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INSTRUCTION MANUAL

Modular System

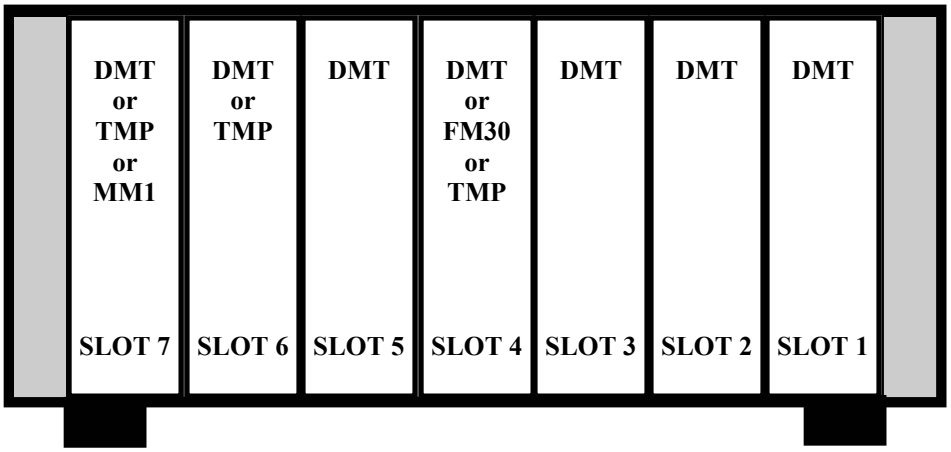
Measurement Systems
from
LION PRECISION

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Overview

The Lion Precision modular system consists of a 7 slot cabinet with an internal power supply for powering modules installed in the slots. Each slot is designed to utilize specific module choices. Normally, the system is ordered with a particular combination of modules and is shipped ready to run. If a module type is changed or moved to a different slot, changes may have to be made to the backplane PCB switches and jumpers.
The diagram below indicates the different modules that can be plugged into each slot:



Available Modules

DMT12 **DMT22**	Dual sensitivity probe driver modules (DMT12 - Bendix connector DMT22 – Lemo connector)
DMT10 **DMT20**	Single sensitivity probe driver modules (DMT10 - Bendix connector DMT20 – Lemo connector)
FM30	Peak capture and TIR module
TMP	Multichannel temperature monitor. Includes index and encoder input options for use with Lion Precision Spindle Error Analysis software
MM1	Digital meter module for monitoring output voltage of each slot. *Note: The MM1 requires 3 slot spaces!*

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M o d u l e s

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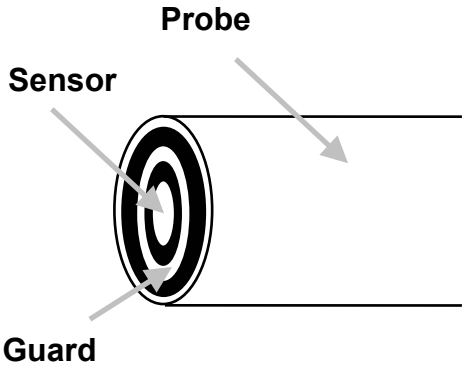
DMT Driver Modules

Introduction:

Lion Precision non-contact systems use *capacitance* gages. This means the measurement of the gap between the probe and its target is based on the capacitance between them. Capacitance is an electrical property of a gap between two conductors. The capacitance is dependent on two things:

1. The distance between probe and target
2. The material that fills the gap

Except in special calibrations, it is assumed the gap is filled with air. While air pressure and humidity do have a slight effect on this capacitance, it is negligible compared to any change in the size of the gap. That leaves the actual size of the gap as the only variable that effects the capacitance.



As the size of the gap changes, the change in capacitance is detected by a change in the electric field that is maintained between the probe and the target. This field is produced by the circular sensor in the center of the probe. The ring around the sensor is called a *guard* and is designed to keep the sensor's field focused on the target. *It is <u>not</u> ground*. The target area is about 30% larger than the area covered by a cylinder extended from the sensor.

