DynAmp

LKAT Plus / LKAT^2

METERING UNIT TESTER (MUT)

Installation, Operation and Service Manual

Manual Item No. 045808

Rev. G

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

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Hazard Warning!

GENERAL

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

DynAmp 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 for use where the operator is either totally electrically isolated or essentially at the same potential as the bus. Ignoring the warnings can result in severe personal injury or equipment damage.

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

Symbol Identification:

General definitions of safety symbols used on equipment and in manual.
Caution/Warning: Refer to accompanying documents for instructions.

SAFETY

The following are general guidelines that should be followed when using the LKAT Metering Unit Tester.

- The operator must be a qualified technician who is familiar with the warnings and the instructions of this manual.
- Always follow all local and plant safety procedures.
- Hazardous potentials may exist in the vicinity of the desired current measurements. Use locally approved safety procedures when working near these hazardous potentials.
- Do not place the equipment in the rain, or under water, or submerge any part of the tester.
- Use of the equipment in a manner not specified by the manufacturer can impair the protection provided.

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

DynAmp, LLC Customer Support

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

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MANUAL REVISIONS

Page	Rev	Revision Summary	Date
all	New	First Issue	03/12
all	A	ECR 1773 – Revise to include Sigma / OEM	11/12
9-11	B	ECR 1911 - Revise to include LKAT2 – Update Section 5, and format from CAR 10190/ Safety, Specifications	07/14
v-vi, 3, 19, 21	C	ECR 1963 – Add 2.2, Spare Parts List and revise Drawing List, revise to include Headings in TOC	03/15
3,5,7,19	D	ECR 2088 – Revise 2.2, Specifications, add sections 4.2 & 4.3 regarding adapters and Non-Failsafe operation, Delete 6.4 Accessories	08/16
11	E	ECR 2184 – Revise Table 4.1 to add 2 columns for LKAT2 mv/kA	11/17
iii, 11, 21	F	ECR 2235 – Update Warranty page verbiage, Revise Table 4.1, Add Drawing Revisions to Table 7.1	10/18
16, 17	G	ECR 2360 – Add new Form 4.B and Section 4.12	10/22

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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.

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2. PRODUCT DESCRIPTION

2.1 GENERAL

The LKAT Metering Unit Tester is used to verify the functionality of Metering Units for all versions of the LKAT family of products. The functions and parameters checked by the tester include :

- Input / output sensitivity
- Trip point scaling
- Trip relay contacts
- Integrity of input / output harnesses and interconnections on Metering Unit

The tools / documentation required to use the LKAT Metering Unit Tester include :

- 4-1/2 digit DMM with 0.05% basic DC accuracy (user provided)
- DMM Test probes (user provided)
- Banana to banana cables (1black / 1 red)
- Product Manual

Special adapters are needed to test LKAT Plus / LKAT2 OEM and Sigma Systems. The required adapters are provided with every LKAT Metering Unit Tester.

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3. SPECIFICATIONS

The specifications of the LKAT Metering Unit Tester :

TABLE 3.1 SPECIFICATIONS

GENERAL	
Typical Head Simulation Accuracy	Better than ±2.5%
Typical Alarm Point Set Accuracy	Better than ±5%
Installation Category	III
Pollution Degree	2
ENVIRONMENTAL	
Operating Ambient Temperature Range	-10°C to +50°C 14°F to 122°F
Humidity	Maximum 85% non-condensing
PHYSICAL	
Tester Weight	1.4 kg (3.016 lb.)
Tester Interconnection Cables	2m (78.8 in.)
Banana to Banana Cables (2)	1m (39.4 in.)
Head Cable Adapters (2)	150 mm (6.0 in.)
Output Cable Adapter (1)	240 mm (9.5 in.)

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4. OPERATION

4.1 SETUP AND OPERATION

The generalized procedure for proper setup and operation of the LKAT Metering Unit Tester ("MUT") is as follows:

- Follow all necessary plant regulations and safety procedures while performing the steps in these instructions.
- Make "as-found" measurements.
- Advise the control system operator of the LKAT System that the output signal will be disconnected.
- Disable LKAT output from rectifier control.
- Disconnect the Measuring Head from the Metering Unit under test. Disconnect the output cable from the Metering Unit under test.
- Refer to applicable "Interconnection" drawing at the end of this manual.
- Connect MUT to the Metering Unit under test (input and output connectors).

4.2 TESTING LKAT SIGMA AND LKAT OEM METERING UNITS

Special adapters are needed to test LKAT Plus / LKAT2 OEM and Sigma Systems. The required adapters are provided with every LKAT Metering Unit Tester.

