DynAmp

LKAT^2 OEM

BI-DIRECTIONAL HIGH CURRENT MEASUREMENT SYSTEM with RECTIFIER PROTECTION FUNCTION

Installation, Operation and Service Manual

Manual Item No. 046264

Rev. C

DynAmp, LLC
3735 Gantz Road
Grove City, Ohio 43123 USA
Phone +1 614.871.6900
Fax +1 614.871.6910
www.dynamp.com
help@dynamp.com

This Page is Intentionally Blank

© 2016 DynAmp, LLC

DYNAMP, LLC WARRANTY

Items and components manufactured by Seller for permanent installation are warranted to be free from defects in material and workmanship for a period of two (2) years from the date of shipment.

Items and components manufactured by Seller for portable and temporary use in more than one location are warranted to be free from defects in material and workmanship for a period of eighteen (18) months from the date of shipment.

Items and components not manufactured and resold by Seller are warranted by their manufacturer.

Warranty repair shall be, at DynAmp's option, in the form of repair or replacement of the defective items or components. Concerning warranty repairs, DynAmp, LLC will be responsible for DynAmp provided time, material and transportation costs (shipping or travel). Actual method of warranty repair / correction will be determined by DynAmp, LLC at DynAmp's sole option. Such warranty repair shall constitute a fulfillment of all DynAmp, LLC liabilities in respect to said items and components. In no event shall DynAmp, LLC be liable for consequential damages.

Information in this document is subject to change without notice.

© 2014, 2016 DynAmp, LLC. All rights reserved.

Reproduction in any manner whatsoever for purposes other than installation, operation, or service by the purchaser or end user without the written permission of DynAmp, LLC is strictly forbidden.

This manual is part of the complete set of product documentation that includes installation, operation, and service instructions, drawings and test results. Users should evaluate the information in the context of the complete set of product documentation and their particular applications. DynAmp, LLC assumes no liability for any incidental, indirect, or consequential damages arising from the use of this documentation.

While all information presented is believed to be reliable and in accordance with accepted engineering practices, DynAmp,LLC makes no warranties as to the completeness of the information.

All trademarks used in association with LKAT^2 are trademarks of DynAmp, LLC.

This Page is Intentionally Blank

TABLE OF CONTENTS

DYNAMP, LLC WARRANTY III

HAZARD WARNING! VII

SAFETY VIII

DYNAMP, LLC CUSTOMER SUPPORT & SERVICE ASSISTANCE IX

MANUAL REVISIONS XI

1. HANDLING AND STORAGE 1

2. PRODUCT DESCRIPTION 3

2.1 SYSTEM OVERVIEW 3
2.2 ADDITIONAL MEASURING HEAD DETAIL 5
2.3 ADDITIONAL METERING UNIT DETAIL 5
2.4 ADDITIONAL INDICATOR AND OUTPUT DETAIL 6
2.5 INTERCONNECTION CABLE DETAIL 6

3. SPECIFICATIONS 7

4. INSTALLATION 11

4.1 HANDLING PRECAUTIONS 11
4.2 INSTALLATION CONSIDERATIONS 11
4.3 OFF-BUS FUNCTIONAL CHECK (Optional) 12
4.4 MEASURING HEAD INSTALLATION 12
4.5 METERING UNIT INSTALLATION 13
4.6 SYSTEM CHECKOUT 14

5. THEORY OF OPERATION 15

5.1 GENERAL 17
5.2 OLOP TECHNOLOGY 17
5.3 SYSTEM FUNCTIONAL DESCRIPTION 18
5.4 LKAT^2 METERING UNIT 19
5.5 LKAT^2 MEASURING HEAD INTERCHANGEABILITY 19
5.6 TROUBLESHOOTING AN ACCURACY DIAGNOSTICS FAULT INDICATION 19
5.7 SYSTEM CALIBRATION OVERVIEW 20
5.8 CALIBRATION ADJUSTMENTS 21
5.9 FIELD CONFIGURATION OF TRIP SETPOINTS 22
5.10 EARTH GROUNDING 24
5.11 THE TERM “FAILSAFE” 26
5.12 NON-FAILSAFE CONFIGURATION 26
5.13 CONFIGURING THE LOW PASS FILTER 26

6. MAINTENANCE & SPARE PARTS 27

6.1 PERIODIC MAINTENANCE 27
6.2 ANNUAL MAINTENANCE 27
6.3 SPARE PARTS 28

7. DRAWINGS 29

© 2016 DynAmp, LLC

FIGURES, FORMS & TABLES

Figure # Title	Page
Figure 3.1 LKAT^2 Frequency Response	9
Form 1 LKAT2 Diagnostic Measurements Form 1 – Zero Primary Current	15
Form 2 LKAT2 Diagnostic Measurements Form 2 – Energized Primary Bus	16
Figure 5.1 Block Diagram of the LKAT^2 System	18
Figure 5.2 Metering Unit Earth Ground Connections	25
Table 2.1 Main and PE PC Board Assembly Features	6
Table 3.1 LKAT^2 System Specifications (subject to change without notice)	7
Table 5.1 Troubleshooting an Accuracy Diagnostics Fault Indication	20
Table 5.2 Trip Configuration Details	23
Table 5.3 Low Pass Filter Switch Settings	26
Table 6.1 Spare Parts List	28
Table 7.1 Drawing List	29

© 2016 DynAmp, LLC

HAZARD WARNING!



GENERAL

All installation, maintenance and service must be performed by qualified technicians who are familiar with the warnings and instructions of this manual.

Use of the equipment in a manner not specified by the manufacturer can impair the protection provided within.

The cover must remain secured at all times during operation to ensure safety of personnel. The cover may be opened using a screwdriver; however, only authorized personnel or technicians should be allowed to open and service the unit.

Disconnect power to the system before servicing or replacing fuses.

DynAmp, LLC does not assume liability for the customer's failure to comply with the rules and requirements provided in this manual.



HAZARDOUS VOLTAGE

This equipment is designed to be connected to hazardous electric voltages. Ignoring the installation precautions and warnings can result in severe personal injury or equipment damage.

To avoid the risk of electrical shock or fire, the safety instructions and guidelines in this manual must be followed. The electrical specifications must not be exceeded and the unit must be installed according to directions provided.



INSTALLATION

This equipment is intended for indoor use. It should be mounted in a well-ventilated area, away from high heat, dust, and corrosive atmosphere. The ambient temperature must not exceed specified limits.

For mounting considerations that fall outside the recommended specifications provided in this manual, the factory should be contacted for approval.

This unit is rated for installation category III and pollution degree 2.

Symbol Identification:

General definitions of safety symbols used on equipment and manual.



Caution/Warning: Refer to accompanying documents for instructions.

© 2016 DynAmp, LLC

SAFETY

The Measuring Head is designed to be installed on high voltage bus bars. All interconnection cables must be safely routed away from bus bars and high voltages. Do not allow any interconnection cable to contact bus bars or high voltages.

Ignoring the installation precautions and warnings can result in severe personal injury or equipment damage. The following are general guidelines to be followed during installation, operation and service of the Metering Unit and Measuring Head.

- All installation, maintenance and service must be performed by qualified technicians who are familiar with the warnings and instructions of this manual.
- Always follow all local and plant safety procedures.
- The cover must remain secured during operation to ensure safety of personnel. Only authorized personnel or technicians should be allowed to open and service the unit.
- Units are not intrinsically safe. Do not place in explosive atmospheres.
- Disconnect power to the system before replacing fuses. Failure to follow these instructions may result in intermittent operation and premature failure and will void the warranty. Replace fuse with correct type, size and value. Refer to the servicing instructions or spare parts list for more information on replacement fuses. Do not bypass the fuses or modify the electronics.
- Service must be performed by qualified technicians only. If use of an oscilloscope becomes necessary during servicing, the scope must be floating and ungrounded or differential probe(s) must be used. The Metering Unit is isolated from the mains via the power transformers. If a grounded scope is used, a hazardous condition is created since current will flow through the probe to ground.
- Use of the equipment in a manner not specified by the manufacturer can impair the protection provided within.
- If a binding screw is used for the mains earth connection, the binding screw must be size M4 (No. 6) or larger.

DynAmp, LLC does not assume liability for the customer’s failure to comply with the rules and requirements provided in this manual.

