User's Guide

DFG51
Digital Force Guage

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1 Introduction

1.1 General Description

The OMEGA® DFG51 microprocessor-based digital force gauge is small, rugged, and lightweight, which makes it an ideal instrument for portable handheld force measurement. The DFG51 has many features which allow it to be used in a variety of applications ranging from simple push-pull force measurement to being part of a sophisticated system for process control or automated testing. The gauges are shipped in a cushioned carrying case with a set of attachments: chisel point, V-groove cone, flat head, hook, and an extension rod. An AC adapter/charger and a certificate of calibration are also included.

1.2 Features

- Standard RS-232, Analog, and Open Collector Inputs
- Peak Memory for Tensile and Compressive Loads
- Pushbutton Selectable Engineering Units in Lbs, Kg, or N
- Programmable Analog and Digital Filtering
- External Trigger Mode for Slave Operation
- N.I.S.T. Calibration Certificate Supplied

1.3 Available Models

MODEL	SCALE VS. RESOLUTION		
	POUNDS	KILOGRAMS	NEWTONS
DFG51-.25	0.25 x 0.0001	100 x 0.05 g	1 x 0.0005
DFG51-.5	0.5 x 0.0002	250 x 0.1 g	2.5 x 0.001
DFG51-2	2 x 0.001	1 x 0.0005	10 x 0.005
DFG51-10	10 x 0.005	5 x 0.002	50 x 0.02
DFG51-20	20 x 0.01	10 x 0.005	100 x 0.05
DFG51-50	50 x 0.02	25 x 0.01	250 x 0.1
DFG51-100	100 x 0.05	50 x 0.02	500 x 0.2
DFG51-200	200 x 0.1	100 x 0.05	1000 x 0.5

2.1 Unpacking

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of the shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.
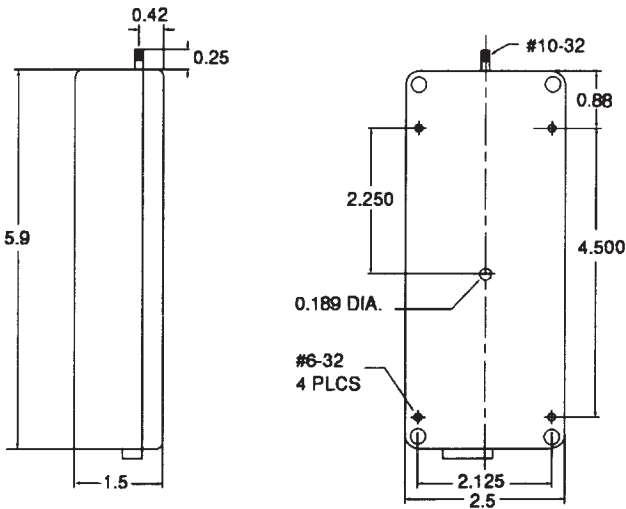
2.2 Mounting Procedure

Figure 2-1. Mounting Dimensions

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To facilitate permanent mounting, the DFG51 has four #6-32 holes and a load-carrying reamed hole to accept a 3/16" diameter dowel pin. In order not to interfere with the internal components of the instrument, this pin should not protrude more than 1/8". Due to low load carrying capacity of the threaded holes, it is important to use the dowel pin in all cases. The position of the mounting holes is shown in Figure 2-1.

2.3 Power Supply

The DFG51 is powered by a 7.2 volt NiCd battery. Since NiCd batteries will discharge while not in use, it may be necessary to recharge the unit when it has not been used for a long period of time. To charge the battery, plug the accompanying charger into a wall outlet and insert the charger jack into the receptacle of the gauge. Charge the battery for 16-18 hours to its full capacity. This will give 10-12 hours of continuous operation. When the gauge is turned off, do not leave the AC adapter plugged in indefinitely, because it will cause the battery to overcharge. During the operation of the gauge, the AC adapter may be plugged in at all times.

Note: When the set point mode is enabled, the power consumption of the gauge increases by approximately 15%. Therefore, in order to prolong the time between a re-charge of the battery, it is advisable to disable this feature if it is not being used.

The DFG51 has three levels of low battery voltage detection. At the first level, the gauge displays a steady "LOW BAT" when recharging is necessary. When this occurs, the gauge will continue to operate for approximately one hour. If the battery voltage drops further, the "LO BAT" indicator blinks. If the power drops down to a critically low level, the whole display, except the "LO BAT" indicator, will flash for three seconds, then the gauge will shut off. If the gauge is in the setup mode, or you are entering the set points and the battery power level drops to the lowest level, the gauge immediately returns to normal operation, the display flashes for three seconds, and the gauge shuts off. This shutoff feature at low voltage levels prevents damage to the battery due to deep discharge.