Refer to the drawing "INTERCONNECTION – TESTER LKAT SIGMA / OEM" at the end of this manual. The drawing shows how to connect the cable adapters. The adapters mate the circular connectors of the Metering Unit Tester to the 8-posiition header plug connectors of the SIGMA / OEM Metering Unit.

Important Note :

LKAT2 OEM versions with serial numbers less than 1409#### and

LKAT2 Sigma versions with serial number less than 1502####

LKAT2 OEM and LKAT2 SIGMA with serial numbers less than those listed above require the use of adapter set 045464 to properly test the Metering Units. The TRIP1 contacts on these systems are reversed from later serial numbers. When testing is required on a System(s) within the serial number ranges listed above, contact DynAmp at help@dynamp.com for information regarding the adapter.

4.3 LKAT2 OEM and Sigma Failsafe / Non-Failsafe Configurations

All standard LKAT2 systems are configured for Failsafe operation. In the event of power loss, the TRIP contacts will change state to alert the user that protection is no longer active.

Some specific applications require the LKAT2 System to be configured for "Non-Failsafe" operation. This configuration prevents the contacts from changing state if power loss

occurs. A yellow label is placed on all LKAT2 Systems that have been configured for Non-Failsafe operation. When using the LKAT Metering Unit Tester on LKAT2 OEM and LKAT2 Sigma systems configured for Non-Failsafe operation, the TRIP indication on the tester will be reversed as noted below:

LED Red: Normal operation, No trip

LED Green: System is in trip mode

4.4 LKAT Measuring Head Size (P1 and P2 dimensions)

Refer to Figure 4.1 and 4.2. Dimensions P1 and P2 are the nominal head aperture dimensions (or “head size”) of LKAT Measuring Heads. This represents the maximum bus bar size that will fit within a given LKAT head aperture. These nominal Measuring Head dimensions determine the Nominal Average Channel Voltage (mV / kA). The user can then adjust the MUT control knobs to set a Channel Voltage to specific levels for testing Trip Setpoint(s). This simulates a Measuring Head channel voltage signal for the Metering Unit testing process.

Measured bus bar dimensions are always less than (or equal to) the nominal head aperture dimensions.

For example, a bus bar with dimensions of 255mm by 310mm requires a Measuring Head with a nominal head aperture of 270mm by 330mm.

Dimensions P1 and P2 may be determined by measuring the LKAT Measuring Head. LKAT Measuring Heads are built in steps of 30mm so if you measure slightly more than a multiple of 30mm, round down to the nearest multiple of 30mm.

The second way to determine P1 and P2 is to measure the bus bar and round to the nearest multiple of 30mm that is larger than the bus bar dimension. If the bus bar dimension is a multiple of 30mm, the Measuring Head dimension will be equal if the head is snug. If there is a gap between the bus bar and the Measuring Head, add 30mm to the bus bar dimension for P1 and/or P2.

The third way to determine P1 and P2 is from the product description in the purchase order documentation generated when the LKAT system of interest was ordered and / or received.

Note:

The Measuring Head halves must be mated and fully “bottomed out” for correct measurement of P1 and P2.

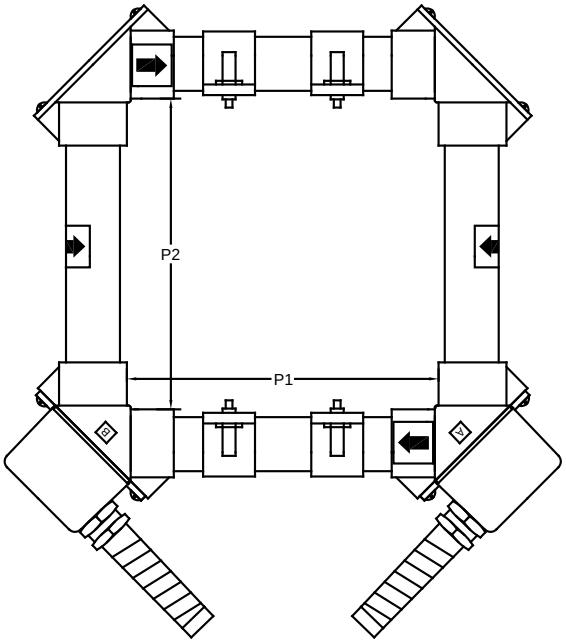

FIGURE 4.1
TYPICAL LKAT PLUS MEASURING HEAD

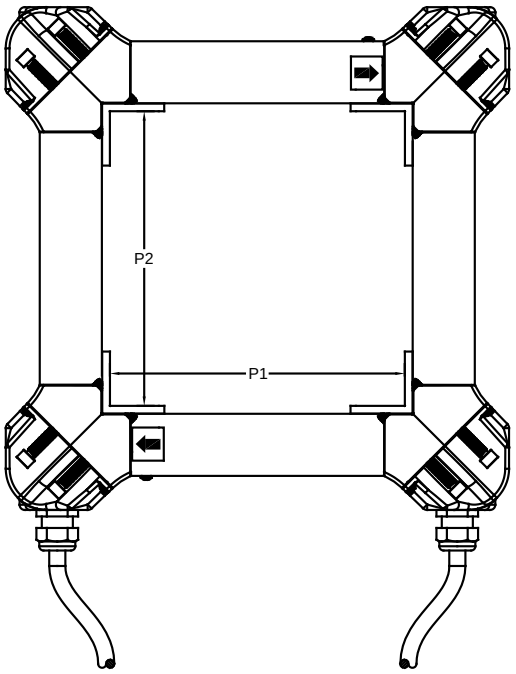

FIGURE 4.2
TYPICAL LKAT^2 MEASURING HEAD

4.5 LKAT Head Signals

There are four individual channel voltage signals transmitted from the Measuring Head to the Metering Unit: A1, A2, B1, and B2. These four signals comprise the un-scaled value corresponding to the measured bus current. The Metering Unit electronics sums the four channel voltages then scales the output signal to the desired mA level proportional to the bus current. When the LKAT system is installed and operating on an energized process current bus, the magnitude of the individual channel voltages are not usually equal, but typically within ±25mV of one another. The deviation between channel voltages is normal. This is due to gradients in the density of the ambient magnetic field and the position of the Measuring Head on the bus bar of interest.

4.6 Record the system data

Identify the serial number for the system under test. The serial number is shown on the LKAT System Nameplate. The serial number is also shown on each head half. The same serial number must be shown on the Metering Unit and Measuring Head. Record the serial number on **Form 4.1 and 4.2 located at the end of this section**.

Identify the Trip Setpoint(s) for the system under test. The Trip Setpoint information is also shown on the LKAT System Nameplate. Record the Trip Setpoint(s) on Form 4.2.

Note:

Serial Number and Trip Setpoint(s) may also be determined from the product description in the purchase order documentation generated when the LKAT system of interest was ordered and / or received.

4.7 Measure the As-Found Data (with Measuring Head installed on Energized Bus Bar and LKAT System operating normally)

Most of the test measurements are made at exposed terminal screws on plugs / connectors located on the Metering Unit Main pc board assembly.

- Standard version of LKAT – loosen the Metering Unit enclosure cover screws (Qty. 2) and open the Metering Unit cover (a hinged door).
- OEM or SIGMA version of LKAT – loosen the Metering Unit Plexiglas cover screws (Qty. 4) and remove the cover.

Form 4.1 lists all test points and units of measure for this set of measurements. Use a DMM to measure Hall IC supply, +15V supply, -15V supply, Input A1, Input A2, Input B1, Input B2, Metering Unit Main Output and Metering Unit PE Output (optional). Record all measured values on Form 4.1

Observe the RMS Display reading (optional). Record the observed value on Form 4.1.

Record the Rectifier Operating Current during measurement of Measuring Head channel voltages (Input A1, Input A2, Input B1, and Input B2) on Form 4.1.

Important Note:

The Metering Unit Main and PE Output (optional) measurements are voltage measurements across the TOTAL resistance of the 20mA current loop output. These measurements include the resistance of the interconnecting wire, in addition to the precision shunt resistor installed across the input that the current loop output is connected to. The interconnecting wire resistance may affect the measurement accuracy. Therefore, the output voltage measurement(s) may not be a precise measurement(s) of the Metering Unit signal(s). The output voltage measurement(s) are a verification that the Metering Unit is operating properly.

4.8 Nominal Average Channel Voltage (mV/kA)

Use Table 4.1 to determine the NOMINAL Average Channel Voltage based on P1 and P2 for the LKAT System to be tested. Record the NOMINAL Average Channel Voltage on Form 4.2.