© 2016 DynAmp, LLC

DYNAMP, LLC CUSTOMER SUPPORT & SERVICE ASSISTANCE

For further assistance, contact DynAmp Customer Support at:

Americas:

Telephone: +1 614.871.6900 Fax: +1 614.871.6910
8:00 AM to 5:00 PM USA Eastern Time
From first Sunday in November to second Sunday in March – 13:00 GMT to 22:00 GMT
From second Sunday in March to first Sunday in November – 12:00 GMT to 21:00 GMT

After Hours Critical Service Emergency:

Telephone: +1 614.871.6906
5:00 PM to 8:00 AM USA Eastern Time
From first Sunday in November to second Sunday in March – 22:00 GMT to 13:00 GMT
From second Sunday in March to first Sunday in November – 21:00 GMT to 12:00 GMT

Central e-mail:

help@dynamp.com

DynAmp web:

www.dynamp.com

© 2016 DynAmp, LLC

This Page is Intentionally Blank

© 2016 DynAmp, LLC

MANUAL REVISIONS

Page	Change	Reason For Revision	Date
all	Rev NEW		03/14
All	A	CAR 10190 – Refine manual	07/14
29	B	ECR 1951 – Update drawing list (size)	10/14
15,16	C	ECR 2029 – Detail added to Form 1 & 2 showing pin numbers	09/16

© 2016 DynAmp, LLC

This Page is Intentionally Blank

© 2016 DynAmp, LLC

1. HANDLING AND STORAGE

DynAmp products are engineered and manufactured for use in industrial environments. However, they contain sensitive electronic and mechanical components which may be damaged and fail if not handled and stored properly. All products must be handled and stored with the same care as any precision measurement instrument. Severe bumps or jolts may damage internal parts and cause malfunction or premature failure. DynAmp products are designed and assembled with conformal coating, shock mounting, and environmental seals, when appropriate or when specified. However, this protection requires that the product must be properly installed and operational before the protection is fully functional. Therefore, adequate protection from humidity, shock, and temperature must be provided during handling and storage prior to installation.

The handling and storage of equipment must be sufficient to meet the storage temperature and humidity specifications of the product and to prevent any condensation or contact with water or any other liquid. The storage location and container or crate must provide adequate protection from precipitation (rain, snow, ice) and direct water contact. Adequate shelter must be provided to prevent the accumulation of precipitation (rain, snow, ice) and water which can lead to the deterioration or failure of shipping containers or crates and cause water ingress. Storage in coastal or industrial areas subject to salt-laden or corrosive air or areas of wind-driven sand or other abrasive dust must be adequate to prevent the deterioration or failure of shipping containers or crates and cause ingress. Frequent inspection of storage areas and storage containers or crates is required to ensure proper storage conditions are being maintained.

If the shipping container or crate is opened and/or the equipment is removed for inspection prior to installation, the equipment must be repackaged in the original undamaged container or crate in the same manner as it was shipped to prevent environmental damage or placed in a storage location that meets the required environmental and storage conditions.

General product storage temperature and humidity requirements:

Storage Temperature:	-40°C to 70°C
	-40°F to 158°F
Storage Humidity:	Maximum 85%, non-condensing

DynAmp, LLC does not assume liability for the customer’s failure to comply with handling and storage requirements.

For further assistance, contact DynAmp customer support.

© 2016 DynAmp, LLC

This Page is Intentionally Blank

© 2016 DynAmp, LLC

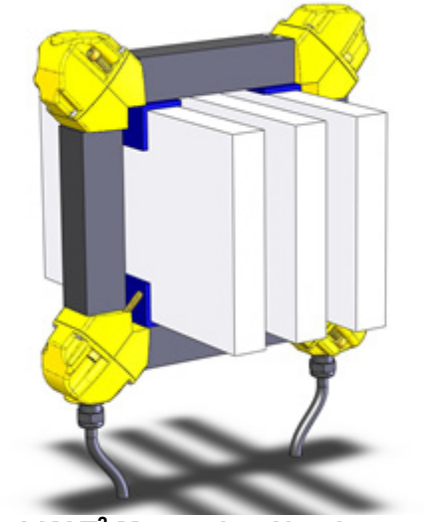
2. PRODUCT DESCRIPTION

2.1 SYSTEM OVERVIEW

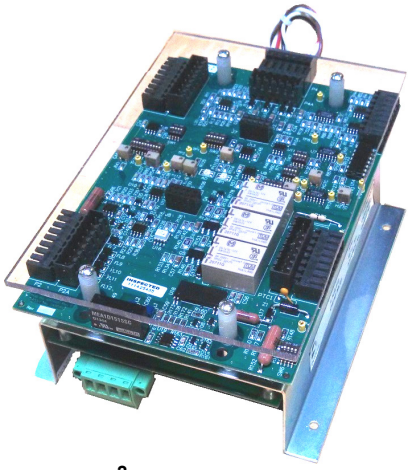
The LKAT^2 combines accurate high current measurement with reverse and overcurrent protection in a single rugged and cost effective system.

The next generation of DynAmp's well proven OLOP^{TM} technology, LKAT^2 offers a new level of accuracy and stability to accurately and reliably measure uni- and bi-directional DC as well as AC bus currents.

The LKAT^2 is particularly well suited to measure power rectifier outputs for control and protection purposes in electro-chemical processes such aluminum, chlorine, copper, manganese, titanium, zinc, electroplating, etc.



LKAT^2 Measuring Head



LKAT^2 OEM Metering Unit

KEY STANDARD FEATURES

True bi-directional performance. Ideal for difficult magnetic applications. No head position or bus analysis needed.

Extremely compact with excellent environmental specifications for installation flexibility, inside or outside.

Multiple, standard switch selectable measurement output signals including mA, mV and V.

Standard Accuracy Diagnostics "AD" continuously monitors system performance providing both local LED and relay contact output. Optional LKAT^2 Protection Extensions, (PE), provides additional functionality for protecting high current rectifiers.

Standard Alarm provides reverse or over-current protection via an LED viewable at the metering electronics and a dry contact relay output.

© 2016 DynAmp, LLC

Each standard LKAT^2 is delivered with the following

- A new, ruggedized two-piece Measuring Head with integrated mounting hardware and bus bar corner (fiberglass angles). Each head half has its own cable for connection to the metering electronics.
- Very compact Metering Electronics with one analog measurement output, one Accuracy Diagnostics system status output and one configurable Alarm output for overcurrent or reverse current protection.
- Comprehensive Users Manual
- Factory calibration data and graphs
- 2-year warranty for permanent installed systems
- Packaging suitable for air /ground transport

AVAILABLE OPTIONS

• Protection Extensions (PE)

The PE option adds additional functionality for protecting high current rectifiers. This option is either factory configured with a new system or can be added to LKAT^2 Systems already in the field. If added in the field, some field configuration may be required.

Second Freely Scalable Analog Output :

This second analog output is independently scaled and fully isolated from the standard LKAT^2 measurement output. In typical applications, it is scaled to provide accurate measurement above the standard rectifier operating range for advanced protection purposes. For example, the primary LKAT^2 output may be scaled to 50kA to provide the highest degree of accuracy and resolution for normal rectifier control. The second PE output may be scaled to 75kA to provide the information to intelligently manage overcurrent situations. Using this signal, the rectifier control system could integrate overcurrent operation to allow 5 minutes at 110%, 1 minute at 120%, 10 sec at 140%.

Two Additional Protection Relays :

These relays bring total number of configurable relays to three. Each can be configured to provide reverse or various degrees of overcurrent protection. Like the standard alarm, these two additional PE alarms come with their own, independent local LED indication and relay outputs.

• Digital current display (3 1/2 digit)

This option is mounted behind the clear front door of the metering electronics enclosure to display either DC or RMS AC bus current locally. Please note that this option reduces the maximum metering electronics ambient temperature to 50ºC. This option can also be added to LKAT^2 Systems already in the field.

• Optional low voltage DC mains

This allows system to be powered by safety mains supplies or even batteries. This option must be specified at time of order and cannot be retrofitted to existing units.

© 2016 DynAmp, LLC

AVAILABLE ACCESSORIES

- **Summing / Totalizing multiple LKAT systems**

A dedicated external module is available for totalizing/ summing up to 10 LKAT measurement signals. This is typically used to provide a true 'total' current signal when multiple rectifiers (with individual LKAT systems) are connected in parallel to provide a higher total current.

- **LKAT-MUT Functional Tester**

This hand-held test set allows users to verify system operation and scaling as well as test relay trip points and output signals in the field.

- **Extended Warranty**

For permanently installed systems, the standard 2-year warranty can be extended in 2-year increments. This must be ordered less than 6 months after the original LKAT system is shipped.

2.2 ADDITIONAL MEASURING HEAD DETAIL

LKAT^2 Measuring Heads contain an arrangement of Hall Effect sensor ICs and signal conditioning electronics. The tubular enclosure is constructed of flame retardant plastic with an internal aluminum frame. Insulation from the bus is provided by the homogeneous (sealed) construction of the head. In the event that the head enclosure components become cracked, the bonding fails, or the weather-tight seal is broken in any way, a replacement head must be substituted. The Measuring Head is not designed to be repaired.

LKAT^2 Measuring Heads are mounted on the bus bar using fiberglass angles positioned on the corners of the bus bar and stainless steel bus bar mounting screws threaded into the Measuring Head structure. Mounting hardware is supplied with each system. These screws are adjusted to bus dimensions specified with each order. When properly installed, the mounting hardware maintains the position of the Measuring Head in the event of temperature fluctuation and / or bus vibration.