2.4 I/O Connector

The RS-232, Mitutoyo BCD, analog and set point outputs are
brought out through a 9-pin connector. This connector also serves
as an input for the externally triggered force capture. The pin
connections and their functions are described below. Note that pins
3, 4, 8 and 9 have dual functions, depending on the mode of
operation.
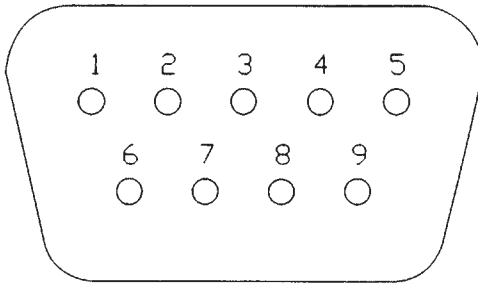
PIN #	SYMBOL	I/O	DESCRIPTION
1	RxD	I	RS-232 receive line
2	TxD	O	RS-232 transmit line
3	REQ	I	Mitutoyo request/External Trigger/Bit 3
4	CLK	O	Mitutoyo clock/"Within" set points/Bit 2
5	GND	–	Ground
6	AN	O	Analog Output
7	V	O	+12 VDC
8	RDY	O	Mitutoyo ready/"Lower than" set points/ Bit 1
9	DATA	O	Mitutoyo data/"Higher than" set points/Bit 0

Figure 2-2. I/O Connector

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3 ▼ Operation

3.1 Controls and Indicators (Refer to Figure 3-1)

Loading shaft

Display

9-Pin I/O connector

Charger/Adapter jack
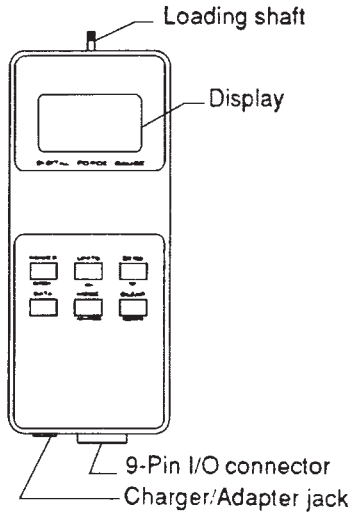
Figure 3-1. Controls and Indicators

POWER (ENTER)   Turns the gauge on and off. Also used to
                  select an option during gauge setup.

DATA   Mitutoyo, depending on setup.

UNITS (▲)   Steps through the choices of units.
                  The units are displayed on the right side of the
                  display. When entering the set points, this
                  button is used to increase the displayed value.

MODE (ADVANCE)   Used to step through a choice of modes of operation and/or display. Normal, Peak tension and Peak compression display choices are always present. Set points and external trigger mode appear only if enabled during setup. In the gauge setup mode, this button is used to scan through the options.

ZERO (▼)   Zeros the display and clears the Peak values. When entering the set points, this button is used to decrease the displayed value.

CLEAR (ESCAPE)   Clears all Peak values stored. Used to return from the gauge setup mode without saving changes.

3.2   Getting Started

1. Screw the appropriate attachment on the end of the threaded shaft (see Figure 3-1). Finger tighten only. This prevents possible damage to the low capacity internal load cell.

2. The housing is reversible so that the display remains upright when the gauge is mounted upside down on a stand. To reverse the case, unscrew the four screws on the back side of the gauge. Detach the top half from the lower half, rotate by 180°, plug the two halves together and tighten the four screws on the back side.

3. Press the POWER button to turn on the gauge. If the display remains blank or the "LO BAT" indicator appears on the display, the battery should be charged. (Refer to Section 2.3, Power Supply).

4. Use the UNITS button to select the desired units.

5. Use MODE to select a desired mode of operation. The choices are:
   T/C – Current reading mode
   T PEAK – Peak reading modes
   C PEAK

   If enabled, the following additional modes will show:
   SP – Set point entry mode
   A – Averaging mode
   Flashing T/C – External Trigger mode

   See the appropriate sections for explanations of these modes.

6. With the gauge mounted on a stand or held by hand, press and release the ZERO button. This automatically tares out the weight of any attachment on the shaft and sets the display to zero.