TABLE 4.1
CHANNEL VOLTAGES VERSUS HEAD DIMENSION

P1 + P2	Channel Voltage mv / kA			
	LKAT+ and LKAT+ OEM	LKAT+ SIGMA	LKAT2 and LKAT2 OEM	LKAT2 SIGMA, LKAT2P, LKAT2 4PC
150	6.20	3.10	6.31	2.95
180	6.18	3.09	6.31	2.95
210	6.17	3.09	6.31	2.95
240	6.15	3.08	6.31	2.95
270	6.14	3.07	6.31	2.95
300	6.12	3.06	6.31	2.95
330	6.11	3.06	6.31	2.95
360	6.09	3.05	6.31	2.95
390	6.08	3.04	6.31	2.95
420	6.06	3.03	6.31	2.95
450	6.05	3.03	6.31	2.95
480	6.03	3.02	6.31	2.95
510	6.02	3.01	6.31	2.95
540	6.00	3.00	6.31	2.95
570	5.99	3.00	6.31	2.95
600	5.97	2.99	6.31	2.95
630	5.96	2.98	6.31	2.95
660	5.94	2.97	6.31	2.95
690	5.93	2.97	6.31	2.95
720	5.91	2.96	6.31	2.95
750	5.90	2.95	6.31	2.95
780	5.88	2.94	6.31	2.95
810	5.87	2.94	6.31	2.95
840	5.85	2.93	6.31	2.95
870	5.84	2.92	6.31	2.95
900	5.82	2.91	6.31	2.95
930	5.81	2.91	6.31	2.95
960	5.79	2.90	6.31	2.95
990	5.78	2.89	6.31	2.95
1020	5.76	2.88	6.31	2.95
1050	5.75	2.88	6.31	2.95
1080	5.73	2.87	6.31	2.95
1110	5.72	2.86	6.31	2.95
1140	5.70	2.85	6.31	2.95
1170	5.69	2.85	6.31	2.95
1200	5.67	2.84	6.31	2.95

4.9 Scaled Average Channel Voltage (mV) to match Rectifier Operating Current

Calculate the SCALED Average Channel Voltage.

Equation 4.1

SCALED Average Channel Voltage (mV) = Nominal Average Channel Voltage (mV/kA) X Rectifier Operating Current during As-Found measurements <OR> at Nominal Trip Setpoint(s)

Record the SCALED Average Channel Voltage on Form 4.2.

To verify proper function of the Measuring Head, compare the algebraic average of measured head channel voltages (as-found) versus SCALED Average Channel Voltage. The deviation between these two values is typically less than 1%.

For example:

Given a 270mm x 420mm standard (non-SIGMA) head operating at 32kA:

P1 + P2 = 690mm

NOMINAL Average Channel Voltage = 5.93 mV/kA (from Table 4.1)

SCALED MUT Average Channel Voltage = 5.93 mV x 32kA = 189.76mV (from Equation 4.1)

4.10 Metering Unit Alarm Trip Points

IMPORTANT NOTE:

Follow all necessary plant regulations and safety procedures while performing any testing.

1. Advise the control system operator that the LKAT system output signal will be disconnected.
2. Disable LKAT output from rectifier control and take appropriate action regarding any additional circuits such as reverse current and/or over-current protection systems.

Standard LKAT Metering Units have two Trip Relays: “AD” Accuracy Diagnostics plus “Trip 1” Alarm. Metering Units with the PE option add two additional Alarm/Trip relays “Trip 2” and “Trip 3”.

For each relay, the associated LED on the MUT verifies normally open & normally closed contact operation when each Trip LED changes from Green to Red. Each associated LED on the LKAT Metering Unit printed circuit board will also change from green to red at the same time as the MUT LEDs that verify relay operation.

When safe to do so,

- Disconnect the signal output cable from the Metering Unit under test.
- Disconnect the Measuring Head cables from the Metering Unit under test (You should see the accuracy diagnostics LED on in the metering electronics change from green to red).
- Disconnect the input power cable from the Metering Unit under test.

Measure the current loop burden (ohms) at P3-1 to P3-2 of the signal output cable after it is disconnected. Record current loop burden on Form 4.2.

- Re-connect the input power cable to the Metering Unit under test.

Connect the MUT to the Metering Unit under test.

- Connect A and B MUT head cables to the Metering Unit.
- Connect MUT signal cable to the Metering Unit.
- Connect a DMM to the MUT output connectors and set the DMM to measure mV DC.

Note: The MUT “output jacks” carry the Average Channel Voltage that is applied to all Measuring Head signal inputs via the MUT “head” cables. This allows the MUT to simulate Measuring Head signals.

Test Accuracy Diagnostics (AD) Trip

- Press “AD” test button on the MUT.
- The “AD” LED on the MUT and the “AD” LED on the Metering Unit should change from Green to Red.
- Check appropriate box on Form 4.2.

Test Trip 1

- Calculate the Trip 1 Scaled Average Channel Voltage.
- Trip 1 Scaled Average Channel Voltage (mV) = Trip 1 Setpoint (kA) x Scaled Average Channel Voltage.
- Record on Test Form 4.2.

Slowly rotate the medium adjustment knob “clockwise” for forward trip or counter-clockwise for reverse trip until Trip1 LED changes from Green to Red. The trip should be relatively close to the calculated value as displayed on the DMM.

Check appropriate box on Form 4.2.

Test Trip 2 (Only available with LKAT PE option)

- Calculate the Trip 2 Scaled Average Channel Voltage.
- Trip 2 Scaled Average Channel Voltage (mV) = Trip 2 Setpoint (kA) x Scaled Average Channel Voltage.
- Record on Test Form 4.2.

Slowly rotate the medium adjustment knob “clockwise” for forward trip or counter-clockwise for reverse trip until 1 LED changes from Green to Red. The trip should be relatively close to the calculated value as displayed on the DMM.

Check appropriate box on Form 4.2.

Test Trip 3 (Only available with LKAT PE option)

- Calculate the Trip 3 Scaled Average Channel Voltage.
- Trip 3 Scaled Average Channel Voltage (mV) = Trip 3 Setpoint (kA) x Scaled Average Channel Voltage.
- Record on Test Form 4.2.

Slowly rotate the medium adjustment knob “clockwise” for forward trip or counter-clockwise for reverse trip until Trip1 LED changes from Green to Red. The trip should be relatively close to the calculated value as displayed on the DMM.

Check appropriate box on Form 4.2.

If Trip point changes are desired, consult the applicable LKAT User's Manual.

4.11 Check Metering Unit Output (Optional)

Connect DMM (set on mV dc) to the MUT output jacks.

Refer to Table 4.1, "Channel Voltages versus Head Dimension" to calculate the Current Loop Output channel voltage (mV/kA).

FS channel voltage =

LKAT Nameplate F.S. current (kA) x channel voltage from Table 4.1 (mV/kA)

Set the MUT adjustment knob(s) to produce the calculated F.S. channel voltage as displayed on the DMM.

Measure the Metering Unit output current where the measurement signal(s) are used (i.e. at the end of the signal cable). The measured signal should be equal to 20mA (±0.5mA).

FORM 4.1
LKAT METERING UNIT TEST MEASUREMENT FORM
AS-FOUND DATA with Energized Primary Bus

Serial Number (SN) : Metering Unit_____ P1 = _____ mm P2 = _____ mm

SN Measuring Head : A half _____ B half _____

Rectifier Operating Current when As-Found Data was recorded (kA) = _____

MEASURE <OR> CHECK	Unit of Measure	(+) DMM at	(-) DMM at	ACCEPTABLE RANGE	DATE ____/____/___	DATE ____/____/___	DATE ____/____/___
Hall IC Supply	DC volts	P4-1	P4-2	+5V (±0.5V) LKAT+ +12V (±0.75V) LKAT2			
+15V supply	DC volts	P4-3	P4-4	+15V (±0.5V)			
-15V supply	DC volts	P4-6	P4-5	-15V (±0.5V)			
Input A1	DC millivolts	P1-1	P1-2	Within ±25mV of Input A2			
Input A2	DC millivolts	P1-3	P1-2	Within ±25mV of Input A1			
Input B1	DC millivolts	P2-1	P2-2	Within ±25mV of Input B2			
Input B2	DC millivolts	P2-3	P2-2	Within ±25mV of Input B1			
Metering Unit Main Output	DC volts	P3-1	P3-2	10.2V max			
Metering Unit PE Output (Optional)	DC volts	P9-1	P9-2	10.2V max			
RMS Display reading (Optional)	kA (Visual reading)			±2% of measured output current			

FORM 4.1B
TESTING LKAT WITH METERING UNIT TESTER (MUT) DATE: _____

HEAD: Serial# A half _____ Serial# B half _____ P1=_____mm P2 =_____mm

METERING UNIT: Serial#_____ Type: ☐LKAT+ / ☐LKAT2 ☐Std / ☐Sigma / ☐OEM

Main Measurement Full Scale_____kA : Output_____ Trip1@_____kA

Optional PE Measurement FS_____kA : Output_____ Trip2@_____kA Trip3@_____kA

Parameter	DC DMM (+) probe	DC DMM (-) probe	ACCEPTABLE RANGE	Data As Found	Data As Found	Data Rescaled
This section for BASIC SYSTEM condition						
System IC Supply	P4-1	P4-2	LKAT**+** +5V (±0.5V) LKAT**2** +12V (±0.75V)	V	V	V
System +15V supply	P4-3	P4-4	+15V (±0.5V)	V	V	V
System -15V supply	P4-6	P4-5	-15V (±0.5V)	V	V	V
This section for MEASUREMENT DATA on "Dead/0kA" and "Live/#kA" bus bar						
Bus kA: ☐from LKAT Head ☐from MUT ☐_____				kA	kA	kA
Channel A1	P1-1	P1-2	±25mV of A2	mV	mV	mV
Channel A2	P1-3	P1-2	±25mV of A1	mV	mV	mV
xA	P1-4	P1-2	0.3V@20°C ±1mV/°C	mV	mV	mV
Channel B1	P2-1	P2-2	Typical ±25mV of B2	mV	mV	mV
Channel B2	P2-3	P2-2	Typical ±25mV of B1	mV	mV	mV
xB	P2-4	P2-2	0.3V@20°C ±1mV/°C			
Average Ch. V	Calculate		(A1+A2+B1+B2) / 4	mV	mV	mV
Average Ch. mV/kA	Calculate / confirm which is used for tests below		☐ Avg.Ch.V / kA ☐ from table 4.1 ☐ from factory data	mV	mV	mV
Main Output **Set SW6** **mA**:all off **10V**:off.off.on.on	P3-1	P3-2	mA burden or V-out ≤ 10.2V	m**A** V	m**A** V	mA V
PE Output **Set PE SW5** **mA**:all off **10V**:off.off.on.on	P9-1	P9-2	mA burden or V-out ≤ 10.2V	mA V	mA V	mA V
Display	Visual read of LCD		±2% of "Main Output"	__ __ __.__	__ __ __.__	mV

TRIP POINT AS FOUND	TRIP POINT ADJUSTMENT	As-Left
Trip1____Avg.Ch.V x Avg.Ch.mV/kA= ____kA	Calc Trip1: ___kA x Avg.Ch.mV/kA=set to ____mV	mV
Trip2____Avg.Ch.V x Avg.Ch.mV/kA= ____kA	Calc Trip2: ___kA x Avg.Ch.mV/kA=set to ____mV	mV
Trip3____Avg.Ch.V x Avg.Ch.mV/kA= ____kA	Calc Trip3: ___kA x Avg.Ch.mV/kA=set to ____mV	mV

AFTER RESCALING/ADJUSTMENT MU: Serial#_____ MU type _____

HEAD: Serial# A half _____ Serial# B half _____ P1=_____mm P2 =_____mm

Main Measurement Full Scale_____kA : Output_____ Trip1@_____kA

Optional PE Measurement FS_____kA : Output_____ Trip2@_____kA Trip3@_____kA

4.12 Rescaling LKAT using LKAT Tester 'MUT'

The section outlines the steps required to re-scale an LKAT and document results on Form 4.1b. This is to be used together with the LKAT Tester Manual 045808 and its drawings.

NOTE : The LKAT MUT is NOT a calibration tool.

Rescaling LKAT systems using the LKAT MUT is effective and moderately accurate, However, it will NOT realize 'datasheet' measurement performance and accuracy.

1) TAKE AND RECORD 'BASIC SYSTEM' AND 'MEASUREMENT DATA'

Document the system information on the top of Form 4.1b using data from the LKAT system labels on the metering unit.

Measure and record LKAT system 'As-Found' data in the 'BASIC SYSTEM' and 'MEASUREMENT DATA' sections of From 4.1B.

Best practice is to use the first data column to record data at 0kA with the LKAT head connected to the metering unit. The head can be on a 'dead' bus or the head can be removed from the bus if needed. Use the second data column to record data with the head connected to the metering unit and mounted on a live bus at a known kA level.

Make sure to record the bus bar kA level for each column and check the box to confirm the source.

After measuring and recording the information,
Calculate the Average Ch.V and the Average Ch.mV/kA and record them on Form 4.1b.
Be sure to check the box to indicate the source of the Avg.Ch.mV/kA you are going to use.

The best source is your calculation.
The second best source is the factory information (you must contact DynAmp to get this).
The third best source is the Table 4.1 in the MUT manual.

For this example to rescale LKAT2 for 20kA:

6.31mV/kA	Avg.Ch.mV/kA from table 4.1 in MUT manual
x 20kA	the new desired rescaled full scale
126.20mV	Avg.Ch.V @ 20kA full scale

2) RESCALE OUTPUT : MAKE CONNECTIONS TO ALLOW RESCALING

Disconnect mains power from the LKAT system
Connect the MUT head cables to the LKAT metering unit head input connectors
Disconnect the normal LKAT system output cable and DO NOT connect MUT output cable.
Connect DMM-1 to the MUT banana jacks and set it to measure DC mV
Connect DMM-2 to the LKAT main measurement output at the LKAT PCB edge connector.

\+ lead to P3-1
- lead to P3-2

If the LKAT measurement output is mA, and DMM can accurately measure 20 mA,
All should be OK, set the DMM to measure 20mA

If the measurement output is configured for mA, but DMM cannot measure mA accurately,
temporarily change the measurement output to 10V full scale using SW6 on the PCB
Now set the DMM to measure 10V

(for this example, we will assume that the DMM can accurately measure 20mA)

Re-connect mains power to the LKAT system

2.1) RESCALE OUTPUT : 1st GAIN RE-ADJUSTMENT

Using the controls on the MUT, adjust so DMM-1 reads 126.20mV
(the MUT is now simulating a head on a 20kA bus bar)
Observe the measurement on DMM-2.
Adjust the 10 turn "GAIN" potentiometer on the main PCB to realize exactly 20mA on DMM-2.
If this is not possible, move the GAIN potentiometer to approximately center of the 10 turns,
then use SW3 to adjust 'coarse' gain to get as close to 20mA as possible.
(SW3 position 1 has the lowest effect while position 10 has the greatest effect).
After using SW3, use the GAIN potentiometer again to realize exactly 20mA on DMM-2.

2.2) RESCALE OUTPUT : 1st ZERO RE-ADJUSTMENT

If you calculated 'Avg.Ch.V at 0kA' on Form 4.1b,
use the controls on the MUT to adjust so DMM-1 reads this Average Channel Voltage.
If you did not calculate Avg.Ch.V at 0kA, simply adjust MUT so DMM-1 reads 0mV.
(the MUT is now simulating a head on a 0kA bus bar)
Observe the measurement reading on DMM-2
If the LKAT system is configured for -20mA…0mA…+20mA, DMM-2 should read 0mA
If the LKAT system is configured for -16mA…+4mA…+20mA, DMM-2 should read 4mA
If the LKAT system is configured for +4mA…+12mA…+20mA, DMM-2 should read 12mA
(this general zero offset can be set/changed via SW2 on the LKAT2 main PCB)
Adjust the 11 turn "BIAS" potentiometer on the LKAT2 main PCB to try to realize exactly 0 or 4 or 12mA as needed on DMM-2.

2.3) RESCALE OUTPUT : 2nd GAIN CHECK / ADJUSTMENT

Gain must be checked again after any zero adjustment
Using the controls on the MUT, adjust so that DMM-1 reads 126.20mV again
(the MUT is again simulating a head on a 20kA bus bar)
Observe the reading on DMM-2.
Adjust the 11 turn "GAIN" potentiometer on the LKAT2 main PCB to try to realize exactly 20mA on DMM-2.

2.4) RESCALE OUTPUT : 2nd ZERO CHECK / ADJUSTMENT

Zero must be checked again after any gain adjustment
Using the controls on the MUT, adjust so that DMM-1 reads Avg.Ch.V at 0kA or 0.0mV
(the MUT is now simulating a head on a 0kA bus bar)
Observe the measurement on DMM-2
Adjust the 11 turn "BIAS" potentiometer on the LKAT2 main PCB to try to realize exactly 0 or 4 or 12mA on DMM-2.

2.5) RESCALE OUTPUT : FINALIZE MEASUREMENT ADJUSTMENTS

Repeat steps 2.3 and 2.5 as needed until no additional adjustments are required.
If you changed output type for rescaling, remember to reset SW6 back to the desired output.
Record all results in the 'Rescale' section of Form 4.1B.

3) CHECK/ADJUST TRIP SETPOINT

Anytime measurement Gain or Zero is adjusted, Trip points must be checked/adjusted afterwards.

When checking or adjusting the trip point, only consider trip points and voltages when you are moving from a 'green / no-trip' condition to a 'red / tripped' condition. This is important to eliminate any hysteresis around the trip point.

3.1) CHECK/ADJUST TRIP SETPOINT : PREPARE AND CHECK

Connect the MUT head cables to the LKAT metering unit
This time, also connect the MUT output cable to the LKAT metering unit.
Connect DMM-1 to the MUT banana jacks and set it to measure DC mV.

Using the MUT controls, adjust so that the LKAT PCB and MUT Trip LEDs are green (no-trip).
Then slowly adjust the MUT controls until LKAT PCB and MUT Trip LEDs are red (tripped).
Note the mV reading on DMM-1 and record on Form 4.1b "As-found"
This as-found mV reading x Avg.Ch.mV/kA = the existing kA trip point.

3.2) CHECK/ADJUST TRIP SETPOINT : ADJUST IF NEEDED

Use the same Avg.Ch.mV/kA to calculate what the Avg.Ch.V should be at desired trip point.
LKAT2 example :

6.31mV / kA	from Form 4.1b
x -2.0kA	desired Trip1
-12.62mV	the Avg.Ch.V at the desired -2kA trip point

Using the controls on the MUT, adjust so DMM-1 reads the desired trip point of -12.62mV
(the MUT is now simulating a head on a bus bar with -2.0kA reverse current)

There are two potentiometers on the LKAT2 main PCB, noted at "TRIP1" as "M" and "F".
"M" is the course/rough adjustment, "F" is the fine adjustment.
Adjust "M" until the LEDs just change color from green to red (Trip1 is now tripped)
Next, adjust "F" until the LEDs just change color from red to green (Trip1 is now 'not-tripped')
Now adjust "F" again until the LEDs just change color from green to red to simulate the bus current going from a non-tripped/OK condition to a tripped/ALARM condition.

