

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

SERVICE INFORMATION

CALIBRATION & MAINTENANCE

4-CHANNEL CHARGE AMPLIFIER

MODEL CA-4

PART No. 876192

USER MANUAL

LING DYNAMIC SYSTEMS LTD.

CA4 MK II

4-CHANNEL CHARGE AMPLIFIER

Calibration & Maintenance Manual

Serial No. _____

Original date of issue. 7 - 2 - 84

Amendments.

Date.	Amendment No.	Serial Nos. Affected.	Amended By.
19.10.88	1 (ECN 4634)	-	M.Y.
2.3.89	2 (ECN 4740)	-	R.K.B.
28.01.92	3 (ECO 5415)	-	M.J.P

LING DYNAMIC SYSTEMS

TABLE OF CONTENTS

		Page No.
	SECTION 1 - INTRODUCTION	2
	SECTION 2 - SPECIFICATION	3
2.1	Charge Amplifier	3
2.2	Monitor and Display	3
2.3	General	4
	SECTION 3 - PROCEDURE UPON RECEIPT	5
3.1	Inventory	5
3.2	Mains Supply Connexion	5
3.3	Mains Supply Voltage Setting	5
	SECTION 4 - TECHNICAL DESCRIPTION	6
4.1	Charge Amplifier	6
4.2	Overload Indication	6
4.3	Normalising Amplifier	6
4.4	Monitoring Section	6
4.5	Power Supply	8
4.6	Digital Display	9
	SECTION 5 - TEST AND CALIBRATION	9
5.1	Initial Settings	9
5.2	Power Supply	9
5.3	Charge Amplifier	9
5.4	Digital Display	10
5.5	Limit Level	11
5.6	DC proportional to g Output	12
5.7	Noise Levels	12
	Fig. 1 - Transformer Primary Connections	13
	CIRCUIT DIAGRAMS ,	
	958540 (Z) Main Interface P.C.B.	
	958550 (Y) Digital Display and Switch P.C.B.	
	962440 (X) Schematic Wiring Diagram.	

No. 876192

SECTION 1 - INTRODUCTION

This manual gives a technical description and calibration procedure for the four-channel charge amplifier, CA4.

Operating instructions are given in the Operator's Manual (Part No. 876191).

Always disconnect the unit from the mains supply before removing components or internal connexions.

The instrument contains devices which are sensitive to electrostatic charge and may be damaged if the usual precautions are ignored.

Equipment Required for Test and Calibration

Oscilloscope	Bandwidth 1 MHz sensitivity 5 mV/cm (ideally memory or storage for use at low frequencies).
Digital Voltmeter	a.c. and d.c. ranges up to 20 volts. Resolution 0.1 mV. Frequency range 1 Hz to 10 kHz.
Sine Wave Oscillator	Frequency range 1 Hz to 10 kHz.
Frequency Counter	Capable of reading 40 kHz with 10 Hz resolution.
Continuity Tester	
Capacitors	1 nF ± 0.5% (4 off) and 10 nF ± 5% (1 off).

Connecting leads as required.

SECTION 2 - SPECIFICATION

2.1 Charge Amplifier

There are four identical charge amplifiers in the unit.

Transducer sensitivity	1 to 99,9 pC/g
Input range	1 to 10000 pC. Overload indicator lights if the signal exceeds the capability of the charge amplifier.
Output	10 mV/g or 100 mV/g selected by a switch on the rear panel. Indication on front panel. Maximum load 2 k. Maximum output 10 volts peak.
Frequency response	10mV/g:- less than 3% down at 1,5 Hz and 10 kHz. 100 mV/g, 10 pC/g:- as above 100 mV/g, 10 pC/g:- less than 3% down at 1,5 Hz and 5 kHz.
Gain accuracy	± 2% at 400 Hz
Gain stability	1% change for a 10 nF change in source capacitance
Noise, referred to input	23 uV, input termination 1 nF, measurement bandwidth 10 kHz.
Cross channel interference	- 55 dB at 1 kHz

2.2 Monitor and Display

The signal from one selected channel is taken to the monitoring and display section.

