	BNC 11
10	Channel 2 V-	24	BNC 24
13	Channel 3 V+	12	BNC 12
14	Channel 3 V-	25	BNC 25
(not Shell)	Shield	13 and Shell	BNC 13

"Gray" LEMO Cable (3084-003)			
LEMO and (Puck) Pins	User Function	DB25 Pins (Cable)	Front Panel (M81)
1	-	1	BNC 1
2	-	14	BNC 14
-	-	2	BNC 2
-	-	15	BNC 15
-	-	3	BNC 3
-	-	16	BNC 16
-	-	4	BNC 4
-	-	17	BNC 17
3	Channel 1 I+	5	BNC 5
4	Channel 1 I-	18	BNC 18
5	Channel 1 V+	6	BNC 6
6	Channel 1 V-	19	BNC 19
7	Channel 2 I+	7	BNC 7
8	Channel 2 I-	20	BNC 20
9	Channel 2 V+	8	BNC 8
10	Channel 2 V-	21	BNC 21
11	Channel 3 I+	9	BNC 9
12	Channel 3 I-	22	BNC 22
13	Channel 3 V+	10	BNC 10
14	Channel 3 V-	23	BNC 23
-	-	11	BNC 11
-	-	24	BNC 24
-	-	12	BNC 12
-	-	25	BNC 25
(not Shell)	Shield	13 (not Shell)	BNC 13

Pin map tables

Left: Lake Shore DB25 to LEMO cable (P/N 112-819)

Right: "Gray" Quantum Design PPMS DB25 to LEMO cable (P/N 3084-003)

Best Practice Wiring and Switch Starting Configurations for PPMS, other Cryostats

Recommended grounding schema: It is recommended to make a single point connection between earth ground and measure common somewhere in the measurement system, ideally to the lowest noise point possible. M81 measure common connections exist on all the BNC shells of the VS-10, CM-10, and VM-10 modules, and the CMR connection of the BCS module. Earth ground is located on the outer shells of the BCS-10 triaxial connectors, as well as the grounding screws on the rear panel of each module. The M81-BNC-DB25 is intended for use with PPMS and other non-guarded setup cryostats generally for applications below 10 MΩ resistances.

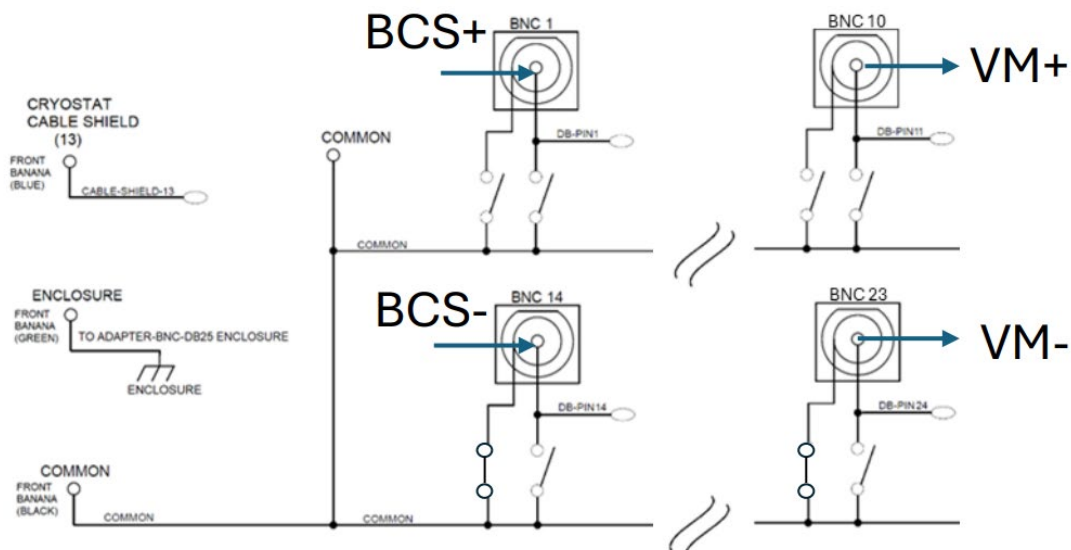
NOTE: Special grounding care (breakout shells switch settings) must be taken when using the supplied triaxial to BNC adapters for the BCS I+ and I- connections, since the triax outer (earth ground) is connected to BNC cable shields. This could inadvertently be tied to measure common if the BCS BNC shell grounding switches are in the closed position. It is recommended to begin with all switches in the UP position (no shells or centers tied to common or together).