Now, use the controls on the MUT to change the 'bus current' and check the actual trip point.
In this example,
Adjust the MUT to move DMM-1 voltage closer to zero than the calculated trip point
The LEDs will change from red to green
Then slowly adjust the MUT to move the voltage farther from zero until
the LEDs change to red noting the actual voltage on DMM-1 where the trip occurred.
The existing trip point in kA is calculated as (DMM-1 voltage) X (Avg.Ch.mV/kA).

Repeat this process, adjusting "F" (and if needed, "M") to realize the desired trip point.
Record final Trip Avg.Ch.V on Form 4.1b

4) WRAP UP AND DOCUMENT

Record all final information in the 'RESCALE' area of Form 4.1B including and changes of metering unit and/or heads used by serial number at the bottom of the form

E-mail one copy to help@DynAmp.com for the following purposes
DynAmp will create and send a new system label to be applied to the Metering Unit
DynAmp will update our internal records to note the changes made
NOTE: If form is not sent to DynAmp, any active warranty coverage will be VOID.

Keep one copy for your records.

FORM 4.2
LKAT METERING UNIT TEST MEASUREMENT FORM
VERIFICATION USING METERING UNIT TESTER ("MUT")

Serial Number _____

NOMINAL Average Channel Voltage (mV / kA) = _____
(from Table 4.1)

Rectifier Operating Current when As-Found Data was recorded (kA) = _____

SCALED Average Channel Voltage (mV) = _____
(from Equation 4.1)

Trip 1 Setpoint (kA) = _____ Scaled Average Channel Voltage (mV) = _____

Trip 2 Setpoint (kA) = _____ Scaled Average Channel Voltage (mV) = _____
(Optional)

Trip 1 Setpoint (kA) = _____ Scaled Average Channel Voltage (mV) = _____
(Optional)

MEASURE <OR> CHECK	**Unit Of measure**	**(+) DMM at**	**(-) DMM at**	**ACCEPT-ABLE RANGE**	**DATE ___/___/___**	**DATE ___/___/___**	**DATE ___/___/___**
AD Trip					☐ OK	☐ OK	☐ OK
Trip1					☐ OK	☐ OK	☐ OK
Trip2 *(Optional)*					☐ OK	☐ OK	☐ OK
Trip3 *(Optional)*					☐ OK	☐ OK	☐ OK
Metering Unit Main Output	DC volts	P3-1	P3-2	10.2V max			
Metering Unit PE Output *(Optional)*	DC volts	P3-1	P3-2	10.2V max			
RMS Display reading *(Optional)*	kA			±2% of measured output current			
Current Loop Burden	Ohms	P3-1	P3-2	500 ohms (maximum)			

5. CALIBRATION

5.1 GENERAL

No calibration required for the LKAT Metering Unit Tester

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6. TROUBLESHOOTING AND REPAIR

6.1 GENERAL

Troubleshooting should begin by isolating the problem to either the Measuring Head or the Metering Unit. Repair, if indicated, should be completed by a qualified technician or at the DynAmp, LLC factory.

6.2 SERVICE ASSISTANCE

For further assistance, contact DynAmp Customer Support.

6.3 SPARE PARTS ORDERS - ROUTINE OR EMERGENCY

Requests for spare parts, either in an emergency or for a routine order, should be directed to "Inside Sales" at DynAmp, LLC during normal hours, if possible, or refer to DynAmp, LLC Customer Support (in front of manual) for after hour Critical Service emergencies. When contacting us, please present as much information as possible including the related equipment Model Number and Serial Number; the required part name and its DynAmp, LLC item number (and other identifying or vendor number(s); and your time needs. An approved Purchase Order Number should be given with your order.

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7. DRAWINGS

TABLE 7.1
DRAWING LIST

DRAWING TITLE	NUMBER	REVISION
Outline, LKAT Metering Unit Tester	02B109284	A
Interconnection, LKAT Metering Unit Tester	02B109285	A
Interconnection, LKAT Sigma / OEM Metering Unit Tester	02B109329	A
Assembly, LKAT Metering Unit Tester Head Adapter Cables	83A109413	-
Assembly, LKAT Metering Unit Tester Output Adapter Cable	83B109416	-