R.M.S. detector	True r.m.s. Signal crest factor of 7 produces an additional 1% error. Calibration: peak or r.m.s.
d.c. output	For normalised output of 10 mV/g: 50 mV d.c./g 200 g maximum. For normalised output of 100 mV/g: 500 mV d.c./g 20 g maximum. Maximum load 2 k, accuracy ± 3%, 3 Hz to 5 kHz.

Digital display	Two ranges reading to 99,9 g and 999 g. Range is changed automatically at approximately 90 g. Maximum reading 999 g for normalised output of 10 mV/g. 100 g for 100 mV/g. Accuracy ± 3% of reading ± 0,1 g (± 0,2 g on 10 mV/g) 3 Hz to 5 kHz.
Acceleration limit	Level set by means of front panel mounted control. Range of adjustment 0 - 999 g for normalised output of 10 mV/g, 0 - 100 g for 100 mV/g. Over limit signal causes indicator to flash and potential free relay contacts to change state. Both normally open and normally closed contacts, rated at 200 mA 50 V d.c. 3 W max, are provided.
Auto Monitor	Each channel signal level is monitored for approximately 8 seconds. A signal level exceeding the Acceleration Limit causes the scanner to stop at that channel.
Control Interlock	Operation of the normalised output level selector switch causes the Acceleration Limit to trip.

2.3 General

Dimensions	Standard 19" rack mounting case 133 mm (5 1/4") high and 300 mm (11 3/4") deep.
Power requirements	110/120 or 220/240 volts 50 - 60 Hz, 22 VA
Weight	7 kg

SECTION 3 - PROCEDURE UPON RECEIPT

3.1 Inventory

Four Channel Charge Amplifier, CA4.
Mains supply IEC connector.
4 off Microdot socket screening caps.
4 off BNC plugs.
4 off self adhesive feet.
Spare fuse, 1A 20 mm x 5 mm.

3.2 Mains Supply Connexion

The mains connexion is made via a flexible three core cable. If a fused plug top is used for the supply to the unit the fuse should be rated at 3A.

3.3 Mains Supply Voltage Setting

The unit is supplied wired for use on mains supplies of 240 volts. To modify for use of other voltages proceed as follows:

a) Isolate from supply and remove the top of the case. The mains transformer is mounted on the rear panel, and the primary connexions are nearer the front of the unit.

b) Refer to Transformer Primary Connections. Fig 1 Sheet 13.

c) Refit the top of the case.

SECTION 4 - TECHNICAL DESCRIPTION

Main Interface P.C.B. Circuit Diagram 958540

4.1 Charge Amplifier

The four charge amplifiers are mounted on the Main Interface printed circuit board and are screened from other components and each other.

IC6 is a low noise FET input operational amplifier operating as a charge amplifier due to feedback through C3. The effective input capacitance of the circuit is given by the value of C3 multiplied by the open loop gain of IC6, and for the components used is approximately 100 uF. Additional capacitance across the input due to connecting cable has a negligible effect.

The resistors R12, R13 and R14 provide DC stabilisation for IC6. The values used are equivalent to a feedback resistance of 2000 M giving a low frequency -3dB point of less than 0.1 Hz. The high frequency - 3dB point is at approximately 80 kHz. Preset RV4 is used to reduce the voltage offset at the output of IC6 so that the required voltage swing is available.

4.2 Overload Indication

If a high sensitivity accelerometer is used the output of IC6 may be limited by the power supply rails. To warn the user that this is likely to occur an overload indicator is fitted. The output of IC6 is full wave rectified by IC1 and compared with a reference level by IC2. The signal at IC2 pin 3 is a half amplitude full wave rectified version of IC6 output. It is compared with a fixed 5.7 volt reference on pin 2 of IC2. If either peak of IC6 output exceeds 11.4 volts the output of IC2 goes low triggering the monostablee formed by IC1 which drives the Overload Indicator on the front panel.