   Note: Although any weight or force up to 100% of the gauge capacity can be tared out, the net capacity decreases if the tare is more than 10% of the gauge nominal capacity.
   (NET CAPACITY = 110% NOMINAL CAPACITY - TARE)

7. The gauge transmits the current data in RS-232 and/or Mitutoyo BCD formats. RS-232 transmission can be selected to be just the numerical data (numeric format) or the numerical data with the units (full format). Refer to Section 3.7, Data Output, for details on transmission formats.

3.3 Gauge Setup

The DFG51 features selectable options, allowing the gauge to be set to the needs and tests being performed.

To get to the Setup Menu, perform the following steps:

1. Turn off the gauge.
2. Press and hold MODE button.
3. Turn on the gauge.
4. Release the MODE button.

The version number of the gauge software is displayed for half a second, followed by the appearance of "FLtA" on the display, confirming that you are in the main menu of the setup mode. In this mode, the secondary functions of the buttons are used.

ADVANCE   Used to scroll through the options.

ENTER   Used to make a selection.

ESCAPE   Use to abort a function, i.e., to return without saving changes.

After a change has been made, the selection "donE" appears on the display. To save the change, press ENTER. If there is more than one change, press ADVANCE to go to the main menu, make other changes, and after the last change, select "donE". If the changes are temporary and you do not want to save them in the non-volatile memory, press the ESCAPE button to go to the main menu, and press ESCAPE again to return to the normal operation of the gauge. These changes are lost once the gauge is shut off.

Note: the auto-shutoff feature is disabled when the gauge is in the setup mode.

An example of the main menu follows. The bracketed words in the first column are examples of the display appearance. The second column explains each feature.

SELECTION	FUNCTION
Analog Filter (FLtA)	Selection of Analog filter.
Digital Filter (FLtd)	Selection of Digital filter for current and peak readings.
RS-232 (232)	Enabling or Disabling of RS-232 communication and selection of parameters.
Output (out)	Selection of output formats.
Automatic transmission (Aout)	Selection of the frequency of automatic RS-232 transmission.
Automatic shutoff (Aoff)	Selection of time delay for automatic shutoff.
Initial Settings (init)	Selection of start-up default settings for units and mode.
Average (A)	Selection of Average mode parameters.
Calibration (CAL)	Gauge calibration.

Any selection from the top level menu leads to the options in the second level. The following tables show the options for each entry in the main menu. After completing the selections from the second level menu, the gauge displays "donE". If "donE" is selected, the gauge saves the changes and resumes normal operation. If the ESCAPE button is pressed at the "donE" prompt, the gauge returns to the main menu.

ANALOG FILTER

SELECTION	OPTION	EXPLANATION
2.5Hz RC filter for all readings	FA 0	Filter off
	FA 1†	Filter on

DIGITAL FILTER

SELECTION	OPTION	EXPLANATION
Digital filter for current (displayed) readings	FC 1	No filtering of current readings
	FC 2	Average of 2 samples
	FC 4	Average of 4 samples
	FC 8†	Average of 8 samples
Digital filter for peak readings	FP 1	No filtering of peak readings
	FP 2	Average of 2 samples
	FP 4	Average of 4 samples
	FP 8†	Average of 8 samples

Options marked † are factory settings.

RS-232

SELECTION	OPTION	EXPLANATION
Select	232d 232E†	Disable RS-232 communication Enable RS-232 communication
Transmission rate (Baud rate)	300 600 1200 2400 4800 9600†	300 bits/second 600 bits/second 1200 bits/second 2400 bits/second 4800 bits/second 9600 bits/second
Data bits, stop bits and parity	7-1E 7-1o 7-2E 7-2o 7-2n 8-1E 8-1o 8-1n† 8-2n	7 data bits, 1 stop bit, even parity 7 data bits, 1 stop bit, odd parity 7 data bits, 2 stop bits, even parity 7 data bits, 2 stop bits, odd parity 7 data bits, 2 stop bits, no parity 8 data bits, 1 stop bit, even parity 8 data bits, 1 stop bit, odd parity 8 data bits, 1 stop bit, no parity 8 data bits, 2 stop bits, no parity
Transmission format	Ft F† Ft n	Full data (numeric + units) Numeric data only

Options marked † are factory settings.

*If the RS-232 is disabled, the Baud rate, Data bits, stop bits and parity, and Transmission format are not applicable and do not appear on the display.

