A-TECH
INSTRUMENTS LTD.
MEASUREMENT & CONTROL FOR RESEARCH & INDUSTRY

sales@a-tech.ca
www.a-tech.ca
TORONTO: 416 754 7008
MONTREAL: 514 695 5147
TOLL FREE: 1 888 754 7008

Product Note #0046
Force Measurement of Actuator using Differential Pressure Transducers and 9243 Strain Gauge Amplifier
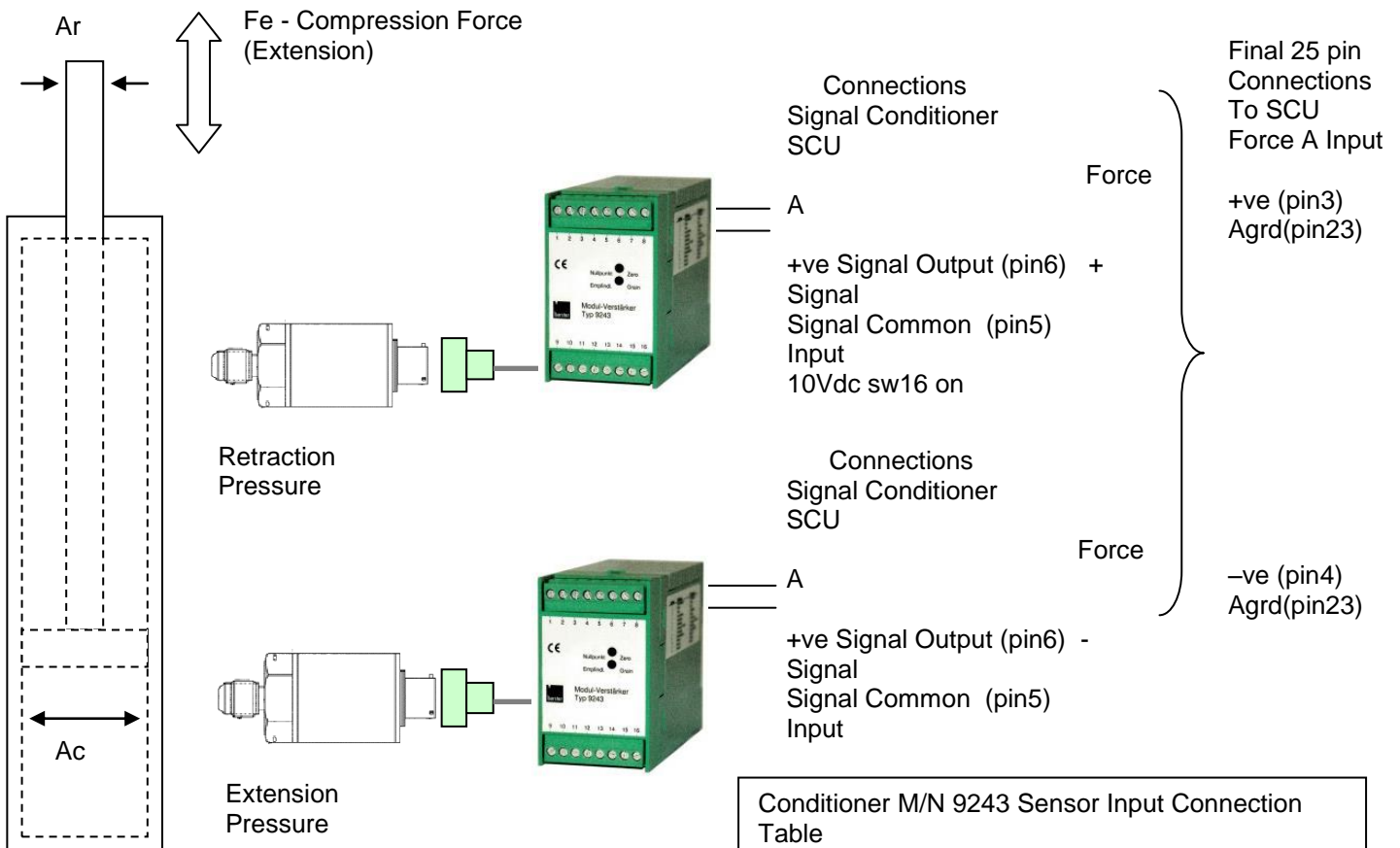
Description:
The following measurement system achieves Force Measurement of and Actuator using Differential Pressure Transducers

Motivation:
In applications where a load cell cannot be mounted, and coarse force measurement is suitable.

Solution:

Ar

Fe - Compression Force (Extension)

Ac

Retraction Pressure

Extension Pressure

Connections
Signal Conditioner
SCU

A

+ve Signal Output (pin6)   +
Signal
Signal Common (pin5)
Input
10Vdc sw16 on

Connections
Signal Conditioner
SCU

A

+ve Signal Output (pin6)   -
Signal
Signal Common (pin5)
Input

Force

Force

Final 25 pin Connections To SCU Force A Input

+ve (pin3)
Agrd(pin23)

–ve (pin4)
Agrd(pin23)

Conditioner M/N 9243 Sensor Input Connection Table

Function	+exc	+sen	+sig	-sig	-exc	-sen
Pin #	11	12	14	13	9	10

sales@a-tech.ca
www.a-tech.ca
TORONTO: 416 754 7008
MONTREAL: 514 695 5147
TOLL FREE: 1 888 754 7008

Fe = (Ae * Pe) representing the resulting Compression Force (Extension)
Me = SOe / SIe
Where, Ae is the effective internal actuator area. (8.30 sq.in.)
Pe at 3000 lb/sq.in. has a F.S. output of 154.59mV (-4.02mV at 0 psi)
Me is representative of the Volt / lb. Conversion to Eng. Units (F.S. = 9.955 Vdc)
SIe is the Signal Input that represents F.S. pressure
SOe is the Signal Output that represents F.S.
Internal Friction Loss and Amplifier Unbalance are assumed as 0 at this time
Thus Fe = (8.30 sq.in. * 3000 lb/sq.in.) = 24,887 lbs.
Me = SOe / SIe = 9.955 Vdc / 0.15861V = 62.764 Gain (100mVi/p = 6.2764 Vo/p)

Fr = (Ar * Pr) representing the resulting Tension Force (Retraction)
Mr = SOr / SIr
Where, Ar is the effective internal actuator area Ac - Ar. (5.89 sq.in)
Pr at 3000 lb/sq.in. has a F.S. output of 135.18mV (-2.78mV at 0 psi)
Mr is representative of the Volt / lb. Conversion to Eng. Units (F.S. = 7.069 Vdc)
SIr is the Signal Input that represents F.S. pressure
SOr is the Signal Output that represents F.S.
Internal Friction Loss and Amplifier Unbalance are assumed as 0 at this time
Thus Fr = (5.89 sq.in * 3000 lb/sq.in.) = 17,671 lbs.
Mr = SOr / SIr = 7.069 Vdc / 0.13796 Vdc = 51.239 Gain (100mVi/p = 5.1239 V o/p)

NOTE: Turn off the Ratiometric Voltage in the Force Cal. Of the SCU properties
This theoretical analysis does not consider errors due to Actuator internal friction.
Thermal errors of the instrumentation are as follows:
9243 Amplifier Errors (Static plus Thermal) – 0.05%F.S. plus 0.05% / 10deg.C. = 0.1% F.S./ 10deg.C. variation
Sensor Errors (Static plus Thermal) - 0.1% F.S. plus 0.4%/ 10deg.C. = 0.5% F.S./ 10deg.C. variation