For differential I-Force, V-Measure Applications (for example, BCS + VM module pairs)

Single BCS and single VM modules, without the use of the CMR feature:

Earth ground connected to measure common via BCS I- and VM- (B input) shell to common switches (x2), in the closed (down) position.

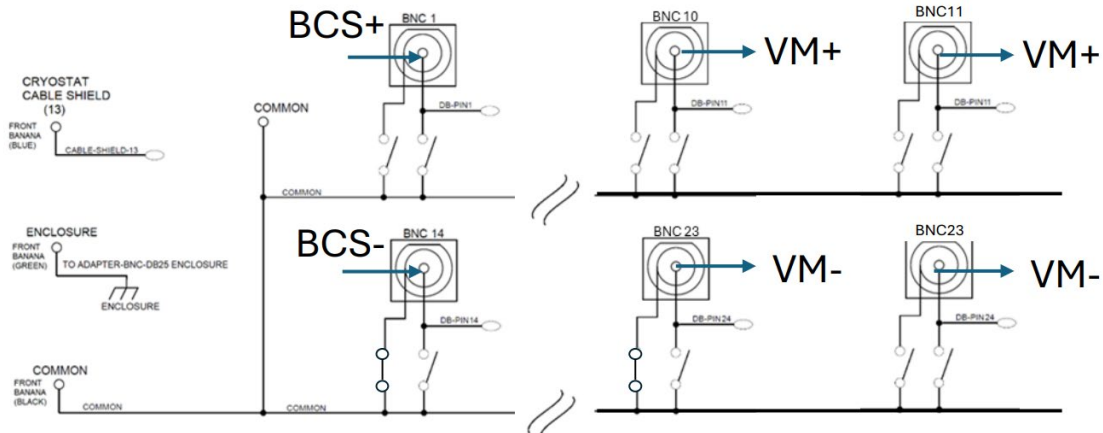
NOTE: Compare noise performance with all shell switches open (fully floating with respect to the earth ground, fully differential configuration), case by case.



Single BCS and multiple VMs, without use of the CMR feature:

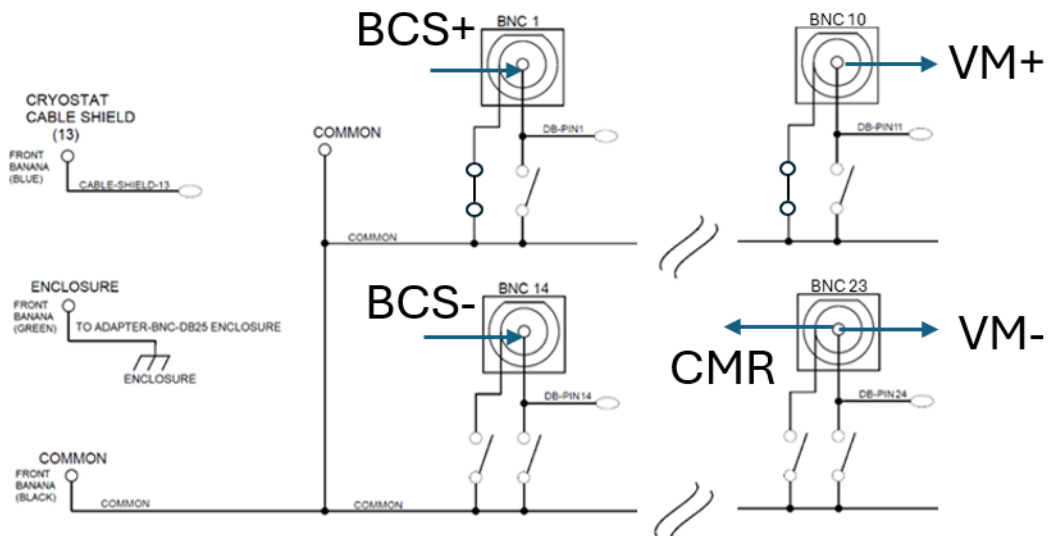
Earth ground connected to measure common via BCS I- and just one VM- (B input) shell to common switches (x2), in the closed (down) position.