OUTPUT

SELECTION	OPTION	EXPLANATION
Selection of Mitutoyo BCD output	bcd d bcd E†	Mitutoyo output disabled Mitutoyo output enabled
Mitutoyo BCD polarity selection (+/-)	nPOL POL†	Mitutoyo data without polarity (absolute value) Mitutoyo data with polarity
Selection of Set Point	SP d† SP E	Set points disabled Set points enabled
Selection of External Trigger mode	Et d† Et E ET L	External trigger mode disabled External trigger mode–Edge* External trigger mode–Level*
Signal transition selection for external trigger	EtHL† EtLH	Data captured during high to low transition Data captured during low to high transition

Options marked † are factory settings.

*If the Mitutoyo output is enabled, selection of the External Trigger mode and the Set Point mode is not available.

Mitutoyo data is normally sent as a signed number, compression force being represented as a positive number and tensile force as negative. Some devices, however, may have difficulty processing negative numbers. If such a situation should arise, select unsigned Mitutoyo transmission format (Mitutoyo data without polarity). In this format, the absolute value of the readings will be transmitted.

AUTOMATIC TRANSMISSION

SELECTION	OPTION	EXPLANATION
Selection of	no†	No auto-transmission
time intervals	1	Transmission of every sample
for automatic	2	Transmission of every 2nd sample
transmission	4	Transmission of every 4th sample
(RS-232 only)	8	Transmission of every 8th sample
	16	Transmission of every 16th sample
	32	Transmission of every 32nd sample
	64	Transmission of every 64th sample
	128	Transmission of every 128th sample

AUTOMATIC SHUTOFF

SELECTION	OPTION	EXPLANATION
Selection of	no	Gauge does not shut off automatically
automatic	1	Gauge shuts off after 1 min. of inactivity
shutoff after	5†	Gauge shuts off after 5 min. of inactivity
a specified	10	Gauge shuts off after 10 min. of inactivity
period of	20	Gauge shuts off after 20 min. of inactivity
inactivity.	30	Gauge shuts off after 30 min. of inactivity

Options marked † are factory settings.

Inactivity is interpreted by the gauge as an absence of communications either through RS-232 or Mitutoyo, force readings do not change by more than ±10 counts and no buttons are pressed.

Prior to shutoff, the display flashes for seven seconds, giving a visual indication of imminent shutdown. If during this time, any condition indicating activity occurs, the gauge will reset its timer and start a new countdown.

INITIAL SETTINGS

SELECTION	OPTION	EXPLANATION
Units	LB†	Pound
	KG	Kilogram
	N	Newton
Mode	A	Average Reading (if enabled)
	T C†	Current Reading
	Et E/Et L	*External Trigger (if enabled)
	PEAK T	Peak Tension
	PEAK C	Peak Compression

Options marked † are factory settings.

*This selection will appear if external trigger mode feature is enabled.
"Et E" is displayed if Edge triggered external mode is enabled and "Et L" is displayed if Level triggered external mode is enabled.

AVERAGE

SELECTION	OPTION	EXPLANATION
Mode	A E	Average Mode Enabled
	A d†	Average Mode Disabled
Parameters	dEL	Initial Delay
	At	Average Time
	trF	Trigger Force

The Initial Delay and Average Time can be set in the range of 0.1 to 300.0 seconds in 0.1 second increments. To set these parameters, press "ENTER" when the corresponding signal is displayed. Use the ▲ and ▼ keys to change the value and Mode to switch between Tension/Compression. Press "ENTER" at the "donE" prompt to save changes or "ESCAPE" to quit.

3.4 Filters

Two types of filtering are available: analog and digital. The analog filter is a low pass RC filter with a cutoff at 2.5 Hz and attenuation of 20 dB/decade. This filter can be enabled or disabled.

The DFG51 utilizes a moving average technique for digital filtering. Averaging is a simple method of filtering a noisy signal. Averaging reduces the effects of fluctuating readings or noise and has a "smoothing" effect. The more readings that are used to average, the greater the filtering effect. A four point moving average is explained below:

$$D_1 = (S_1 + S_2 + S_3 + S_4)/4$$

$$D_2 = (S_2 + S_3 + S_4 + S_5)/4$$

The first displayed value (D_1) is the average of the first four sample values ($S_{1,2,3,4}$). The second displayed value (D_2) is obtained by discarding the oldest sample (S_1) and including the latest sample (S_5) to computer the average. The number of samples that are averaged is selectable (1, 2, 4, or 8). Selecting "1" means that the filter is disabled, since the average of one value is equal to the value itself.

The analog and digital filters should be disabled for the highest performance in the capture of peak forces.

3.5   External Trigger Mode

This mode is useful for measuring an electrical switch actuation force, as well as synchronizing several gauges for capturing force readings in multiple locations. There are two settings: edge triggered or level triggered. For both settings, the transition at which the data is captured is also selectable. Readings can be captured during the high to low transition of the signal, i.e. during switch closure or when the line goes from low to high, i.e. when the switch opens or "breaks"./ In the edge triggered capture mode, the reading is captured as soon as the line makes the transition and is retained until the CLEAR or ZERO buttons are pressed. In the level triggered capture mode, the reading is also captured immediately after the transition, and is displayed for as long as the line is at the active level. When the signal makes the reverse transition, the display zeros out. This allows for readings to be temporarily held at many steps during a process.

When the external trigger mode is enabled, the MODE button sequences through an additional mode apart from the current and peak modes. The external trigger mode is indicated by a flashing "C" or "T" on the display. Shown below is a typical switch testing setup. When the switch is activated, the force reading is captured. Use the MODE button to go into the external trigger mode.
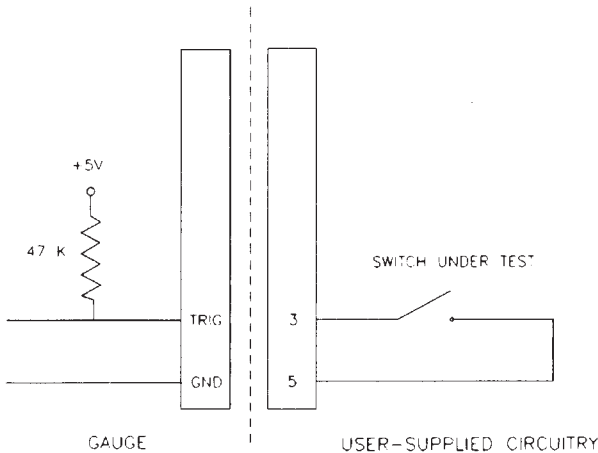

Figure 3-2. Typical Switch Testing Setup

3.6 Set Points

This feature is used to control a process or to perform "in tolerance" checks. A low set point and a high set point are specified. There are three open collector lines associated with this feature. Depending on whether the force reading is lower, in between or higher than the set points, one of the three lines is grounded. When the force reading is lower than the lower set points, pin 8 of the connector is grounded and pins 9 and 4 are floating. If the reading lies between the upper and lower set points, pin 4 is grounded. When the reading is higher than the upper set point, pin 9 is connected to ground.

The set point feature is activated during the gauge setup. Refer to Section 3.3, Gauge Setup, for more details on how to enable the set point feature.

To enter or change the set points, press MODE until "SP" is displayed. Press the ENTER button. The upper set point is displayed. Use "▲" and "▼" buttons to change the value and use MODE button to switch between tension and compression. When The correct high set point is displayed, press ENTER to go to the low set point. Set the low set point in the same way. Press ENTER. The display will show "donE". If you want to save the changes permanently, press ENTER, otherwise press ESCAPE. The gauge will display "SP". Press MODE to switch the mode.

Note: This mode of operation increases the power consumption of the gauge by approximately 15%. In order to prolong the time between recharge of the battery, it is advisable to disable this feature.

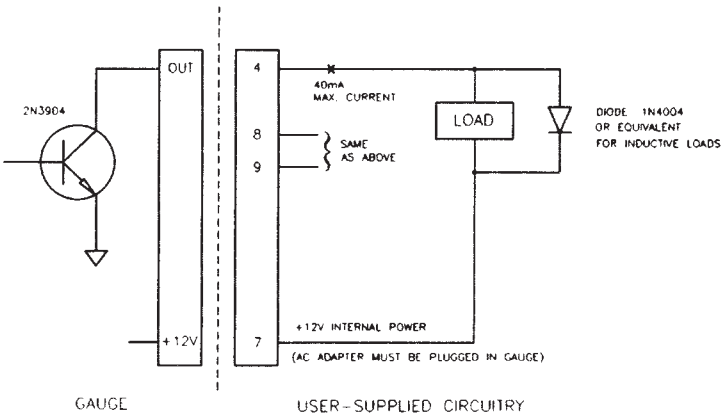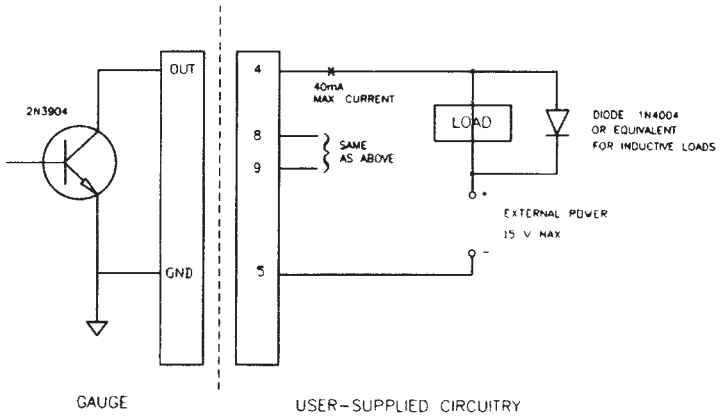Following are examples of the set point outputs application.

**Figure 3-4. Examples of Set Point Outputs Applications**

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3.7 Average Mode

This mode of operation is used to obtain an average force/torque reading over a specified period of time. It is useful in peel force testing, muscle strength measurement, friction force measurement or any other test requiring time-averaged readings.

There are three user-programmable parameters associated with this mode: Trigger Force, Initial Delay, and Average Time. The programming of these parameters and the enabling of the Average mode are done during the gauge setup. See Section 3.3, "Gauge Setup," for more information.

To begin testing, select the Average mode using MODE and press CLEAR or ZERO. The process of calculating the average reading begins automatically when the actual force/torque reaches the programmed trigger value. A flashing "A" is the indication of a test in progress. The readings obtained during the programmed initial delay will not be part of the calculated average, however, the peak reading will be stored for later recall. The conclusion of the test is indicated by an alternating "A" and the calculated average value on the display. A new test is initiated by pressing CLEAR or ZERO.

The graph below illustrates a typical peel force versus time test.
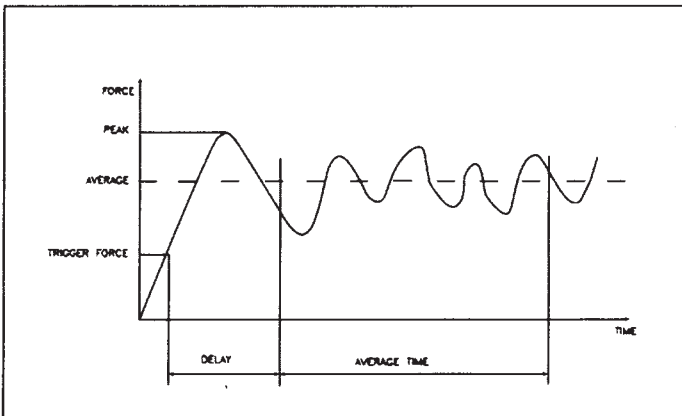
3.8 Data Outputs

Data can be transmitted to an external device in three different formats: RS-232, Mitutoyo BCD and Analog.

RS-232: Press the DATA button to transmit the data. This data corresponds to the displayed reading when the transmission is initiated. Data can also be requested by the external device by sending ASCII'?' to the gauge. The RS-232 format can be selected to transmit just the data (numeric format) or the data with the units (full format).

RS-232 Numeric Format:

-XXXXXX <CR><LF>

Line Feed

Carriage Return

Space

Data including decimal point

Sign*
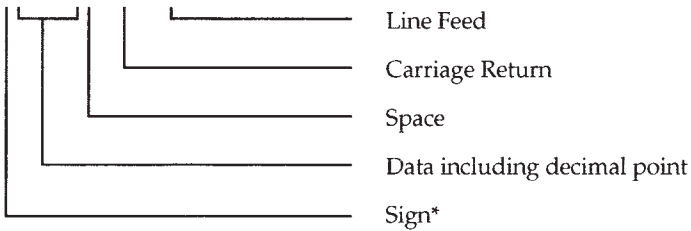
RS-232 Full Format:

-XXXXXX YY<CR><LF>

Line Feed

Carriage Return

Units

Space

Data including decimal point

Sign*
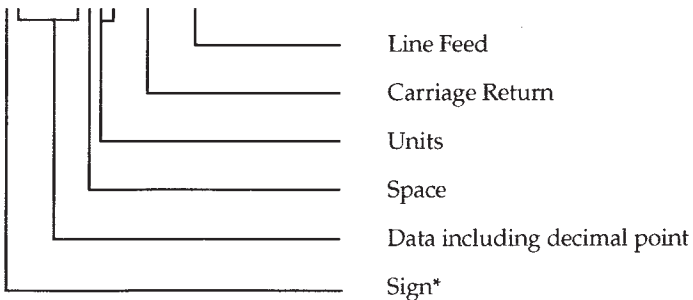
*Space for compression (C) readings.
Minus for tension (T) readings.

In addition, the RS-232 channel can be used for full gauge control utilizing the built-in Gauge Control Language. See Section 3.9 for more details.

Mitutoyo BCD: The DFG51 interfaces to Mitutoyo printers, data collectors, multiplexers and any other device that accepts Mitutoyo BCD format. Pressing the DATA button on the gauge will transmit the displayed data. The DATA button on Mitutoyo printers can also be used to initiate the transmission.

Analog: The analog output is frequently used by cart recorders and other such devices. The output is ±1 VDC. Compression produces positive voltage output. Tension produces negative voltage output.

Note: The display will show "Err" and no data will be transmitted if "DATA" is pressed prior to the conclusion of a test in the Average and External Trigger modes.

3.9 Gauge Control Language

The gauge can be operated externally from a terminal or a PC through the RS-232 channel. The following is a list of commands the gauge recognizes. The commands may be either in upper or lower case. All commands have to be followed by either Carriage return (Hex "0D") or Carriage Return + Line Feed (Hex "0D + 0A").

COMMAND	FUNCTION	SPECIFIER
LB	Switch units to pounds	None
KG	Switch units to Kilograms	None
N	Switch units to Newtons	None
CUR	Current Mode (Real time display)	None
PT	Peak Tension Mode	None
PC	Peak Compression Mode	None
ET	External Trigger Mode	None
Z	Zero Display and clear peaks	None
AM	Average Mode	None

COMMAND	FUNCTION	SPECIFIER
CLR	Erase the peaks in memory	None
?	Request the displayed reading. The reading may be current, peak, or external trigger mode reading.	None
?C	Request the current reading	None
?PT	Request peak tension reading	None
?PC	Request peak compression reading	None
?ET	Request external trigger mode reading	None
FLTC	Filter for current (displayed) readings	1,2,4 or 8 (Samples averaged)
FLTP	Filter for peak readings	1, 2, 4 or 8 (Samples averaged)
FLTA	Filter analog	0 (Off) or 1 (On)
AOFF	Auto-shutoff	0 (no auto-shutoff) 1, 5, 10, 20, 30 (minutes)
AOUT	Auto-transmit	0 (no auto transmission) 1, 2, 4, 8, 16, 32 64, 128 (samples/ transmission)
FULL	RS-232 data transmission with units	None

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COMMAND	FUNCTION	SPECIFIER
NUM	RS-232 data transmission without units	None
MIT	Enable Mitutoyo output	None
MITD	Disable Mitutoyo output	None
NPOL	Mitutoyo BCD transmission; no polarity (unsigned data)	None
POL	Mitutoyo BCD transmission with polarity (signed data)	None
ETE	Edge-triggered external trigger mode	None
ETL:	Lever-triggered external trigger mode	None
ETD	External trigger mode disable	None
HL	External trigger mode reading captured during high to low transition	None
LH	External trigger mode reading captured during low to high transition	None
SP	Set point mode	None
SPD	Set point mode disable	None
SPH	High set point	Number
SPL	Low set point	Number
A	Average Mode enable	None
DEL	Initial delay	0.1 to 300.0 (seconds)
AT	Average time	0.1 to 300.0 (seconds)

COMMAND	FUNCTION	SPECIFIER
TRF	Trigger force/torque	Value
S	Set output bit (open collector, negative logic)	0, 1, 2
C	Clear output bit (open collector, negative logic)	0, 1, 2
R	Read status of output bit or level of input pin	0, 1, 2
PM	Send data to a Mitutoyo compatible device	None
SAVE	Save current settings in "non-volatile" memory	None
LIST*	Lists the current settings and status	None
CAL	**Warning:** Do not use this command unless you are prepared to recalibrate the gauge. See Section 4.	None

*A typical output of the list command is as follows:

"V3.00;KG;PC;FLTC8;FLTP1;FLTA0;AOUT00;AOFF00;FULL;MITE;POL;B"

The output of the "list" command has a number of fields, each separated by a semi-colon (;). The first field is the version (revision level) of the gauge program. Following the version are the features and their current settings. The abbreviations of these features are the same as the commands used to set them. The last field shows the battery power level. The number ranges from 0 to 3. "B 0" shows the battery is fully charged. "B 3" indicates the battery is very weak and automatic shutoff is about to occur. For more information on low power detection, see Section 2.3, Power Supply.

All detected errors are reported back to the RS-232 device by means of error codes. Each code is a number preceded by a "*". Following is a list of possible error messages and their meanings.

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ERROR CODE	DESCRIPTION
*10	Illegal command
*11	Not executable at this time; e.g. "SPH" command when set point feature is disabled
*21	Invalid specifier; e.g. "AOFF 2"
*22	Number too large
*30	Weight, used to calibrate, is greater than expected
*31	Weight, used to calibrate, is lower than expected
*50	Communication error
*51	Command string too long

SAMPLE PROGRAM

Below is a sample program in BASIC, to control the gauge externally through a personal computer. Make sure the gauge is properly connected to the PC. Enable RS-232 output on the gauge and set the baud rate to 1200, 8 data bits, 1 stop bit, and no parity.

The program sets the units of the gauge to Kilogram and zeros the display. Press any key to get current data from the gauge. Use the "ESC" key to exit.

▼4 Calibration

Mount the gauge to a firm stand so that the gauge shaft faces downward. Turn the gauge on and let it warm up for approximately ten minutes.

Turn the gauge off. While pressing MODE button, turn it on. Use the ADVANCE button to scan the menu until "CAL" appears on the display. Press ENTER three times consecutively to select Calibration. Such a key sequence prevents the gauge from being calibrated inadvertently. The display will show "null". With no weights suspended, press ZERO. Next the display shows "SPAn", prompting you to suspend a precision test weight, equal to the nominal capacity of the gauge. Bring the suspended weight to rest. Press the ENTER button. Scrolling dashes will appear on the display until the weight is stable. If the weight is off by more than 15% than the expected weight, the gauge will not calibrate. If the force is greater than the nominal force, the display shows "nnnn" and if the force is lower, "uuuu" is displayed. Press ESCAPE to return to the menu and restart the calibration procedure. When the correct weights are used, and the calibration procedure has been successful, "donE" will appear on the display. Press ENTER to save the changes. This terminates the calibration procedure. At any time during the procedure, the ESCAPE button can be pressed to escape calibration without altering the previous settings.

Calibration from a remote terminal or computer, through RS-232, is slightly different from "manual" calibration. When there are no weights suspended, send the "Z" command. After hanging a weight that is equal to the nominal capacity of the gauge, transmit the "CAL" command to calibrate the gauge. If the weight is greater or less than the expected weight, error 30 or 31 is reported, respectively. If the calibration has been successful, no message will follow. If you want to save the changes, send the "SAVE" command, or if you want to restore the previous calibration settings, do not transmit the "SAVE" command, turn off the gauge and then turn it on again.

▼5 Specifications

Accuracy:	±0.20% of full scale, ±1 LSC (least significant count)
Sample Rate:	65 samples per second
Display:	4-1/2 character LCD with 0.3″ high characters. Indicators for low battery, mode and units.
Display Update:	Variable between 2.5 and 30 per second depending on digital filter settings and mode.
Outputs:	RTD sensor (Pt100) RS-232, Mitutoyo, Analog, Set point outputs, and External trigger input. RS-232: Programmable baud rate between 300 and 9600, Mitutoyo: Binary Coded Decimal (BCD) data output. Analog: ±1 VDC ±0.15%, Zero offset ±10%.
I/O Connector:	9-pin D-type male
Operating Temp. Range:	40° F to 100° F (5° C to 45° C)
Thermal Effects:	
Zero:	0.03% F.S. / ° C
Span:	0.01% F.S. / ° C
Max. Load:	150% F.S.
Full Scale Deflection:	0.010 inch maximum
Tare Capacity:	10% F.S.
Construction:	Cast aluminum housing
Battery:	Rechargeable NiCd 7.2V battery. AC operation possible using the included AC adapter/charger.
Battery Life:	10-12 hours of continuous operation
AC Adapter/ Battery Charger:	115 VAC
Size:	5.9″ x 2.5″ x 1.5″
Weight:	0.9 lbs
Shipping Weight:	2.3 lbs

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of theproduct, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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