An interconnection cable assembly is integral to each half of the Measuring Head. Measuring Heads with extra-long interconnection cables are also available - consult the factory for details. Standard Measuring Head cable assemblies are terminated with keyed connectors to ensure correct hookup. The interconnection cables from the Measuring Head are identified as "A" and "B". Connecting head cable "A" to Metering Unit "B" will not result in damage to the head or electronics, but may degrade the calibration accuracy of the system.

2.3 ADDITIONAL METERING UNIT DETAIL

The LKAT^2 OEM metering unit is supplied without an enclosure. The Plexiglas PC board cover must be installed during normal operation.

The main PC board assembly (and PE PC board assembly, if specified) includes receptacles for external connection to the Measuring Head, the Metering Unit measurement signal(s) and relay outputs, and the input of mains power. When properly mated with the associated cable assembly, these connections are also environmentally protected.

Internally, all LKAT^2 Metering Units include both a Power Supply pc board and a Main pc board. These PC boards are mounted to a steel chassis which is then mounted on a steel panel. The Metering Unit pc board cover allows the user to view various LED (or LCD) status indicators. For more information, refer to the "Theory of Operation" section of this manual.

© 2016 DynAmp, LLC

There are two optional pc board assemblies that may be added onto the Main pc board in the LKAT^2 Metering Unit:

- The Protection Extensions (PE) pc board assembly
- The Display pc board assembly.

One or both of these pc board assemblies may be added to an LKAT^2 Metering Unit in the field. It is not mandatory that they be factory installed and/or calibrated. The optional pc board assemblies may be calibrated on site, using the LKAT^2 Main Output as the reference measurement.

2.4 ADDITIONAL INDICATOR AND OUTPUT DETAIL

As noted on the specifications page, The LKAT^2 System Metering Unit includes several visual indicators. These include:

- Accuracy Diagnostics (operational status) LEDs: green = OK, red = system problem (see Section - “Theory of Operation”).
- Over / Reverse Current Trip status LEDs: green = measured current does not exceed the setpoint, red = measured current exceeds the setpoint.
- (Optional) Illuminated LCD digital display of measured current.

Available via the Metering Unit output cable:

- Isolated signal output proportional to bus current being measured. This output may be configured for various zero and full-scale values.
- Normally open and normally closed relay contacts indicate operational status (same as green and red LEDs).
- Normally open and normally closed relay contacts indicate over / reverse current trip status (same as green and red LEDs)..

The table below lists the features associated with the Main and PE pc board assemblies.

Table 2.1
Main and PE PC Board Assembly Features

	Main PC Board Assembly	with PE PC Board Assembly
Isolated Output	1	+1 for 2 total
Operational Status LEDs & Relay Contacts	1	+0 for 1 total
Overcurrent / Reverse Trip Status LEDs & Relay Contacts	1	+2 for 3 total

Checking field calibration of LKAT^2 Systems requires use of a reference current transducer with calibration accuracy of 0.1% full-scale or better. Contact DynAmp, LLC for calibration of the LKAT^2 System. Refer to “Maintenance and Spare Parts” section for more information.

2.5 INTERCONNECTION CABLE DETAIL

The LKAT^2 OEM System is not supplied with cable assemblies for power input and System output signal(s). The user must supply these cable assemblies. Refer to the System wiring diagram for details about interconnection.

© 2016 DynAmp, LLC

3. SPECIFICATIONS

Table 3.1
LKAT^2 System Specifications (subject to change without notice)

MAIN ANALOG SIGNAL OUTPUT	
Main Output Full-Scale Measuring Range	±5kA to ±150kA *(Contact factory for full-scale measuring ranges > 100kA)*
Signal Output Type (configurable) mA output max. burden : 10V mA output max. loop/load resistance : 500Ω V output min. load resistance : 100kΩ	**Zero kA** **± Full-scale kA** 0mA ±20mA max. 4mA +20 & -12mA 0V ±1V 0.2V -0.6V to +1V 0V ±10V 2V -6V to +10V
Signal Output Calibration Accuracy *	±0.25% full-scale
Linearity Error *	±0.1% of full-scale
Repeatability Error Limits *	±0.1% of full-scale
Response Time (t_d) *	≤ 50 μs
di/dt Accurately Followed *	500 A/μs
Frequency Response *	Switch selectable low-pass filter : No filter / 330hz / 660hz (refer to Figure 3.1 for additional info.)
Temperature Sensitivity	±50ppm/°C or better
Mains Voltage Sensitivity	±0.001%/V
* At DynAmp reference conditions : Ambient 25°C ± 2°C (77°F ± 4°F) / Mains 120/240V AC RMS, 60Hz ± 1Hz	
MAIN STATUS INDICATORS	
Accuracy Diagnostics	Indicates LKAT^2 System proper operation or operational problem
Accuracy Diagnostics Status LEDs	Green LED indicates proper operation Red LED indicates operational problem
Accuracy Diagnostics Status Relay Function	Relay coil de-energizes when operational problem detected or mains power lost.
Over / Reverse Current Trip Setpoint Qty. (1)	Factory/field configurable to trip on either over current (+5…+100% of full-scale) or reverse current (-5%...-100% of full-scale). Setpoint accuracy ±2%
Over / Reverse Current Status LEDs	Green indicates operation OK – No Trip Red indicates measured current exceeds Trip Setpoint
Over / Reverse Current Status Relay	Relay coil de-energizes when measured current exceeds Trip Setpoint or mains power lost.
All Relay Function	Form C : Normally Open and Normally Closed Contacts (non-latching)
All Relay Contact Ratings	120/250 VAC : 8A 30 VDC : 8A Relay response time 10mS typical

© 2016 DynAmp, LLC

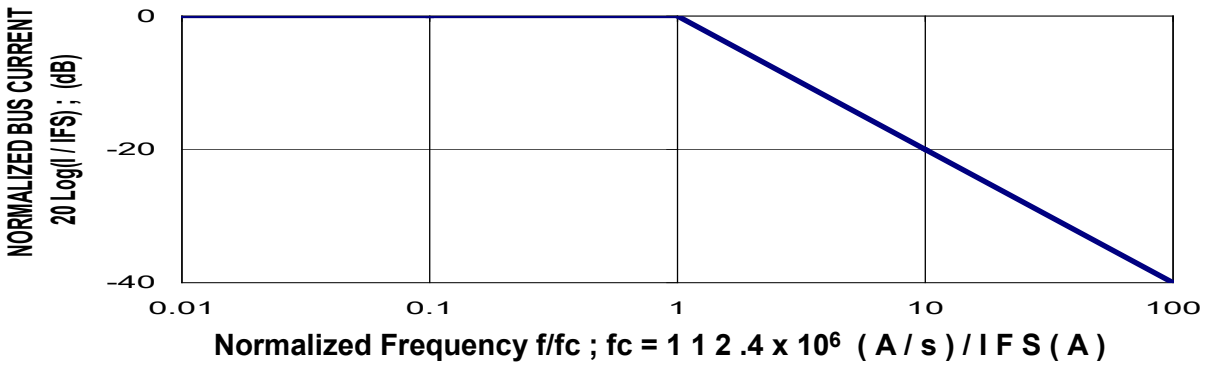
OPTIONAL PROTECTION EXTENSIONS (PE)	
PE Full Scale Measuring Range *(scaled independently and isolated from main output)*	±5kA to ±200kA *(Contact factory for full-scale measuring ranges > 100kA)*
PE analog output configuration and performance specifications	Same as Main output above with all configuration and scaling independent from main output
PE Over / Reverse Current Trip Setpoints -Qty. (2) - Field configurable	Function and specification same as Main Over / Reverse above with independent LEDs, configurations, scalings and outputs
OPTIONAL DISPLAY	
Digital Display of Bus Current in kA units	3 ½ Digit Green LCD ±2% Full-scale
Displayed Value (configurable)	DC or True RMS
NOTE: *Optional display reduces maximum ambient temperature of metering unit to 50°C*	
GENERAL	
Input Power *(any voltage within the specified range can be connected without any wiring changes)*	85 to 264Vac @ 47 to 440Hz / 110 to 264Vdc.
Burden on Mains (max)	30 VA
Working Voltage: Signal Output to Metering Unit Low Voltage Circuit	450Vrms
Working Voltage: Bus to Metering Unit Low Voltage Circuit	1500Vdc
Working Voltage: Mains Supply to Metering Unit Low Voltage Circuit	264Vrms
Working Voltage: Mains Supply to chassis	264Vrms
Working Voltage: Output to chassis	450Vrms
Isolation : Head surface to signal outputs	6000Vrms for 1 minute
Isolation : Mains supply to signal outputs	1000Vrms for 1 minute
Isolation : Mains or signal output to chassis	2000Vrms for 1minute
Installation Category	III
Pollution Degree	2
ENVIRONMENTAL	
Operating Ambient Temperature Range of Metering Unit Location	-10°C to 60°C (14°F to 140°F)
Operating Ambient Temperature Range of Measuring Head	-20°C to 80°C (-4°F to 176°F)
Environmental rating: Measuring Head and cable connection at Head	IP65
Environmental rating: Metering Unit and cable connection at Metering Unit	IP10