4.3 Normalising Amplifier

The normalising amplifier, IC4, standardises the vibration signal to either 10 mV/g or 100 mV/g. The level is set by the analogue switches, IC7 and IC8 which select the appropriate feedback resistor. The switches are controlled by the rear panel 10 mV/g - 100 mV/g switch via R29, R32, D6 and D9. This switch also lights the appropriate indicator above the front panel Output socket. The gain of the normalising amplifier is set to suit the transducer being used by the Sensitivity pC/g control which is a variable resistance having a maximum value of 999k. Presets RV2 and RV3 provide gain adjustment for 10 and 100 mV/g respectively. IC3 provides buffering for the D.C. blocking capacitor C5 and drives the front and rear panel output sockets.

4.4 Monitoring Section

The output from one channel is switched to the monitoring section by IC10. The r.m.s. to d.c. conversion is performed by IC15. Averaging is provided by C18 and a buffer in IC15 together with C16, C17 and R51 form an output filter to give the additional smoothing needed for operation at low frequency. d.c. offset at the output of IC15 is nulled by RV6. The change in calibration required for sine or random signals is performed by IC16, gain being set by switches in IC23. IC9 provides the d.c. proportional to g output. The attenuator formed by R35, R36 and R37 reduces the d.c. level at the output of IC16 to one tenth when the 100 mV/g normalised level is selected. The output from the attenuator is buffered by IC12 which supplies the DVM IC on the front panel. If the output of IC12 exceeds approximately 900 mV IC26 switches the DVM input through the attenuator formed by R38, R39 and R40 to change to the higher display range. IC26 also illuminates the decimal point on the display on the lower range.

The Limit level from the front panel is buffered by IC19 and then compared with the output of IC16 by IC22. If the limit level is exceeded IC22 output goes low and this sets flip flop IC27. The Q output of IC27 going high enables the Over Limit L.E.D. flasher astable circuit, IC28, R58 and C25, and turns off the Over Limit relay RL1 via TR1. The flip flop IC27 is also set by the interlock input going low as the 10 mV/g - 100 mV/g switch on the rear panel is operated.

Six of the front panel switches are connected to an encoding IC, IC11, which provides debouncing and two-key rollover. The code for the last switch pressed is present on the output of IC11.

Last switch pressed	IC11 Outputs			
	D	C	B	A
Read Channel Level 1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
Set Limit	0	1	0	0
Auto Monitor	1	0	0	0

Unless the CA4 is in the Auto Monitor mode, the output codes are decoded by IC18 which controls the analogue switches in IC10 and the L.E.D.s in the front panel switches.

In the Auto Monitor mode the outputs of IC11 are blocked by half of IC14 and IC25 while the A and B inputs of IC18 are driven from IC17 through the other half of IC14. IC17 is connected as a counter which is held at zero (Read Channel Level 1) until the Auto Monitor mode is selected, when it counts the rising edges of the oscillator formed by IC28, R66, RV8 and C24. At each rising edge the next channel is selected and switched to the monitoring section. If the over limit condition is detected the oscillator output is blocked by IC25, to stop the scanning.

4.5 Power Supply

The output from the supply transformer is full wave rectified by BR1 and smoothed by C28 and C29 to give plus and minus 23 volts. This is regulated to plus and minus 15 volts by IC29 and IC31 respectively. A third regulator, IC30, provides +5 volts from the +15 volt rail for the front panel DVM. The minus 5 volt supply required by the DVM IC is provided by the zener diode D12 and R62 from the -15 volt supply.

The transformer secondary is protected by fuses FS1 and FS2 rated at 1A. The voltage regulators are internally protected against overload or short circuit.

4.6 Digital Display

Digital Display and Switch P.C.B.s Circuit Diagram 958550

The auto-ranged Analogue Level from the Main Interface board is filtered by R2 and C3 and digitised by IC1. The calibration of IC1 is adjusted by RV2, RV1 controls the internal clock frequency. The output from IC1 drives the three seven segment displays directly. The Sine/Random push button switch is debounced by one half of IC2 which then clocks the other flip flop in IC2 to alternately set the Sine output, pin 12 of IC2, high or low. This controls the gain of IC16 on the Main Interface board. The outputs of the second flip flop control the g r.m.s. and g peak L.E.D. indicators via TR1 and TR2.