NOTE: To avoid creating ground loop conditions, it is not recommended to connect more than one VM shell to a breakout common/earth ground.



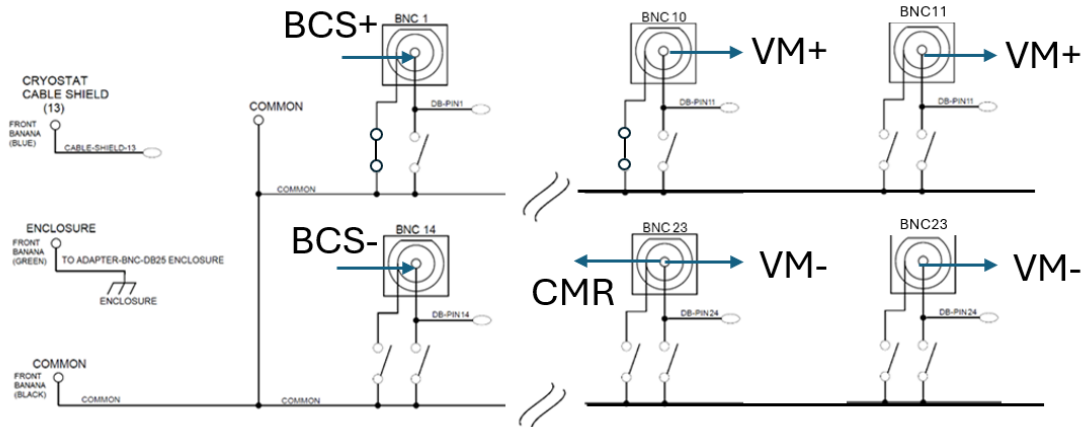
Single BCS and single VM, using the CMR feature:

Earth ground connected to measure common via BCS I± and VM+ (A input) shell to common switches (x2), in the closed (down) position. CMR shell and VM- shell remain floating.



Single BCS and multiple VMs, using the CMR feature:

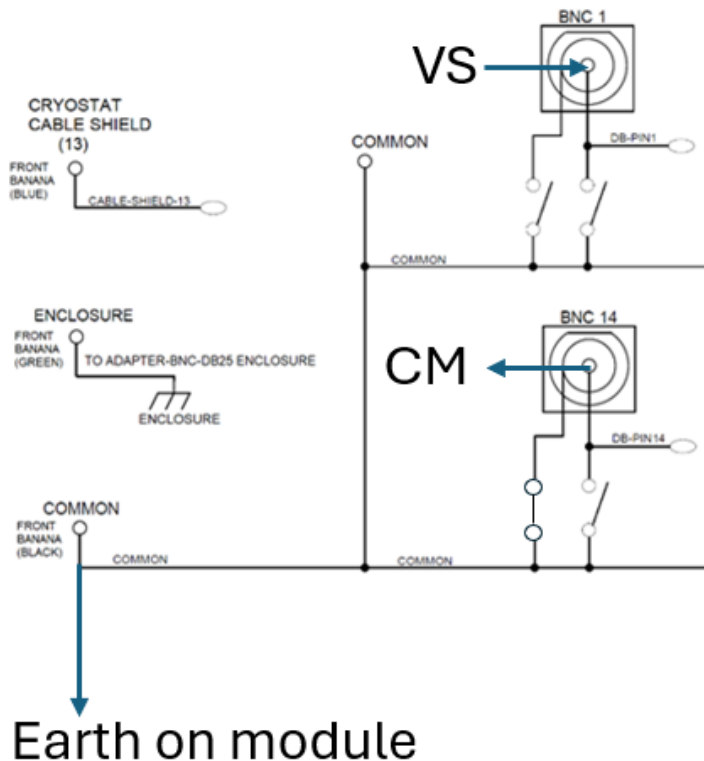
Earth ground connected to measure common via BCS I+ and VM+ (A input) shell to common switches (x2), in the closed (down) position. CMR shell, VM- shell, and shells of remaining measure modules remain floating.



For V-Force, I Measure Applications (for example, VS+CM 1:1 module pairs)

Single VS and CM:

Earth ground connected to measure common at the CM-10 shell for best noise performance.
NOTE: Compare noise with fully floating configuration (no shell switches closed), case by case.

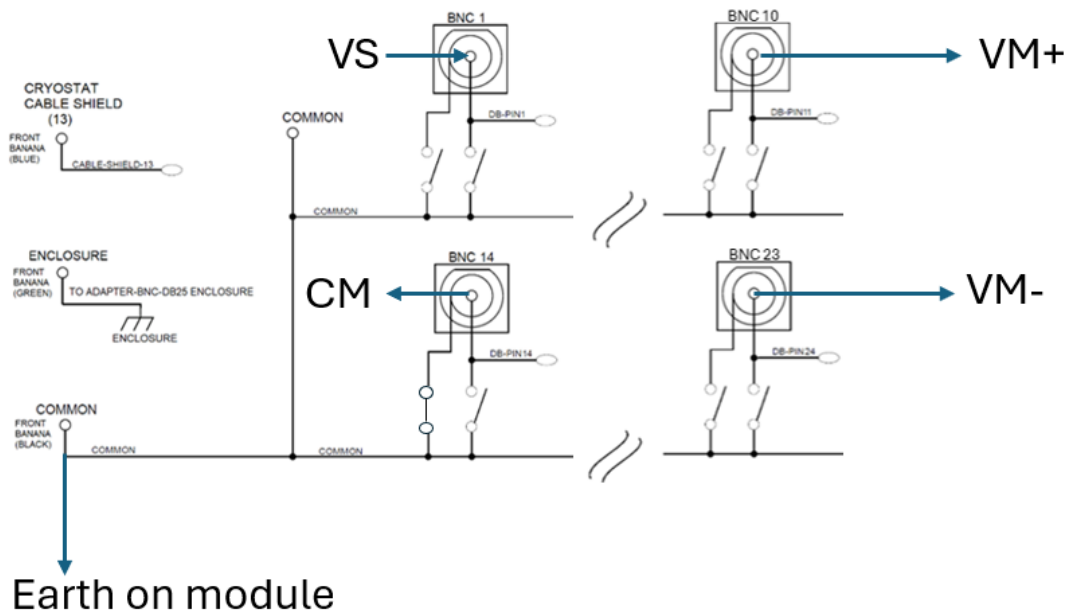


For Setups such as Hall Bar
 (for example, BCS+2xVM 3 V_x/V_y and other multi module setups)