The DMT Drivers are electronic modules used to drive Lion Precision's capacitance probes. The driver creates, controls, and monitors the electric field at the sensor. As the field changes, the Driver detects the change and produces an output voltage that is linearly proportional to the change in the gap. In the calibration process, the factory sets the sensitivity of this voltage change in volts/inch or volts/mm. The sensitivity of a particular calibration is listed on the calibration sheets that accompany every system. These sheets list the sensitivity as well as the frequency response and measurements taken throughout the range of the probe. The linearity of the calibration is calculated based on these measurements and listed on the calibration sheet. Copies of the original calibration sheets are available from the factory if the originals are lost.

Lion Precision recommends factory re-calibration once a year to maintain highest accuracy.

Target Size and Shape

The target area, the area that is *seen* by the probe, is about 30% larger than the area covered by a cylinder extended from the sensor.

For standard calibrations, the probe is calibrated to a flat surface larger than the tip size. Targets which are not flat or are not 30% larger than the tip of the sensor will have an error introduced.

Systems to measure smaller or non-flat targets can be specially calibrated for a particular type of target.

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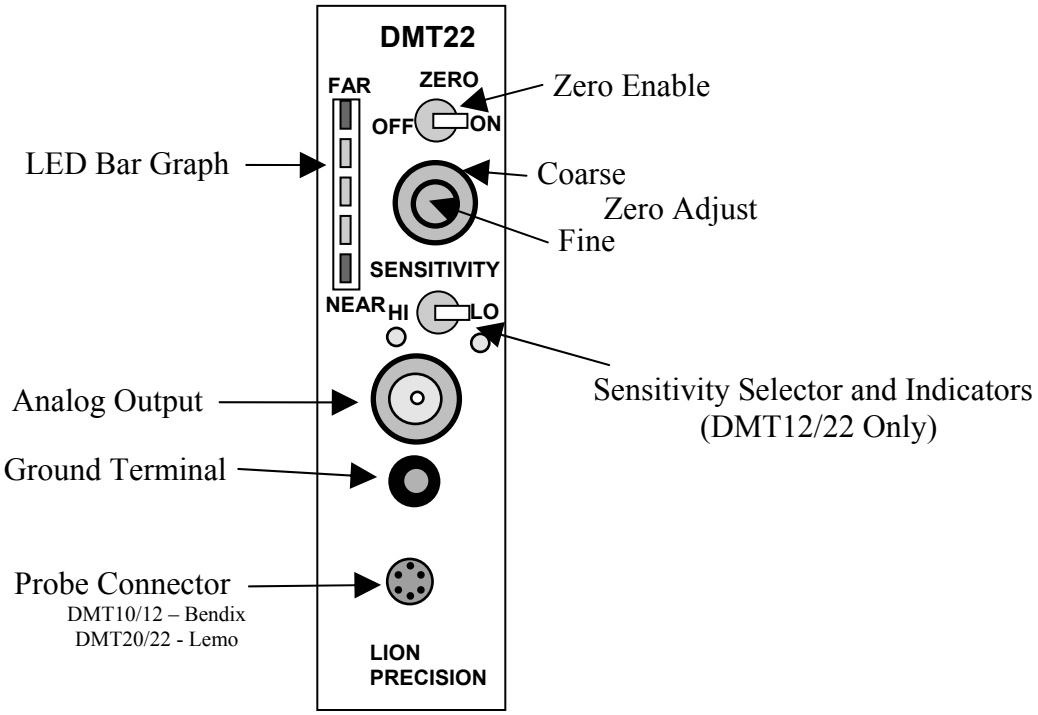
Contact the factory for details.

Features

The DMT Drivers features include:

- **Low noise output**
- **Selectable bandwidth**
- **Temperature stability**
- **2 user selectable sensitivities (DMT12 and DMT22 only)**
- **Zero Adjust Enable/Disable**
- **LED Bar Graph for easy probe setup**

Basic Operation

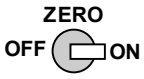


Zero Adjust



Used to adjust the analog output voltage after the probe is initially positioned. Typically the analog output voltage is adjusted to zero volts at nominal standoff (center of active range). There is a coarse adjustment, the outer control, and a fine adjustment, the inner control. When the factory calibrates the module both of these adjustments are at their mid position when the probe is at nominal standoff.

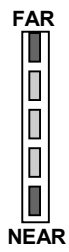
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Zero Enable

When in the off position, the zero adjust knob has no effect.

LED Bar Graph

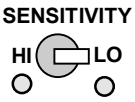


The LED Bar Graph is used to identify the *calibrated range* of the probe. Green LEDs indicate the probe is in its calibrated range and the output voltage is an accurate representation of the gap. Red LEDs indicate the probe is out of range and the output voltage is not valid. At nominal standoff (center of range), the module is calibrated to output 0 volts. The zero control allows the operator to adjust the output to 0 volts when the probe is not precisely positioned at its original standoff.

It is possible to position the probe toward the end of the calibrated range and adjust the output voltage to 0 volts. In this situation, the probe can go out of its calibrated range while the output voltage continues to appear valid. The output voltage may continue to change, but the output is no longer guaranteed to be accurate.

The bar graph is independent of the zero control. The center (green) LED corresponds to the center of the probe's calibrated range. The "FAR" (red) LED will light if the maximum gap is exceeded. The "NEAR" (red) LED will light if the minimum gap is exceeded. During initial probe positioning, turn on the module and position the probe until the center green LED is activated. To precisely position the probe at the center of the calibrated range, turn off the zero adjustment and monitor the output voltage. When the output voltage is 0 volts, the probe is at the same nominal gap at which it was calibrated. Regardless of zero adjustment, the output value is valid as long as the probe is in its calibrated range (green LEDs) and the output is does not exceed 12 volts.

Sensitivity Selector (DMT12/22 Only)



Selects the LO or HI sensitivity calibration. The DMT12/22 is calibrated with two completely different calibrations. Typically, the LO sensitivity calibration is for general measurement and the HI sensitivity is for higher resolution measurements. The HI sensitivity calibration will require the probe to be moved closer to the target and the total measurement range will be significantly reduced. The current sensitivity selection is indicated by the HI and LO LEDs. If the DMT12/22 is under computer control, the switch will have no effect and the LEDs will indicate the computer selected sensitivity.

Analog Output



Provides connection to the analog output voltage which is directly proportional to the distance between the sensing surface of the capacitance probe and the surface of the material being measured. This voltage is also available at the card edge connector pin 8. A typical output voltage range is ±10VDC. The specific ranges are listed on the accompanying calibration sheets.

Ground

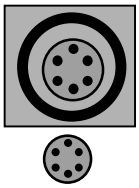


A banana plug type cable can be connected here for grounding the target. In most cases, separate grounding of the target is not necessary. If the target is completely isolated from ground by an insulator, grounding the target may be necessary.

Target grounding will usually reduce the noise in the output signal. When low noise operation is critical separate grounding is recommended even if the target is well grounded through another path.

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Probe Connector



DMT20/22 Driver modules use a Lemo type connector for connecting to the probe. Connect the probe by aligning the red dots on the connectors and inserting the probe connector. To disconnect, pull on the knurled barrel of the probe connector to release it. DO NOT pull on the cable.

DMT10/12, older model drivers, use a Bendix connector. When plugging a probe into the module be sure to align the key-way and then turn the outer shell clockwise until it locks into place.

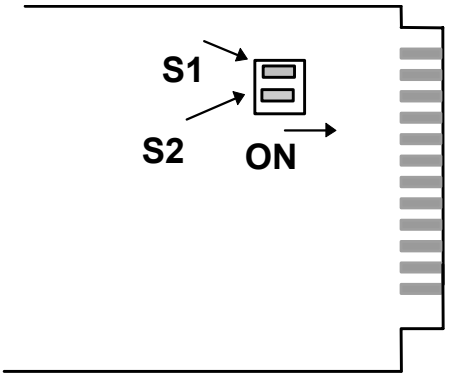
Bandwidth Settings

The DMT Driver Modules provide a 2 position dip switch for setting bandwidth. All other jumpers and dip switches are factory set and should not be changed since they will affect the calibration of the module. This dip switch is located as shown in the drawing. The following table shows the bandwidths available and their associated dip switch settings. The bandwidth listed on the accompanying calibration sheets is measured in the 20KHZ setting.

Bandwidths listed are approximate. Actual value depends on the probe being used and the calibration.

	S1	S2
20KHZ	OFF*	OFF*
10KHZ	ON	OFF
1KHZ	OFF	ON
100HZ	ON	ON

*Standard factory configuration



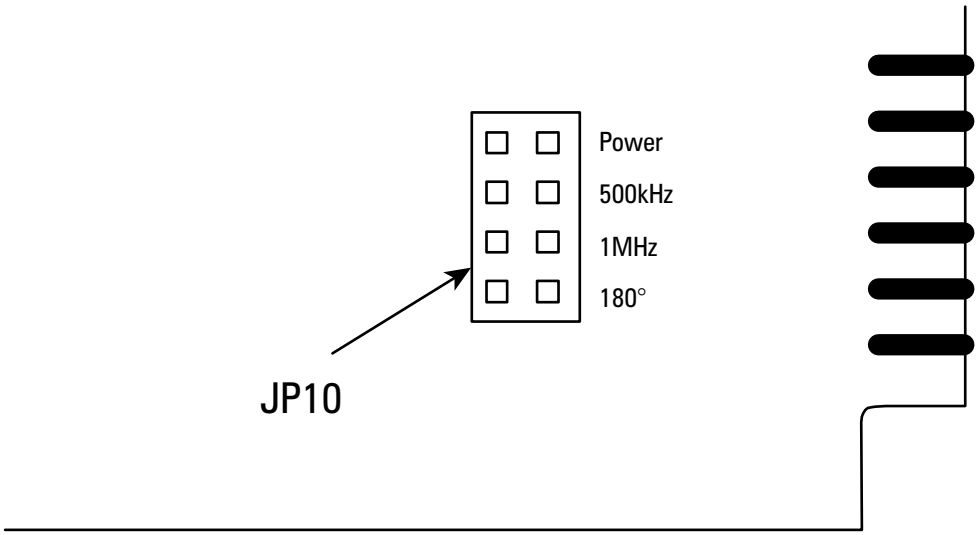
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Multiple Drivers (Master Slave Operation)

Multiple sensors with a common target require synchronization of the driver oscillators. One driver module is configured as a Master and the others as Slaves. Oscillator phase (normal or 180°) can be selected on each driver. When an even number of senors is used, performance is enhanced when half of the drivers are phased at 180° . When an odd number of sensors is used, there is no advantage to 180° phasing.

Use provided jumper straps to configure the oscillator. 1MHz/500kHz selection is an integral part of the original calibration and should not be changed.

Oscillator configuration JP10	
Pins	**Function**
Power	Jumper for Master, leave open for Slave
1MHz	Selects 1MHz frequency
500kHz	Selects 500kHz frequency
180°	Jumper for 180°, leave open for Normal



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Specifications

Power Requirements	±15 VDC ± 10% @ 130 mA each
Linearity Error	±0.3% Full Scale or better, dependent on calibration
Bandwidth	Static to 10KHz ±5% -3dB: 20 KHz Typical
Ranges	Dual; Selectable per calibration (DMT12/22 Only)
Meets ANSI/ASME B5.54 Standard	Yes
Probe Interchangeability	Yes, typical sensitivity variation 2% for same probe model
Operating Temperature	4°-66°C 40°-150°F
Thermal Stability	0.3% F.S.
Oscillator Frequency	Probe cable: < 12 feet - 1MHz, > 12 ft - 500KHz
Output Impedance	0Ω
Noise Output	6 mV p-p @ 10KHz B.W.

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FM30

Overview

The FM30 is a signal processing peak capture module. The FM30 takes the signal from slots 1 and 2 (A + B) and can output the sum or difference of the two channels. This type of function can be used to measure thickness, flatness and other dimensions requiring a two probe measurement. This signal source (A, B, or A+B) can be further processed through internal peak capture circuitry. The function options are as follows:

- DISP - Displacement - The unprocessed signal selected with the signal source switch.
- MIN - Minimum - The minimum peak of the selected signal source
- MAX - Maximum - The maximum peak of the selected signal source
- TIR - Total Indicated Reading - The difference between the minimum and maximum peak readings
- TRK TIR - Tracking Total Indicated Reading - The difference between the minimum and maximum peak readings except the peaks are allowed to slowly fall off. This allows for reading decreases in the TIR value without requiring a reset.

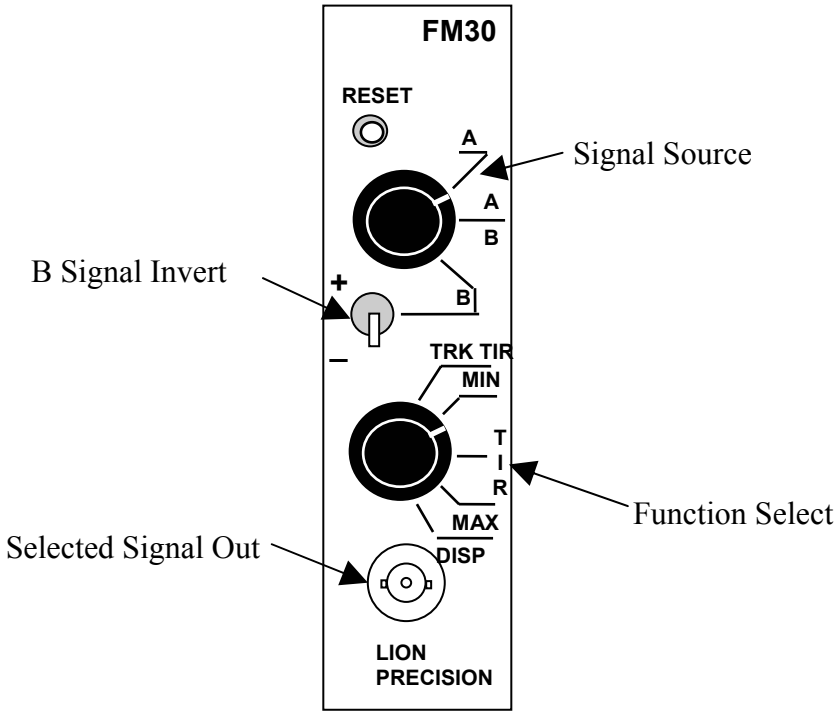
Features

The FM30 features include:

- **Sum/Difference Amplifier**
- **Max/Min Peak Capture (with Internal/External Reset)**
- **TIR (Total Indicated Reading)**
- **Tracking TIR**
- **Selectable bandwidth**

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Basic Operation



Signal Source

Selects one of the following signals to be processed and output from the FM30:

- A - Signal from slot 1
- B - Signal from slot 2 (can be inverted by B signal invert switch)
- A+B Sum - The sum of the signals from slot 1 and slot 2. Inverting B (slot 2) produces a difference of slot 1 and slot 2

B Signal Invert

This switch selects whether or not the signal from slot 2 is to be inverted. Inverting the slot 2 signal (B) during an A+B sum generates the difference between slot 1 and slot 2 outputs.

Function Select

This switch is used to select which of the signals is directed to the module's signal output pin (pin 8). This output is normally connected to an MM1 digital meter module. The description of each function is found above.

Selected Signal Out

This BNC is used to measure the selected signal out of the FM30.

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Filter Settings

The FM30 provides a selectable filter between the signal source selection and processing circuitry. A 4 position dip switch sets filter cutoff. When the module is removed from the system the dipswitch is found just behind the signal source selector switch. There are 4 filter options:

- Unfiltered - All switches off
- 1KHZ - Switch 1 ON
- 100HZ - Switch 2 ON
- 2HZ - Switch 3 ON

> If switch 4 is labeled EXTERNAL CONTROL, be sure this switch is off. The FM30 no longer supports external control and will not operate properly if this switch is on.

Specifications:

Channel A or B Output Error	±0.2%
Difference Error	±0.2%
Summing Error	±0.2%
Tracking TIR Error @ Frequency (Not recommended for use below 100Hz)	(4 Hz –30%) (10 Hz –15%) (20 Hz –5.0%) 100 Hz ±0.3% 1KHz ±1.5% 5KHz ±4.0% 10KHz ±4.0%
TIR Error @ Frequency	DC ± 0.3% 1KHz ±1.3% 5KHz ±4.0% 10KHz ±4.0%
Droop Rate	1mV/15sec (67µV/sec)
BNC Output Error	-3% Scaling Error

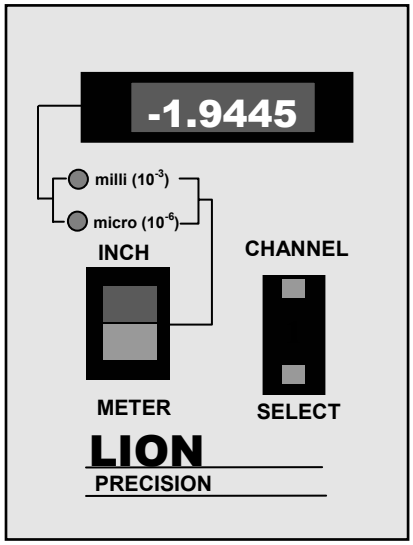
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MM1 Meter Module

Overview

The MM1 Meter Module is used for monitoring output voltages from the modules in the system. A thumbwheel selector switch selects the slot number to monitor. The MM1 can be calibrated with up to four calibrations for each slot. A calibration includes voltage scaling for the digital meter and decimal point selection. The DMT12/22 module has two selectable calibrations. When the selected calibration is changed, the MM1 automatically changes to a different meter calibration.
The MM1 includes an INCH/METER switch. When METER is selected a separate metric calibration is selected to scale the english calibrated output to metric voltages, giving a direct reading metric value. Each calibration will display in units of milli-inches, micro-inches, milli-meters, or micro-meters. The multiplier LEDs, along with the position of the INCH/METER switch, indicate the units of the display.
The MM1 Meter Module reading is accurate to within ±5 counts (LSD) of the meter reading.

Basic Operation



Inch/Meter

This switch selects the INCH or METER display/calibration. Specific display scaling is usually thousandths of an inch (milli-inch) or millimeters. The calibration sheets that accompany the system give specific data on the calibration of the system.

Channel Select Switch

This switch selects which of the slot outputs is being monitored. Slot 1 is the right most slot in the system. Pushing the top button will decrement the indicated slot number, the bottom button increments the slot number. Only 1-4 are valid slots. If another number is selected the meter input will be floating and the displayed number will be meaningless.

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Back Panel Connectors:

The modular system back panel provides a connector for direct connection to National Instruments E-Series boards/cards. The connector is designed for use with the Lion Precison Spindle Error Analyzer System. The following tables list the signals that may be useful for other users.

> Any connector pin not listed must be left unconnected! These connections control internal system functions; connecting to them could cause the system to malfunction.

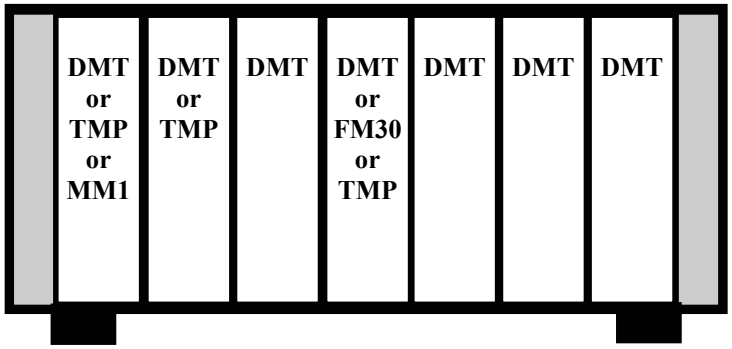
E-Series Data Acquisition Card Connections

	Pin	Name	Signal	Notes
Analog Signals	68 34	ACH0 ACH8	Slot 1 analog out Analog Ground	ACH8 becomes the (-) input in differential mode
	33 66	ACH1 ACH9	Slot 2 analog out Analog Ground	ACH9 becomes the (-) input in differential mode
	65 31	ACH2 ACH10	Slot 3 analog out Analog Ground	ACH10 becomes the (-) input in differential mode
	30 63	ACH3 ACH11	Slot 4 analog out Analog Ground	ACH11 becomes the (-) input in differential mode (for the FM30 this is the output after processing)
	28 61	ACH4 ACH12	Slot 5 analog out Analog Ground	ACH12 becomes the (-) input in differential mode
	62 26	ACH5 ACH13	Slot 6 analog out Analog Ground	ACH13 becomes the (-) input in differential mode
	25 58	ACH6 ACH14	Slot 7 analog out Analog Ground	ACH14 becomes the (-) input in differential mode (for the MM1, this is the selected channel's output as scaled for the panel meter)
	57 23	ACH7 ACH15	Out-Of-Range / Index Analog Ground	Monitors out-of-range conditions or reads Index Pulse input. (out-of-range is disabled when using Index pulse inputs)
Digital Signals	4	DGND	External Control Detect	When an E Series card is connected to the back panel, this line is pulled to ground which disables front panel Sensitivity switches on DMTs
	52	DIO-0	DMT Sensitivity	1 = LO, 0=HI All DMTs effected
	17	DIO-1	A0	Lines for addressing individual sensors on TMP1 temperature module
	49	DIO-2	A1	..
	47	DIO-3	A2	..
	19	DIO-4	A3	..
	4	DGND	Enable	
	11	PFI0/TRIG1	Encoder	
	16	DIO-6	Start	Must be high (1) to allow index pulses
	48	DIO-7	ACH7 Function Select	High (1) selects Index, Low (0) selects Out-Of-Range
	51	DIO-5	Encoder Enable	Must be low (0) to allow encoder pulses
	7,9,12, 13,15, 18,24, 27,29, 32,35, 36,39, 50,53, 56,59, 64,67	Ground		

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Configuring the Back Panel for New or Different Modules

The back panel PCB into which the modules are inserted uses jumpers and dip switches to configure each slot for the type of module to be used in that slot. When a system is shipped from the factory the jumpers and switches are set for the ordered configuration of the system and will only need to be changed if the module types are changed or new modules are added. Dip switches for empty slots are configured for DMT driver modules when shipped from the factory. Dip switches are only used on slots 4, 6, and 7. Slot 5 is configured for DMT drivers only. Slot 7 has two dip switches. Each dip switch is labeled as to which slot it configures.

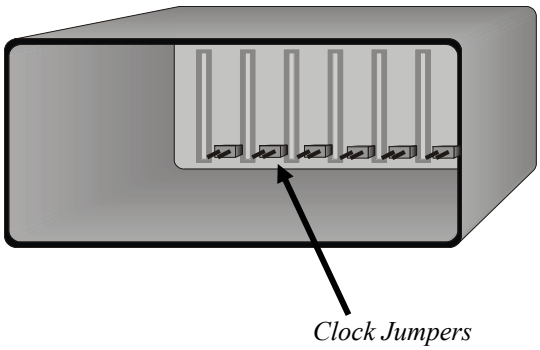


DIP Switch Settings

To configure the slot for a particular type of module, turn all dip switch positions to OFF. Then turn on only those switches that are labeled for the module that is being installed. (The FM30 module can only be used in slot 4. To configure slot 4 for FM30 all dip switches should be off).

Label	Type of Module
T	Temperature Module (TMPx)
M	MM1 Meter Module
D	DMT Driver Module

Clock Jumpers



On the *inside* of the system enclosure, toward the bottom of the backplane PCB are clock jumpers. These jumpers couple the master oscillator signal from the preceding slot to the current slot. **To prevent injection of clock frequency noise, these jumpers are left disconnected when there is no driver module in the slot**. If a driver module is added to a slot the clock jumper must be added (unless the new driver is not to be synchronized with existing drivers). These jumpers work in series. Driver modules must be in consecutive slots. If a slot is skipped it must have the clock jumper connected to couple the clock signal to the next slot.

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