The Read Channel Level, Read Limit and Auto Monitor push button switches are connected in a matrix configuration and connect to IC11 on the Main Interface board.

SECTION 5 - TEST AND CALIBRATION

5.1 Initial Settings

Check that the unit is set for the mains supply voltage to be used (see section 3.3).

Set all Sensitivity pC/g controls on the unit to 10,0. Set the rear panel 10 mV/g - 100 mV/g switch to 10 mV/g. Set the Set Limit adjuster fully clockwise.

5.2 Power Supply

Measure the voltages on the test points listed in the table below with respect to the bus bar on the rear panel. Check that the readings are within the specified tolerances.

Test Point	Voltage	Tolerance
TP3	+15 volts	± 0,6 volts
TP4	-15 volts	± 0,6 volts
TP5	+5 volts	± 0,2 volts
TP6	-5 volts	± 0,5 volts

Check that the noise on the ± 15 volt supplies is less than 4 mV r.m.s. 1 Hz to 10 kHz.

5.3 Charge Amplifier

(The operation of each channel should be tested in turn.)

1. Monitor the voltage on TP1 and adjust RV4 to reduce the voltage to less than 50 mV d.c.

2. Connect the oscillator output to the Input microdot socket via a 10 nF capacitor. Set the oscillator to 5 Hz and monitor TP1 on the oscilloscope. Increase the oscillator output level until the Overload indicator begins to flash. Check that the waveform on the oscilloscope is a sinewave with an amplitude of more than 20 volts peak to peak.

USE 1nF

3. Disconnect the oscillator and 10 nF capacitor. Connect the DVM to the output BNC socket and adjust RV1 to null the d.c. offset at the output to less than 1 mV.

4. Connect the oscillator output to the Input microdot socket via a 1 nF capacitor. Set the oscillator output to 5,00 volts r.m.s. at 400 Hz. Adjust RV2 to set the voltage at the output BNC socket to 5,00 volts r.m.s.

5. Check the gain at other settings of the Sensitivity pC/g control using the relationship:

$$\text{Gain} = \frac{10 \text{ pC/g}}{\text{Sensitivity pC/g}}$$

6. Set the Sensitivity pC/g control to 01,0. Set the oscillator output to 500 mV r.m.s. at 10 kHz. Check that the signal at the output BNC socket is not less than 4,85 volts r.m.s.

7. Repeat the test in paragraph 6. with the oscillator frequency set to 1,5 Hz.

8. Set the 10 mV/g - 100 mV/g switch on the rear panel of the CA4 to 100 mV/g and set the Sensitivity pC/g control to 10,0. Set the oscillator output to 500 mV r.m.s. at 400 Hz. Adjust RV3 to set the voltage at the output BNC socket to 5,00 volts r.m.s.

9. Set the Sensitivity pC/g control to 01,0. Set the oscillator output to 50mV r.m.s. at 5 kHz. Check that the signal at the Output BNC socket is not less than 4,85 volts r.m.s.

10. Depress the Read Channel Level p.b. switch for the channel currently being tested. Check that as it is pressed the integral L.E.D. indicator lights and that the indicators in the other three p.b. switches are all extinguished. Vary the oscillator output level and check that the digital display responds to a change in level. Also check that both the front and rear panel Inputs and Outputs are functional by transferring the test leads from one to the other.

11. Set the 10 mV/g - 100 mV/g switch on the rear panel of the CA4 to 10 mV/g and set the Sensitivity pC/g control to 10,0. Repeat the procedure from the beginning of paragraph 5.3 for each of the four channels in turn.

5.4 Digital Display

1. Connect TP2 on the Display p.c.b. to the +5 volt supply TP5 on the Main Interface p.c.b. Check that the digital display shows 8,8,8. Remove the connexion.

2. Adjust RV1 on the Display p.c.b. to obtain a frequency of 40 kHz on TP1 on the same p.c.b.

3. Disconnect the oscillator from the microdot Input socket. Set the 10 mV/g - 100 mV/g switch on the rear panel of the CA4 to 10 mV/g. Adjust RV6 to null the d.c. level at TP2 on the Main Interface p.c.b.