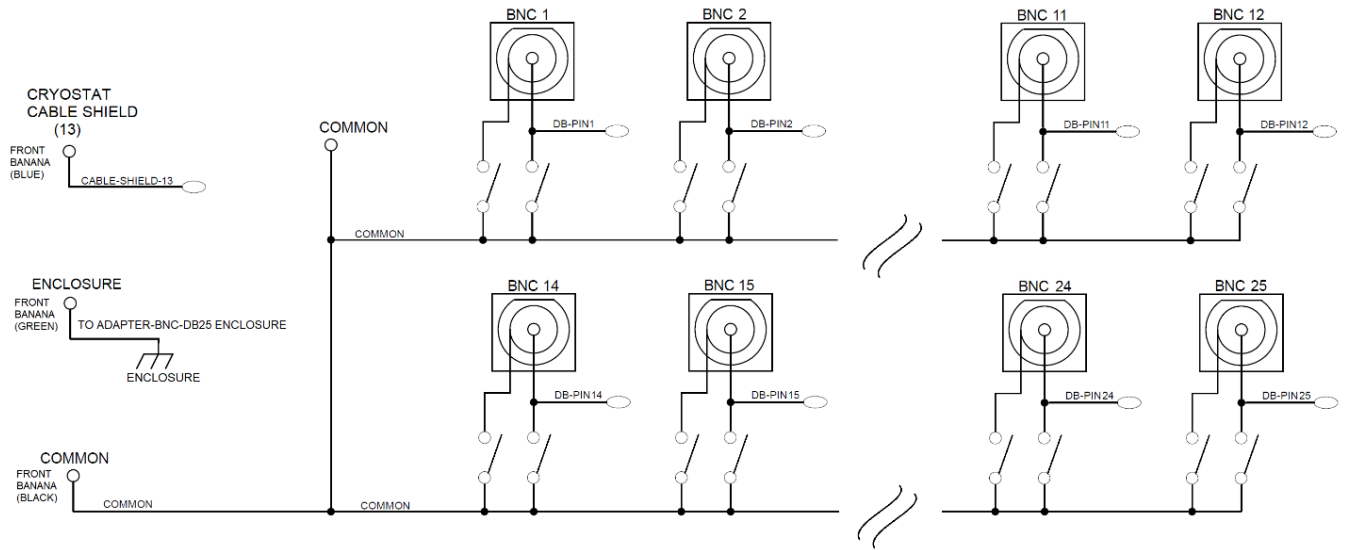
VS + CM + VM

Earth ground connected to measure common at the CM-10 shell for best noise performance, other measure module shells remain floating.

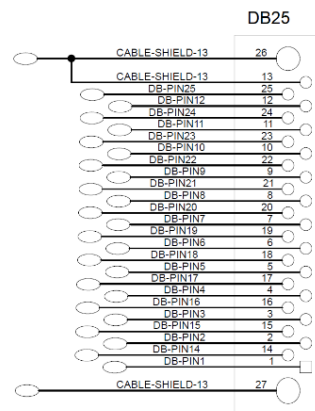
NOTE: Compare noise with fully floating configuration (no shell switches closed), case by case.



Breakout Box Schematic

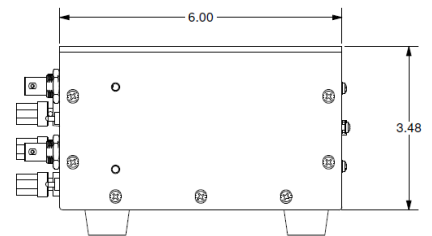
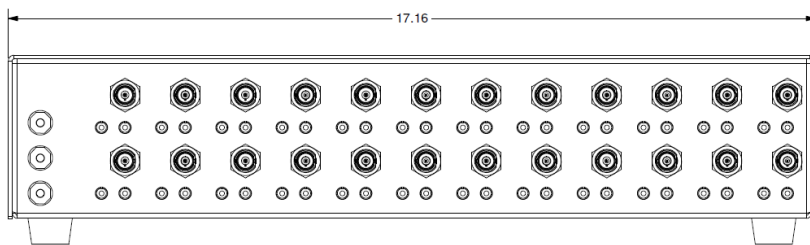


BNCs ISOLATED FROM ENCLOSURE



DB15 ISOLATED FROM ENCLOSURE

Dimensions



Lake Shore Technical Support

The Lake Shore Technical Support Department is staffed Monday through Friday between the hours of 8:00 a.m. and 5:00 p.m. EST, excluding holidays and company shut down days: <https://www.lakeshore.com/support/>.

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