© 2016 DynAmp, LLC

PHYSICAL	
Measuring Head Weight	Typically 1 to 6 kg (3 to 13lbs.)
Metering Unit Weight (Typical)	Typically 1kg (3lbs.)
Standard Length Head Connection Cables (2) Optional custom lengths may be available up to 50m (164 ft.)	10m (33 ft.) Cable fixed to Measuring Head
Standard Length Signal Output Cable (1) Optional custom lengths are available	Not supplied with OEM System
Standard Length Power Input Cable (1) Custom lengths are available	Not supplied with OEM System

Figure 3.1
LKAT^2 Frequency Response

Normalized LKAT Bandwidth



F.S. Bus Current (kA)	5 to 50	60	70	80	90	100
Corner Frequency (kHz)	2.248	1.873	1.606	1.405	1.249	1.124

© 2016 DynAmp, LLC

This Page is Intentionally Blank

© 2016 DynAmp, LLC

4. INSTALLATION

4.1 HANDLING PRECAUTIONS

LKAT^2 Systems should be handled with the same care as any precision measuring instrument. Severe jolts or bumps to the Measuring Head or Metering Unit may cause movement of internal parts, and possibly a malfunction. **Personnel involved in the installation should be familiar with the technical terms, warnings, and instructions in this manual, and all plant safety rules, and be able to follow these.**

The complete system should be inspected for shipping damage at the earliest opportunity. Visible damage must be reported to the carrier immediately. Concealed damage (not evident until the system is operated) must be reported to DynAmp, LLC immediately.

4.2 INSTALLATION CONSIDERATIONS

Read the following before mounting the head:

1. The Measuring Head is designed to be installed on high voltage bus bars. All interconnection cables must be safely routed away from bus bars and high voltages. Do not allow any interconnection cable to contact bus bars or high voltages. Ignoring the installation precautions and warnings can result in severe personal injury or equipment damage.
2. Always follow all local and plant safety procedures when the unit is to be installed on a live bus.
3. Choose a mounting location for the head where the ambient air temperature does not exceed the specified temperature limits. The LKAT^2 Measuring Head may be located indoors or outdoors, but should be kept away from extreme heat and solvents. Head installations in direct sunlight are not recommended, as excessive temperature rise could result in measurement error or damage to the head enclosure. If the head is to be installed in an especially harsh environment, please contact the factory to discuss special requirements.
4. No part of the head or Metering Unit should be submerged under water.
5. The head must be installed with proper polarity. An arrow indicates the direction that conventional bus current must flow through the aperture (+) to (-). No damage will occur if the head is reversed, but the system output will indicate current flow in the reverse direction.
6. Measuring Heads are shipped in matched halves. Make sure that the same serial number is present on the both halves of the Measuring Head and the Metering Unit. The two head halves should mate squarely and evenly without forcing or twisting.
7. The Measuring Head is not grounded; however, the head cables should be disconnected from the Metering Unit prior to installation or maintenance to minimize the possibility of electrical shock. When properly connected, the power input cable will ground the LKAT^2 Metering Unit chassis and panel. Refer to drawings at the end of this manual and connection detail in “Earth Grounding”.
8. Measuring Heads are shipped with mounting hardware. The mounting screws may require adjustment for appropriate position and holding force on the bus. Refer to Outline & Mounting – LKAT^2 Measuring Head drawing.

© 2016 DynAmp, LLC

Whenever possible, the head should be installed on the longest straight run of the bus that is available in an area free of other bus structures. The status accuracy diagnostics LEDs and relay contacts indicate proper operation in a given head location.

4.3 OFF-BUS FUNCTIONAL CHECK (OPTIONAL)

After unpacking the LKAT^2 System (but prior to installation), the following functional check of the system is recommended:

1. Locate a convenient temporary power source for the LKAT^2 System. This may or may not be in the location where the system will be installed. The power source must be in the range 85 to 264Vac @ 47 to 440Hz, or 110 to 264Vdc. The system draws a maximum of 30 volt-amperes.
2. Refer to the drawing "Wiring Diagram, LKAT^2 System" included at the end of this manual. Attach a suitable connector to the unterminated end of the input power cable assembly for connection to the power source to be used for this check.
3. Connect the Measuring Head cables A & B to the Metering Unit.
4. Connect the power input cable assembly to the Metering Unit and energize the unit.
5. Observe the LEDs on the Main pc board assembly. If the LEDs light green, the system is functioning properly. If LED (Accuracy Diagnostics "AD") lights red, skip to "Troubleshooting an Accuracy Diagnostics Fault Indication" in the "Theory of Operation" section of this manual. If LED (Trip 1) lights red, make measurements and complete the form "LKAT^2 Diagnostic Measurements Form – Zero Primary Current" and contact the factory.

Refer to Form 1 – Zero Primary Current. Allow the system one hour to stabilize prior to making measurements. Make measurements and record data shown on the form. File the completed test form for future reference. It is OK to make these measurements away from location where the LKAT^2 System will be installed, but this should be noted on the form.

4.4 MEASURING HEAD INSTALLATION

The head halves are mated together around the bus. The Measuring Head is comprised of two "L" shaped halves. Each half is identified with a serial number which must match followed by an "A" or "B". One interconnection cable exits from each corner box on each half. The two halves are held together by four locking screws which are installed after the head is securely positioned around the bus bar.

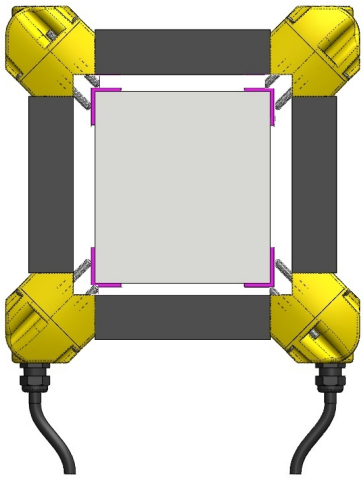
When the Measuring Head is installed on a running ("horizontal") bus, the head interconnection cable assemblies should exit the corner enclosures on bottom side of the bus bar. This reduces chances of ingress by pollutants and minimizes heating of the head electronics by the bus.

For rising ("vertical") busses, the head interconnection cables may be located on any side of the bus, depending on mechanical and thermal considerations. Avoid mounting boxes above vertical bus. The head should be mounted so conventional (+) to (-) current flows in the direction of the arrow on the Measuring Head.

The following tools and materials are required for installation:

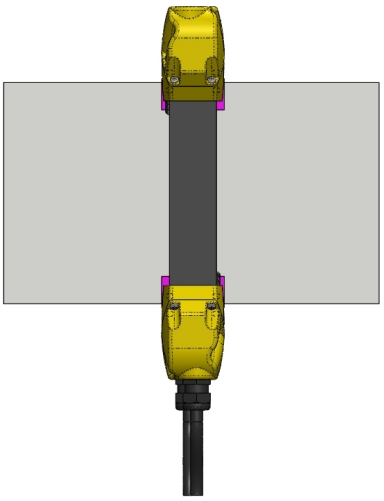
3/16" hex wrench (included with Measuring Head)
Drill, drill bits, mounting hardware, screwdrivers, wrenches, etc.
Cable puller, cable ties, ladder, etc.

© 2016 DynAmp, LLC



Front View

Installation Configuration



Side View

The following is the recommended sequence for installing the Measuring Head:

1. Refer to the Outline and Mounting drawing for the Measuring Head at the end of this manual.
2. Determine the position where the Measuring Head will be installed. Bus bar(s) should be free from grease and dust for the best adhesion of the LKAT 90° mounting angles to the bus bar(s).
3. Connect the head cable assemblies to the Metering Unit.
4. Remove the backing from the adhesive foam strips on the mounting angles. Align the mounting angles in position on the corners of the bus bar in the desired location.
5. Position the two “L-shaped” head halves around the bus and the mounting angles. Mate the two halves, pressing them together until the tubes bottom out on the elbows.
6. Install the four locking screws on the outside of the square tubes adjacent to the place where the head halves split apart. Do not over tighten the locking screws. Refer to Outline & Mounting – LKAT^2 Measuring Head drawing.
7. Tighten the bus mounting screws a few turns at a time in a circular pattern around the aperture of the head, on the front side, then on back side of the head. For most applications, the head should be centered on the bus bar. The bus mounting screws should press against the foam tape on the mounting angle surface on the outside of the bus bar. Refer to Outline & Mounting – LKAT^2 Measuring Head drawing.
8. Route the head interconnection cables away from the bus and other high voltages.
9. Connect the power cable assembly to appropriate power source and LKAT^2 Metering Unit.

4.5 METERING UNIT INSTALLATION

The location of the Metering Unit should be determined by the following factors:

1. Ambient air temperature must stay in the specified range at all times.
2. The location should not be exposed to direct sunlight.

© 2016 DynAmp, LLC

3. The location should be within reach of the head cables supplied with the system. Standard head cable length is 33 feet (10 meters). Extra-long head cables may also be ordered for special applications.
4. Route interconnection cables away from bus and other high voltages.

Refer to Metering Unit Outline & Mounting drawing at the end of this manual. Anchor the panel in the desired location after ensuring adequate cable reach.

Refer to the LKAT^2 OEM System Wiring Diagram. Connection to the input power is made using 4-position plug P5 mounted on the LKAT2 OEM power supply pc board. Use of 18 AWG (or larger) type SJT (or equivalent) cable for input power wiring.

The output requires 8 conductors for the main pc board assembly and 8 conductors for the optional PE PCB assembly. These cables must be connected to the P3 and P9 plug(s) supplied with the system. Use of 20AWG twisted pair cable (4 or 8 pairs) is recommended.

4.6 SYSTEM CHECKOUT

Recheck all wiring connections against the drawings to ensure proper installation. Energize the LKAT^2 System. Confirm that the green status LEDs are illuminated. If accuracy diagnostic LED lights red, skip to “Troubleshooting an Accuracy Diagnostics Fault Indication” in the “Theory of Operation” section of this manual

With the bus energized, the Metering Unit digital display (optional) should indicate the primary current (in kA units). The current loop should produce a maximum output signal at nominal system full-scale bus current, for any bias offset (for example +4mA).

Photocopy the appropriate LKAT^2 Diagnostic Measurements Forms. Form 1 is for diagnostic measurements at zero bus current (with the Measuring Head on or off the bus). Form 2 is for diagnostic measurements with the Measuring Head installed on the bus with the bus energized. Follow the directions to measure and record necessary information.

NOTE :

- These forms are intended to help keep accurate records of LKAT^2 functional tests.
- This information may prove valuable in the event of a malfunction.
- These measurements do not constitute system calibration.
- Space is provided for the recording of three sets of readings.
- Voltages may vary slightly with temperature extremes.
- System performance will typically remain within nominal specifications when measured levels fall within the acceptable limits shown on the forms.
- Levels must be measured and recorded under test conditions shown on the forms.
- The Metering Unit cover must be open during system checkout, as all measurements are made inside Metering Unit on Main pc board terminal blocks. The cover should remain firmly closed during normal operation.

Always complete these forms in full **before** contacting the factory.

© 2016 DynAmp, LLC

Form 1
LKAT2 Diagnostic Measurements Form 1 – Zero Primary Current

Instructions:
1.) Ensure that the Metering Unit is energized and both head halves are mated and connected to the Metering Unit.
2.) Ensure that head is off bus, or that bus is de-energized.
3.) Measure and record the information below (make additional copies of this form as needed).
4.) Record Serial Numbers

TEST CONDITIONS:
ZERO PRIMARY CURRENT (Head may or may not be installed on bus);
LKAT^2 SYSTEM must be ENERGIZED for AT LEAST ONE HOUR.

MEASURE	(+) DMM at	(-) DMM at	ACCEPTABLE RANGE	DATE ____/____/___	DATE ____/____/____	DATE ____/____/___
$+V_{Hall}$ Supply-A	P4-1	P4-3	+12V (±0.5V)			
$+V_{Hall}$ Supply-A	P4-2	P4-3	+12V (±0.5V)			
+15V supply	P4-4	P4-5	+15V (±0.5V)			
-15V supply	P4-6	P4-5	-15V (±0.5V)			
Input A1	P1-1	P1-2	0V (±5mV)			
Input A2	P1-3	P1-2	0V (±5mV)			
Input B1	P2-1	P2-2	0V (±5mV)			
Input B2	P2-3	P2-2	0V (±5mV)			
Output Current Loop Burden at Full-Scale	P3-1	P3-2	10.2V max			

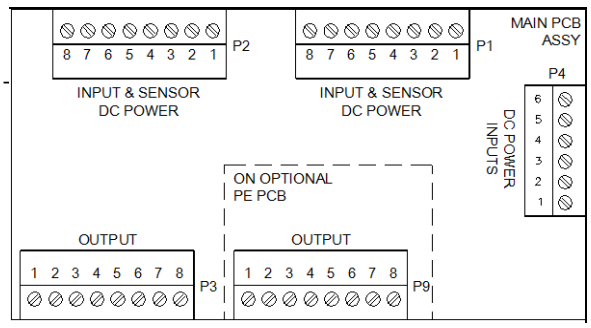
Serial Numbers :

Metering Unit _____

Measuring Head

A Half : _____

B Half : _____



© 2016 DynAmp, LLC

Form 2
LKAT2 Diagnostic Measurements Form 2 – Energized Primary Bus

Instructions:
1.) Assure that the Metering Unit is energized and both head halves are mated and connected to the Metering Unit.
2.) Assure that head is on bus and that bus is energized.
3.) Measure and record the information below (make additional copies of this form as needed).
4.) Record Serial Numbers and Current Loop Burden Resistance (Ohms)

TEST CONDITIONS:
ENERGIZED PRIMARY BUS
LKAT^2 SYSTEM must be ENERGIZED for AT LEAST ONE HOUR.

MEASURE	(+) DMM at	(-) DMM at	ACCEPTABLE RANGE	DATE ____/____/___	DATE ____/____/____	DATE ____/____/___
$+V_{Hall}$ Supply-A	P4-1	P4-3	+12V (±0.5V)			
$+V_{Hall}$ Supply-A	P4-2	P4-3	+12V (±0.5V)			
+15V supply	P4-4	P4-5	+15V (±0.5V)			
-15V supply	P4-6	P4-5	-15V (±0.5V)			
Input A1	*P1-1*	*P1-2*	*Within ±25mV of Input A2*			
Input A2	*P1-3*	*P1-2*	*Within ±25mV of Input A1*			
Input B1	P2-1	P2-2	Within ±25mV of Input B2			
Input B2	P2-3	P2-2	Within ±25mV of Input B1			
Output Current Loop Burden at Full-Scale	P3-1	P3-2	10.2V max			

Serial Numbers :

Metering Unit _____

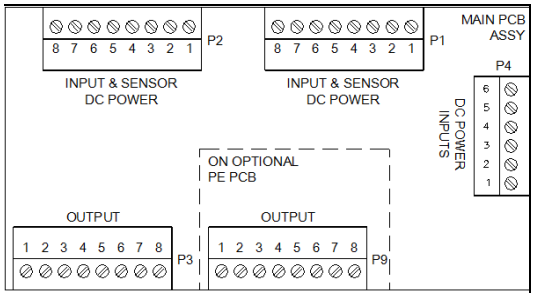
Measuring Head

A Half : _____

B Half : _____

Current Loop Burden Resistance

(Ohms)_____



© 2016 DynAmp, LLC

5. THEORY OF OPERATION

5.1 GENERAL

The LKAT^2 System uses open-loop, open-path (OLOP) technology to convert the magnetic field associated with a current carrying conductor into an isolated milliampere current loop output. This output is scaled to be proportional to the primary conductor current. In addition, a local digital display of the primary bus current (in kiloAmperes) is visible when the optional RMS Display pc board is added to Metering Unit.

Each Measuring Head is a sealed unit and is not designed for repair in the field. However, a working knowledge of the LKAT^2 System theory of operation will help facilitate timely and accurate diagnosis in the event of problems.

5.2 OLOP TECHNOLOGY

The term “open-loop” means that the magnetic circuit does not generate an opposing magnetic field to null the field produced by the primary conductor inside the Measuring Head. The term “open-path” indicates that the sensor is an air-core design, without magnetic core material.

The LKAT^2 System operation is based on Ampere’s Law, which states: “the line integral of B (magnetic flux density) around any closed path is equal to $\mu_O I$ (permeability multiplied by current)”. In practical terms, this means that integrating a closed path around a primary conductor will yield a value proportional to the net primary current.

This integration is implemented using a specific array of Hall Effect ICs. The LKAT^2 System effectively minimizes errors typically present in other open-loop sensors: zero drift, thermal drift, position sensitivity, and susceptibility to external magnetic fields. The absence of a magnetic core practically eliminates errors due to saturation, hysteresis, and core set (remanance) commonly associated with ferrite material.

A generalized block diagram of the LKAT^2 System is shown in Figure 5.1.

© 2016 DynAmp, LLC

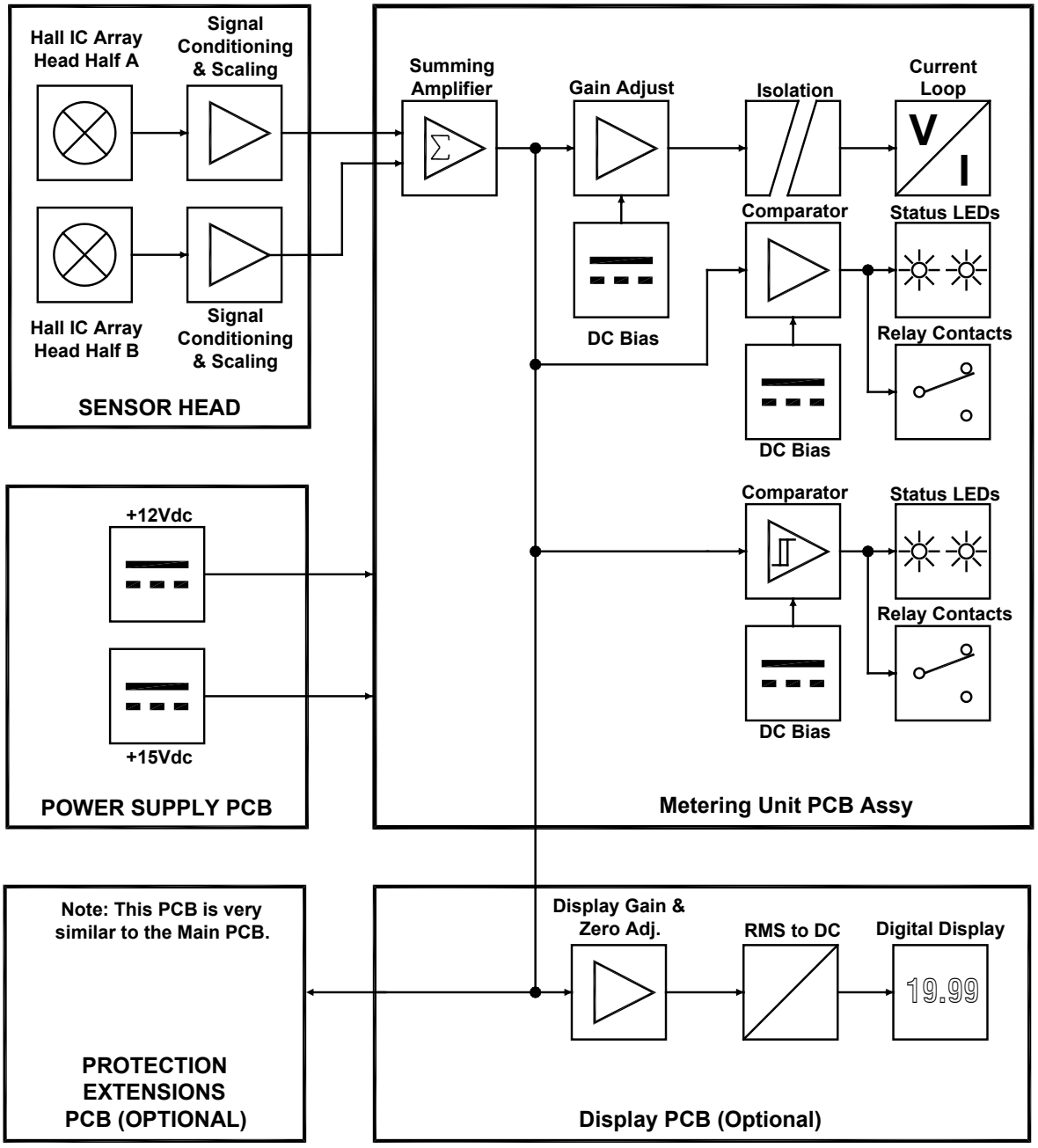


Figure 5.1
Block Diagram of the LKAT^2 System

5.3 SYSTEM FUNCTIONAL DESCRIPTION

The flux density associated with the primary current is sensed by arrays of Hall ICs in the Measuring Head. The outputs of these devices are summed and filtered, then transmitted to the Metering Unit where these signals are dc biased and scaled. The Accuracy Diagnostics status LEDs and relay contacts are driven by a signal input that compares the various Hall groups with voltage setpoints. When the Hall group signal exceeds the reference, the green

© 2016 DynAmp, LLC

LED will go out and the red LED will illuminate. The relay coil will de-energize under the same conditions. The Trip Setpoint LEDs and relay contacts operate in a similar manner.

Main PCB LED is a RED / GREEN the Accuracy Diagnostics status LED. This LED indicator and Main PCB relay CR2 contacts may be used to monitor the following conditions:

- Measuring Head imbalance
- Power supply failure
- Measuring Head disconnected
- Sensor electronics failure
- Other circuit failures causing loss of measurement accuracy

Occurrence of one or more of the conditions above will deenergize CR2 relay coil, changing the state of the contacts and changing the LED indication from green to red. Refer to the section “Troubleshooting an Accuracy Diagnostics Fault Indication” in this section for more information about determining the cause and eliminating a fault condition.

5.4 LKAT^2 METERING UNIT

Refer to drawings in the back of this manual. The LKAT^2 Metering Unit consists of a universal input power supply and Main pc board mounted together on a steel U-chassis. Input, output, and power connections are made via pc board edge connector plugs.

Input power connects to the Power Supply pc board assembly. The power supply pc board includes a slo-blo type fuse, in-rush and overcurrent protection, as well as MOV overvoltage clamping. The power supply provides outputs of ±15Vdc and +12Vdc required by the system electronics. These outputs connect to the Main pc board assembly via a short wire harness.

Connections to the Measuring Head are made via the Main pc board assembly.

5.5 LKAT^2 MEASURING HEAD INTERCHANGEABILITY

DO NOT connect LKAT Classic or LKAT Plus – doing so will damage the Measuring Head.

LKAT^2 Measuring Heads of various sizes will operate properly when connected to the LKAT^2 Metering Unit. However, the LKAT^2 System is ***factory calibrated as a system.*** As a result, optimal measurement accuracy is achieved when the Metering Unit is connected to the head it was calibrated with, and installed on the size bus bar it was designed for.

5.6 TROUBLESHOOTING AN ACCURACY DIAGNOSTICS FAULT INDICATION

A problem may be detected when the LKAT^2 System is energized with A and B head cables connected to the Metering Unit. When the Main PCB AD status LED illuminates RED and / or Main PCB CR2 status relay coil changes state, a possible fault condition has been detected. This is true whether or not the Measuring Head is installed on the bus. The following table is intended to help the user determine and eliminate the cause of the fault.

© 2016 DynAmp, LLC

Table 5.1
Troubleshooting an Accuracy Diagnostics Fault Indication

Main Green LED	Main Red LED	Contact P3-3 to P3-5	BUS ON	BUS OFF	Possible problem	Action / Check
ON	OFF	Open	X	X	System operating	DC measurements (optional)
OFF	OFF	Closed	X	X	No input power	Verify input power connection
OFF	OFF	Closed	X	X	DC power supply	Verify DC power on main pcb
OFF	ON	Closed	X	X	Head halves disconnected	Verify head interconnections at Metering Unit
OFF	ON	Closed	X		Head imbalance	Adjust position of head for green ON, red OFF
OFF	ON	Closed	X	X	Measuring Head malfunction	Measure head input signals at zero bus current; output should be < 5mVdc; substitute known good Measuring Head
OFF	ON	Closed	X	X	Other problem	Contact factory

5.7 SYSTEM CALIBRATION OVERVIEW

DynAmp does not specify exact required intervals of calibration for its products.

The end user of the product is responsible for identifying the appropriate interval between calibrations. The intervals should be determined based on the following factors:

- Requirements of a Quality Management System
- Accuracy and permissible limits of errors
- Purpose and usage
- Experience with similar products
- Stability of the product
- Past history
- Other characteristics of the product

Reference: "ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories" and Laboratory Accreditation Bureau "Guidance for Documenting and Implementing ISO/IEC 17025:2005 and Laboratory Guidance."

As a guideline, DynAmp recommends a 24-month interval of calibration for all permanently installed products and a 12-month interval of calibration for all products used in portable applications.

Calibration may be performed as:

- Field Calibration (On Process Bus)
- Field Calibration (On Test Bus)
- Factory Calibration

IMPORTANT NOTE
DynAmp, LLC assumes no responsibility for the accuracy of LKAT^2 Systems calibrated by any person other than a DynAmp, LLC Technician.

© 2016 DynAmp, LLC

Generally, system calibration compares the output of the device under test (“DUT”) to a reference.

The best calibration method is to return LKAT^2 Systems to the factory for calibration on a test bus in a very controlled environment with extremely stable and accurately measured current. This requires that the LKAT^2 Measuring Head be removed from process bus. The head and associated Metering Unit must be returned together, and should have the same serial number. The signal output and input power cable assemblies do not need to be returned for factory calibration. Specific details of factory calibration are beyond the scope of this manual.

Field calibration is possible using a 0.1% accurate current measurement system, such as the DynAmp LKP, LKCO or Opti-Cal as a reference. Due to significantly larger size and mass, it may be difficult to install a comparably rated LKP Measuring Head in on the same bus as the LKAT^2. An existing LKCO or DynAmp’s portable Opti-Cal system is better suited for this purpose.

Field calibration accuracy depends on the stability of the test bus current, the accuracy of the reference current measurement system and ammeters, as well as the linearity of the LKAT^2 System.

5.8 CALIBRATION ADJUSTMENTS

IMPORTANT NOTE
To avoid injury and/or electrical shock, personnel performing calibration must review and observe all hazard warnings and safety precautions stated throughout this product manual.

LKAT^2 System calibration adjustments are summarized below.

All Bias and Zero adjustments are made at zero bus current.

All Scaling and Gain adjustments are typically made at full-scale current.

Refer to pc board assembly drawings at the end of this manual for location of switches and potentiometers, as well as tables listing proper switch settings. Except for step 1) below, each table is shown on the appropriate pc board assembly drawing.

Forms 1 and 2 are used to check and record system power supply and channel voltages.

Main PCB – Current Loop Output

- Output Bias (coarse) : SW2C…SW2F
- Output Type : SW6
- Output Gain (coarse) : SW3
- Output Bias (fine) : Trimpot
- Output Gain (fine): Trimpot

Main PCB – Trip 1 Setpoint

- Trip 1 Protection Polarity : SW2A and SW2B
- Trip 1 Setpoint : Trimpots (medium) and (fine)

© 2016 DynAmp, LLC

Optional PE PCB – Current Loop Output

- Output Bias (coarse) : SW4
- Output Type : SW5
- Output Gain (coarse) : SW1 and SW2
- Output Bias (fine) : Trimpot
- Output Gain (fine) : Trimpot

Optional PE PCB – Trip 2 & 3 Setpoints

- Trip 2 Protection Polarity : SW3
- Trip 2 Setpoint : R33 (medium) and R46 (fine)
- Trip 3 Protection Polarity : SW3
- Trip 3 Setpoint : R34 (medium) and R47 (fine)

Optional RMS Display PCB – Display

- Decimal Point position
- DPM Mode
- RMS Signal Conditioning Options : SW1F, G, & H (SW1-6, 7, & 8)
- Input Scale Factor : SW1E (SW1-5)
- Input Attenuation : SW1A, B, C, & D (SW1-1, 2, 3, & 4)
- DPM Gain (fine) : R12

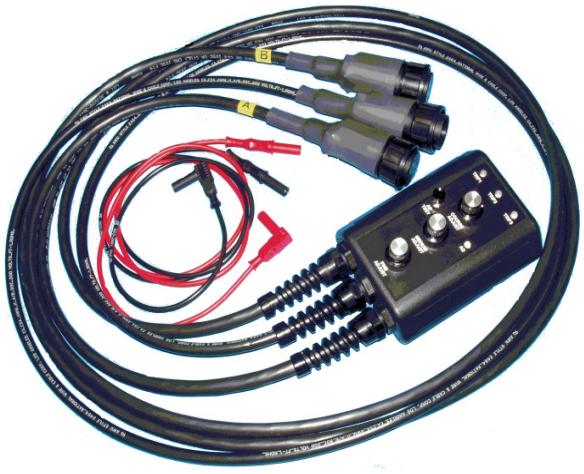
NOTE
The Optional PE and/or RMS Display pc board assemblies may be added, configured and calibrated in the field. In this case, the Main pc board assembly output signal is used as the reference output signal with the LKAT^2 System measuring normal bus current.

5.9 FIELD CONFIGURATION OF TRIP SETPOINTS

LKAT Metering Unit Tester

(LKAT MUT)

The LKAT MUT is a portable tester that can be used with a standard digital multi-meter to check LKAT system trip set points without removing the LKAT Measuring Head. The LKAT MUT provides a signal to the LKAT Metering Unit electronics to simulate an alarm condition. The connectors included with the LKAT MUT allow the tester to be connected directly to the LKAT Metering Unit electronics to verify scaling, proper operation, or change of the LKAT trip set points. More information on the LKAT MUT can be found at www.dynamp.com or by contacting DynAmp.



© 2016 DynAmp, LLC

Trip setpoints may be re-configured on site for any level between 5% and 100% of full-scale. The trip polarity may also be re-configured on site. However, the Accuracy Diagnostics trip setpoint should not be adjusted without consulting the factory.

Refer to assembly drawings for the Main pc board and PE pc board (optional) included at the end of this manual. To change trip polarity adjust SW2A and SW2B according to the table on the assembly drawing.

The trip setpoint is proportional to the current where the trip will occur: “Trip Current” – from Metering Unit nameplate.

The easiest method to check or change trip setpoints is to use the DynAmp LKAT MUT system which is specifically designed to simplify this process as well as verify proper operation afterwards.

To configure the trip setpoint without the LKAT MUT or complete test stand, the following method can be used.

Refer to Table 5.2, “Trip Configuration Details”. Adjust coarse and fine potentiometers to produce calculated New $V_{STPT.}$

Measure the existing setpoint voltage (V_{STPT}); use the equation below to calculate the new setpoint voltage.

$$\text{New } V_{STPT} = \frac{\text{Old } V_{STPT}}{\text{Old Trip Current}} \times \text{New Trip Current}$$

Example:

Old V_{STPT} = 7V
Old Trip Current = 70kA
New Trip Current = 80kA

$$\frac{7V}{70kA} \times 80kA = 8V \text{ (New } V_{STPT})$$

Table 5.2
Trip Configuration Details

Trip Circuit	V_{STPT} Location	Medium Adjust Trimpot	Fine Adjust Trimpot
1 (Main)	TP6 (Main)	R91	R98
2 (PE)*	TP2 (PE)*	R33	R46
3 (PE)*	TP3 (PE)*	R34	R47
Use TP0 for zero volt reference (circuit common) for voltage measurements for trip setpoint configuration.			

- * Optional

NOTE

The LKAT^2 is supplied with factory configured trip setpoints configured as specified in the LKAT^2 Worksheet at the time of order. If the trip setpoints are reconfigured in the field, the customer must realize that the trip setpoints shown on the LKAT^2 Metering Unit nameplate will no longer be correct. In this case, DynAmp suggests that the nameplate be changed to reflect the new trip setpoint (following reconfiguration).

© 2016 DynAmp, LLC

5.10 EARTH GROUNDING

Many local electrical codes require non-conducting metal parts of electronic equipment to be connected to Earth Ground for safety reasons. This connection is intended to prevent electrical shock if the Input Mains Line voltage is accidently connected to normally non-conducting metal parts of the equipment. In a failure where the chassis is accidently connected to Mains Line voltage, current will flow via the connection to Earth. This in turn will trip the protective circuitry on the Mains Line.

Here is a detailed description of the Earth Ground connection path (See Figure 5.2):

1. The BLK and WHT wires of the Input Power Cable Assembly are connected by the customer to Mains Power. The GRN wire may or may not be connected to Earth Ground, depending on the local electrical code where the LKAT equipment is installed.
2. CONN4F is the connector end of the Input Power Cable Assembly. CONN4F contacts are connected BLK = Contact “A” (LINE or +VDC), WHT = Contact “C” (NEUTRAL or -VDC) and GRN = Contact “E” (Earth Ground).
3. CONN4F mates with the front side of CONN4M flanged connector on the Metering Unit Enclosure.
4. On the back side of CONN4M, its contacts terminate one end of the Input Power Harness.
5. Plug P5 terminates the other end of the Input Power Harness. P5-4 is the Earth Ground conductor
6. Plug P5 mates with Receptacle P5 on the Power Supply PC Board Assembly.
7. Receptacle P5 is soldered to copper foil traces on the Power Supply PC Board Assembly.
8. The copper trace connected to P5-4 makes electrical contact with the steel standoff inserts of the steel PCB mounting bracket.
9. The PCB mounting bracket makes electrical contact to the Metering Unit steel panel via the (4) steel mounting screws used to secure the PCB mounting bracket to the panel.

IMPORTANT NOTE
There is no electrical connection from any part of the LKAT Main PCB or its optional daughter PCBs to Earth / Chassis ground or the steel PCB mounting bracket or panel. The use or non-use of the Earth Ground provision does not have any impact on the performance of the LKAT system.

© 2016 DynAmp, LLC

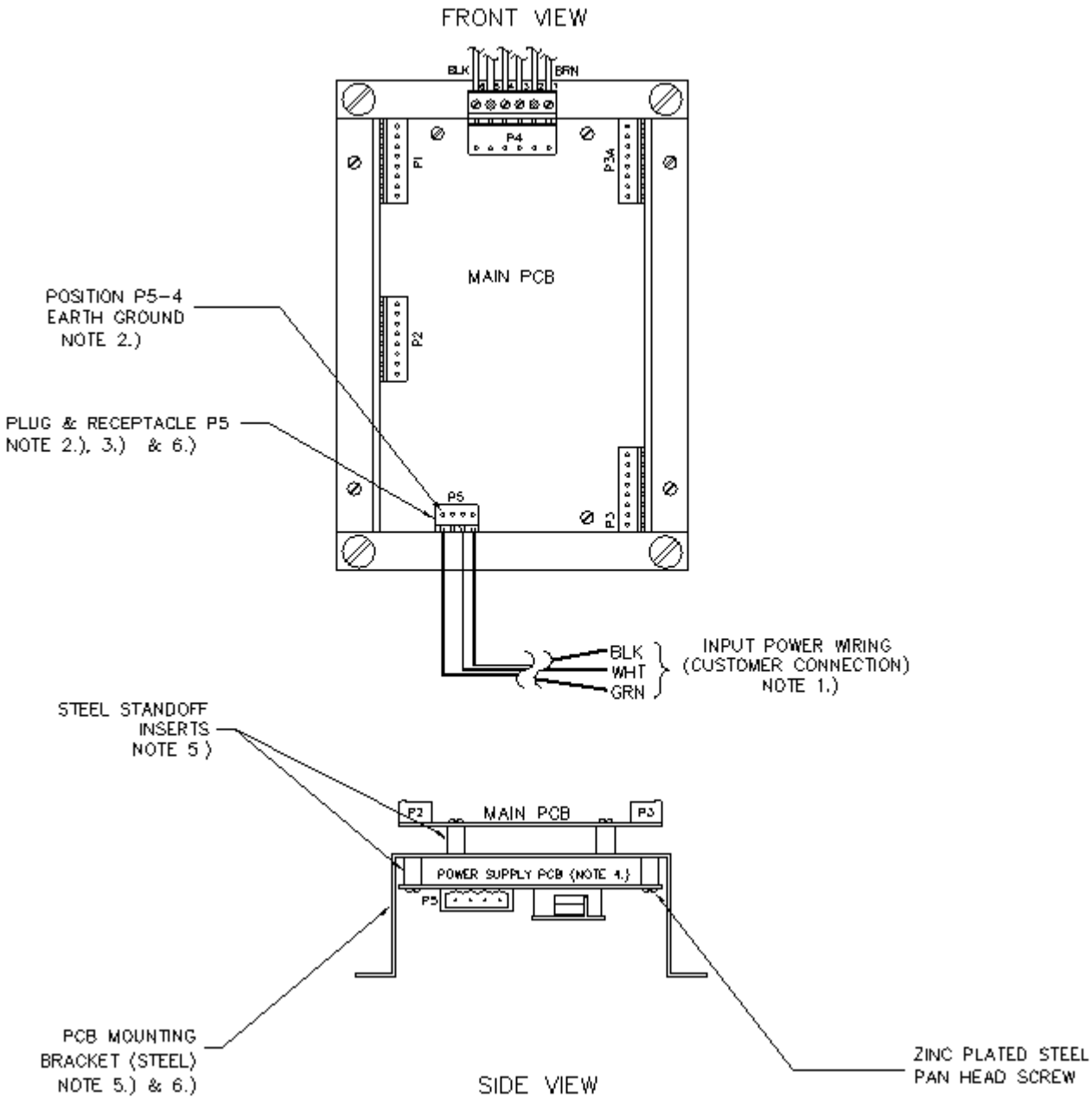


Figure 5.2
Metering Unit Earth Ground Connections

5.11 THE TERM “FAILSAFE”

The LKAT^2 System is failsafe as factory configured. When the system is energized, all relay coils are energized and all contacts change state; that is, open contacts close and closed contacts open. During any alarm condition, relay coils de-energize, which changes the state of the relay contacts.

In the failsafe configuration, loss of input power to the LKAT^2 Metering Unit de-energizes the alarm relay coils. This causes the relay contacts to change state and indicate an alarm condition.

5.12 NON-FAILSAFE CONFIGURATION

For some applications, the user requires the alarms to be “non-failsafe”. That is, the system should not produce an alarm when there is loss of input power. Alarm conditions other than loss of input power must continue to result in an alarm.

To convert the LKAT^2 System to non-failsafe operation requires modification of the Main pc board assembly. Refer to the Main pc board assembly drawing at the end this manual. For non-failsafe operation remove R179 zero ohm resistor (jumper) and install R177 zero ohm resistor (jumper).

5.13 CONFIGURING THE LOW PASS FILTER

The LKAT^2 System includes a two pole configurable low pass filter. This filter may be enabled without affecting the scaling of the output in the pass band. The frequency response of the LKAT^2 without the low pass filter activated is shown in Figure 3.1.

Refer to the Main pc board assembly drawing at the end this manual. To configure the low pass filter, set switches as shown in the table below.

Table 5.3
Low Pass Filter Switch Settings

SW1 position	A	B	C	D
No low pass filtering	OFF	OFF	OFF	ON
330 Hz cutoff	OFF	OFF	ON	OFF
660 Hz cutoff	ON	ON	ON	OFF

© 2016 DynAmp, LLC

6. MAINTENANCE & SPARE PARTS

6.1 PERIODIC MAINTENANCE

As is true with any electronic system, proper maintenance will tend to prolong the service life. DynAmp, LLC recommends the following program be performed at the recommended interval to prevent or detect damage to the LKAT^2 System and to ensure reliable performance. Always use appropriate measures to correct any problems found. Following the suggested maintenance schedule may assist in early diagnosis of problem(s) to minimize repairs and down time.

IMPORTANT NOTE:
If Main pc board LED (AD Status LED) is illuminated RED and / or the status relay coil de-energizes, a fault condition may exist in the LKAT^2 electronics. When this occurs, the system may require immediate attention. Refer to "Troubleshooting an Accuracy Diagnostics Fault Indication", in the "Theory of Operation" section of this manual.

6.2 ANNUAL MAINTENANCE

Refer to the "Calibration" section of this manual for calibration intervals.

If possible, perform the steps described in section titled "System Checkout" in the "Installation" section of this manual at least once per year to verify performance of the LKAT^2 System. This may help to prevent or detect damage to the system and to ensure reliable performance. Use appropriate measures to correct any problems found. If LKAT^2 System equipment is exposed to outdoor temperatures, DynAmp, LLC recommends these steps be performed during the hottest time of the year.

In addition, the following steps should be performed once each year as part of annual maintenance:

1. Visually inspect Measuring Head and interconnection cable for evidence of severe overheating, cracks, separation of bonded surfaces, or excessive corrosion. Record any suspect conditions.
2. Inspect the Measuring Head mounting screws and adjust as needed.
3. Visually inspect Metering Unit for evidence of severe overheating, corrosion, or condensation. Record any suspect conditions and take appropriate action.
4. Clean as necessary; remove any oil or grease with a mild detergent. Do not use abrasives or strong chemical solvents as they may damage the cables or erase the silk-screen markings from the Metering Unit.
5. Disconnect power to the system before servicing or replacing fuses.

CAUTION
To avoid the risk of shock and electrocution, always disconnect all cable assemblies before performing any cleaning on the Metering Unit.

6.3 SPARE PARTS

The following table lists the minimum recommended quantities for spare parts for the LKAT^2 System. As spares are used, replacements should be ordered. Since continuous operation of high-current measurement systems is often critical, stocking spare parts should be given high priority.

The LKAT^2 System Measuring Heads require special repair procedures and materials. However, the heads are very reliable and should require little or no repair over its service life. Please refer to the nearest authorized DynAmp, LLC service center for information on repairs.

Disconnect power to the system before servicing or replacing fuses.

Table 6.1
Spare Parts List

DESCRIPTION	ITEM NO.	RECOMMENDED QUANTITY
Fuses, 2A 250V Slo-Blo 5mm x 20mm	43054	5 (each)
Angle, LKAT^2 Mounting 100mm	46039	8 (each)
Screw , LKAT^2 mounting SHCS 1/4-20 X 3”	46028	2 (each)

Spare System		
Complete System (Head & Metering Unit calibrated as system)	*	TBD
Metering Unit	46265	TBD
Measuring Head	**	TBD

* Item number same as original system
** Contact DynAmp, LLC

.

© 2016 DynAmp, LLC

7. DRAWINGS

Table 7.1
Drawing List

DRAWING TITLE	NUMBER
Wiring Diagram: LKAT^2 OEM System	83B109387
Assembly: LKAT^2 OEM Metering Unit	84A109388
Assembly: LKAT^2 Main PCB	75A109352
Assembly: LKAT^2 AC/DC Power Supply PCB	75A109412
Assembly: LKAT Protection Extensions PCB	75A108587
Assembly: LKAT RMS Display PCB	75A108588
Outline and Mounting: LKAT^2 Measuring Head	02B109349
Outline and Mounting: LKAT^2 OEM Metering Unit	02A109389

© 2016 DynAmp, LLC