4. Adjust RV7 to null the d.c. level at TP7. Depress the Sine/Random p.b. switch and re-adjust RV7 as necessary to obtain the best null for both g r.m.s. and g peak settings. Also check that the g r.m.s. and g peak illuminated indicators change state each time the Sine/Random p.b. switch is depressed.

5. Adjust RV5 to set the digital display on the CA4 to read 00,0.

6. Connect the oscillator output to the CHANNEL 1 Input microdot socket via a 1 nF capacitor. Set CHANNEL 1 sensitivity pC/g to 10,0. Depress the Read Channel Level 1 p.b. switch and check that the integral L.E.D. indicator is illuminated. Set the oscillator output to 900 mV r.m.s. at 400 Hz. Set the Sine/Random setting to g r.m.s. and adjust RV2 on the Display p.c.b. to obtain an indication of 90,0 on the display.

7. Slowly increase the oscillator output level and check that the CA4 display changes range before reaching 99,9.

8. Set the oscillator output to 5,00 volts r.m.s. at 400 Hz and check that the CA4 display indicates 500 ± 15 g r.m.s.

9. Set the 10 mV/g - 100 mV/g switch on the rear panel of the CA4 to 100 mV/g. Set the oscillator output to 500 mV r.m.s. at 400 Hz and check that the CA4 display indicates 50,0 ± 1,5 g r.m.s.

10. Set the oscillator output to 1.00 V peak (0.707 V r.m.s.) at 400 Hz and check that the CA4 display indicates 100 g ± 3 g peak. (3)

11. Vary the oscillator output level between 4,75 mV r.m.s. and 5,25 mV r.m.s. and check that the CA4 display indication is 00,5 g r.m.s. Adjust RV5 if necessary to achieve this.

12. Set the 10 mV/g - 100 mV/g switch on the CA4 to 10 mV/g and repeat the previous paragraph, adjusting RV6 if necessary to achieve the required indication.

13. Repeat the two previous paragraphs as necessary until further adjustment is not required to achieve an indication of 00,5 g r.m.s. under both conditions.

5.5 Limit Level

1. Set the oscillator output level to zero. Depress and release the CA4 Limit Reset p.b. switch and check that the Limit L.E.D. indicator is illuminated constantly. Also check that there is continuity between the N.C. Over Limit contacts and an open circuit between the N.O. contacts.

2. Change the position of the 10 mV/g - 100 mV/g switch and check that the CA4 Limit L.E.D. indicator commences to flash. Also check that there is continuity between the N.O. Over Limit contacts and an open circuit between the N.C. contacts. Depress the Limit Reset p.b. switch to restore the Limit L.E.D. indicator to a steady 'on' state.

3. Depress the CA4 Set Limit p.b. switch and check that its integral L.E.D. lamp lights and remains lit after the push button is released. Set the CA4 10 mV/g - 100 mV/g switch to 10 mV/g and adjust the Set Limit control through the front panel to produce an indication of 90,0 on the CA4 display.

4. Depress the Read Channel Level 1 p.b. switch and increase the oscillator output to check that when the CA4 display reaches 90,0 ± 2,0 the Limit L.E.D. indicator begins to flash.

6. Depress the Auto Monitor p.b. switch. Check that as it is pressed the integral L.E.D. indicator lights and remains lit when it is released. Check that the four L.E.D. indicators in the Read Channel Level p.b. switches light in turn one at a time starting with 1. Adjust RV8 to achieve an 'on' time for each channel of approximately 8 seconds.

7. Increase the oscillator output level to greater than 900 mV r.m.s. Check that when the scanner comes to channel 1 the display indication increases to greater than 90,0 and the Limit L.E.D. indicator commences to flash. Also check that the scanner remains at channel 1 until the oscillator level is reduced and the Limit L.E.D. indicator is restored to its steady 'on' state by pressing the Limit Reset p.b. switch.

5.6 d.c. proportional to g Output

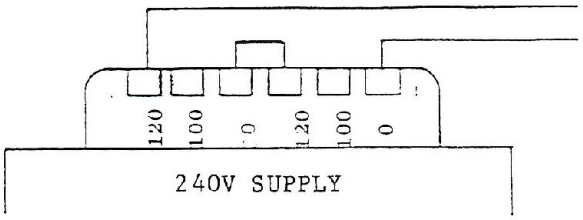
1. Depress the Read Channel Level 1 p.b. switch and set CHANNEL 1 Sensitivity pC/g to 10,0. Set the oscillator output to 5,00 volts r.m.s. at 400 Hz. Measure the voltage on TP7 and check that this is 5,00 ± 0,05 V d.c. with the Sine/Random p.b. selector switch to g r.m.s. Check that when set to g peak the voltage on TP7 is 7,07 ± 0,1 V d.c.

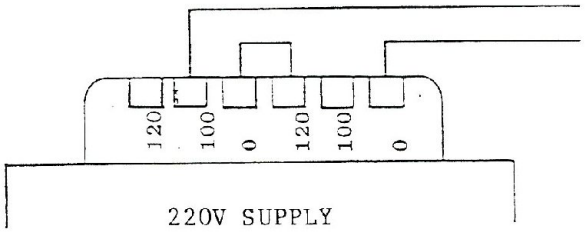
2. Set the oscillator output to 2,00 volts r.m.s. at 400 Hz, and set the Sine/Random p.b. selector switch to g r.m.s. Check that the voltage at the d.c. proportional to g BNC socket is 10,0 ± 0,2 V d.c.

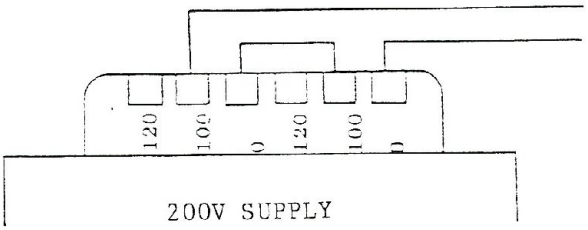
5.7 Noise Levels

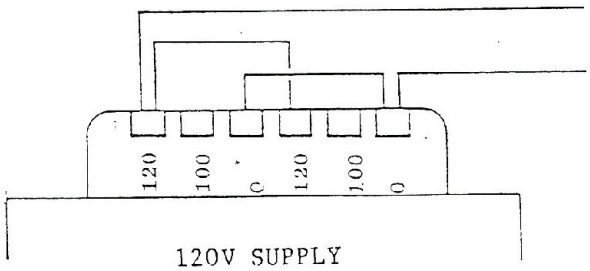
1. Disconnect the oscillator and connect a 1 nF capacitor across the Input microdot socket for each channel. (It is best to solder these inside the unit behind the rear sockets or between lugs 2 and 4 on the Main Interface p.c.b.) Fit the covers to the unit. Set the 10 mV/g - 100 mV/g switch to 10 mV/g and the Sensitivity pC/g control to 01,0 on all channels. Measure the output from each channel and check that it is less than 230 uV r.m.s. (measurement bandwidth 10 kHz). Remove the 1 nF capacitors.

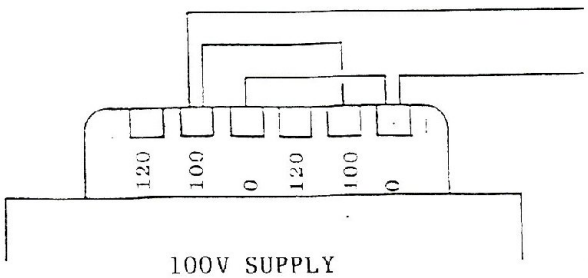
2. Connect the oscillator to the Input microdot socket of CHANNEL 2 via a 1 nF capacitor. Set the 10 mV/g - 100 mV/g switch to 100 mV/g and the Sensitivity pC/g control to 10,0 on all channels. Set the oscillator output to 500 mV r.m.s. at 1 kHz. Check that the crosstalk at CHANNEL 3 Output BNC is less than 9 mV r.m.s.











No. 876192

Figure 1 - TRANSFORMER PRIMARY CONNECTIONS

Amendment No. 2

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP