HOW TO CONNECT THE INSTRUMENTS

SR04 / SL06 / SL07

TO VARIOUS TYPE OF SENSORS

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Introduction
This document has been prepared to help users to connect our instrument to thirdy party sensor manufacturer. We explained some hints and good rules to follow when you prepare a cable. Comments and experience about are welcome and when possible and appropriate your experience will be integrated in the document.

Some hints on cable prepartion.
Prepare a cable is an important work in seismology. Use of cables of high quality it is not an option, it is important for the good performances of the pair seismometer-digitizer.

Quality of a cable is not only a question to use expensive wireware it is mostly a question of careful cable preparation. Of course expensive cables usually offers also high durability and resistance to corrosion and other agents like rats that could find attractive to taste the plastic and copper; if this risk is high specific cables exists, we recomend you to use them especially if you have to deploy the cable outdoor and/or undeground.

Speaking strictly in terms of money saving a shielded CAT5 cable (Ethernet networks cables) can works very well for seismometer cables and it is really inexpensive; nevertheless choice of high quality CAT5 cables can make the difference in the reliability of your installation.

Cold, dust, humidity and other elements can deteriorate the performance of a connection not only due to a bad cable quality (cheap cables are subjected to insulation loss and flexibility loss if exposed to high temperature variations).

Single copper conductor cables (as majority of CAT5 cables are made) are subjected also to conductor breaks when one of the end has ben scrapped during working, this kind of cable should be avoided.
Multstranded CAT5 cables are available, they are not only more flexible but also more reliable. Version of this cable exists for industrial applications with insulation and high mechanic resistance shielding and coating as well resistant to corrosion.

However use of high quality cable is useless if you don't follow an high quality assembly processing performed by a skillful and trained technician. Insulation between pins must be guaranteed with heat shrink plastic to be applied before soldering the wire to the connector pin. This practice, even if rather nasty sometime, is mandatory for make up a high quality cable.

Check your cable before use!
Another important thing to emphasize is to ***check your cable before use it!***
Sometime a user make a cable and it is fully confident to have placed every wire in the proper position. More often that you believe it happens that a wire has been switched with another.

Fault finding in this condition can become VERY difficult, the seismometer could seems to work and also the waveform signal could seems ok, but when signal condition changes or if you do not have the possibility to check the waveform of the channels all at the same time may happen that you realize that the cable is wrong only when you had left the field and are back at your office!

Even worst a bad cabling can damage the circuit of a digitizer or of a seismometer, maybe both.
Before use the cable you should **always** check the connection from one to the other end and see they match the provided schematic. Not only but the schematic could be unreliable for your specific instrument that could be different from the documents we have used to prepare this. So a your double check is mandatory to be in the safe side and avoid bad surprises.

Signals which SARA instruments based on the SADC20 A/D board can accepts
All SARA 24 bit digitizers, unless otherwise specified, can accept signals in one of these ways:

Differential Unipolar	The measure is made between the two signal's wires. The two signals can only swing in the positive range respective to ground.
Differential Bipolar	The measure is made between the two signal's wires and they can swing from positive to negative respective to ground.
Single Ended Unipolar	The measure is made using a single input and respective to ground and the signal can only swing in the positive range.
Single Ended Bipolar	The measure is made using a single input and respective to ground and the signal can swing in both positive and negative range.

There are some restriction on how the SADC20 can be used in these conditions; first of all each condition exclude the others so a channel when configured in a way cannot accept a different signal untile re-configured for the new situation. There are also some limitations in the ranges that can be accepted for each condition and some signal conditioner (voltage divider) could be needed to be applied before enter the signal in the A/D board or in the instruments.

The figure 1 illustrates how to configure the analogue front-end of the SADC20 for these options. A paragraph illustrating the various type of voltage divider follows.

All this can sound complicated anyway in the pages after you will find a number of sheet illustrating detailed information on how connect popular sensors to our digitizer (A/D or instrument).

At the end of the story if it is needed you can always ask us for a ready-to-go cable!

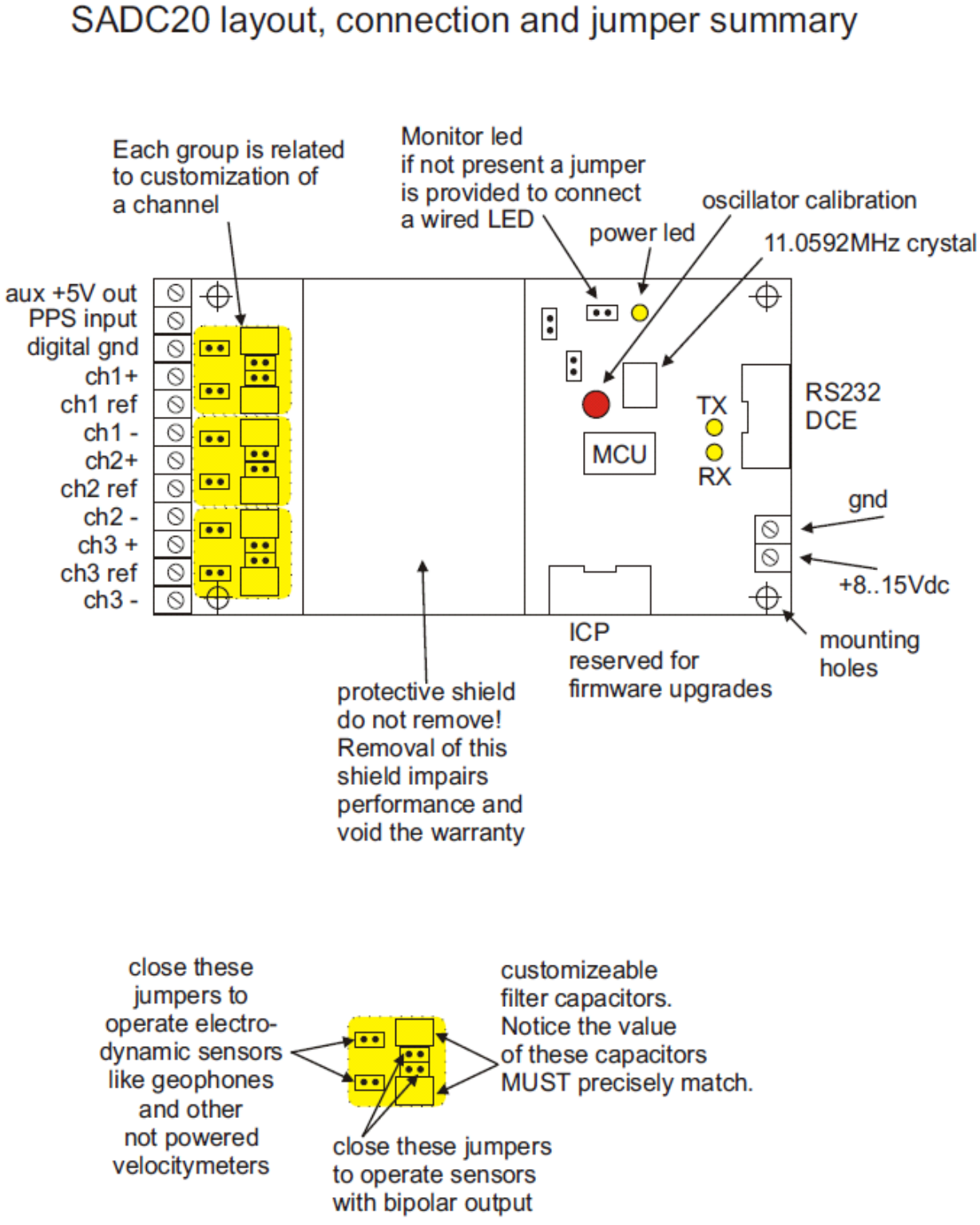

figure 1
SADC20 layout, connection and jumper summary

Pure coil sensor jumper setting

active bipolar output sensors

SIGNAL DIVIDER FOR THE SADC20 BASED INSTRUMENTS

The instruments based on the SADC20 A/D board are optimized for use with electrodynamic sensor (classic moving coil velocimeteres) but it can accept also active sensors like FBA or BroadBand sensors. Almost in all cases you may need a certain level of signal attenuation in order to adapt the high sensitivity of these active sensors with the high sensitivity of the SADC20 converter.

Pure electrodynamic sensors are usually interfaced to the SADC20 without attenuation and the nominal input range it is +/-1V (2V peak-to-peak).

Sensors with high output range (i.e. +/-10V, +/-5V) can be interfaced with the SR/SL instruments applying a voltage divider in the cable that connect the sensor to the instrument. The voltage divider must be ALWAYS applied at the recorder/digitizer end.

Here the schematic of the voltage dividers:

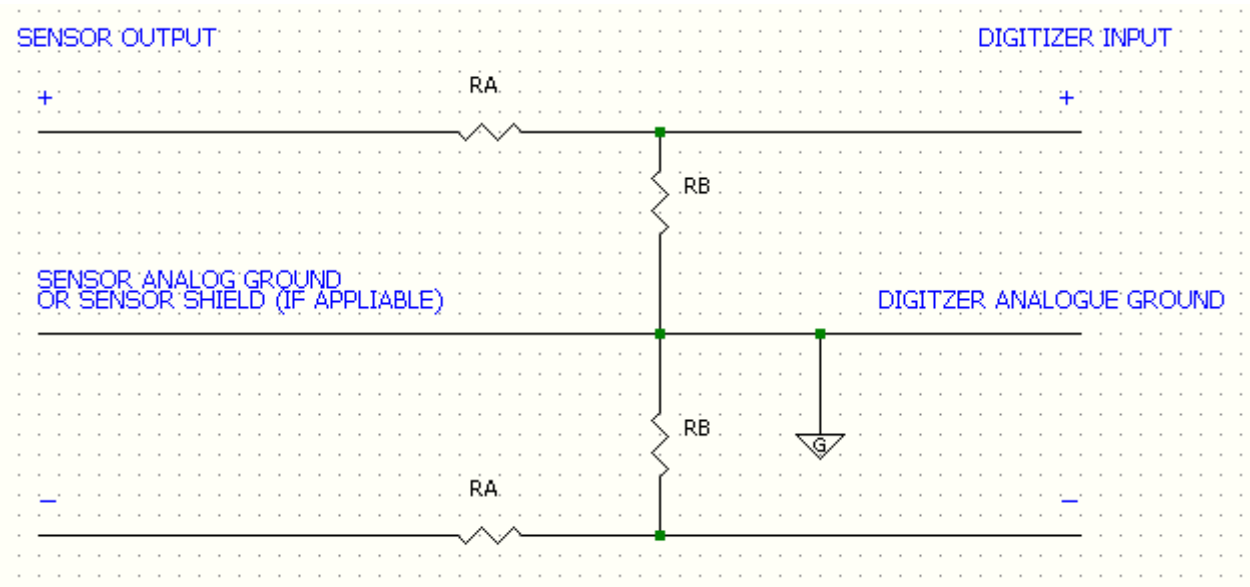

figure 2
voltage divider schematic

Here the exact values to use in order to match the internal circuitry of the SADC20 in the various conditions:

Input range	RA	RB
+/-10V differential input (20V p-p)	10 kOhm	2.95 kOhm
+/-5V differential input (10V p-p)	7.5 kOhm	8.2 kOhm
+/-4V differential input (8V p-p)	7.5 kOhm	13 kOhm
+/-2V differential input (4V p-p)	0 Ohm	no resistor

GURALP CMG-40T

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04/SLxx		LINKING TABLE		CMG-40T	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	01	A	Velocity +ve, vertical channel
2	ch2 + North-South sensor	03	02	B	Velocity –ve, vertical channel
3	ch3 + East-West sensor	05	03	C	Velocity +ve, N/S channel
4	ch1 - Vertical sensor	02	04	D	Velocity –ve, N/S channel
5	ch2 - North-South sensor	04	05	E	Velocity +ve, E/W channel
6	ch3 - East-West sensor	06	06	F	Velocity –ve, E/W channel
7	+12V service power	07		G	Mass position, vertical channel
8	shield / ground	08		J	Mass position, N/S channel
9	shield / ground	08		L	Mass position, E/W channel
10	service power return	09		M	– 12 V DC supply (3-way power option)
			08	N	Signal ground
				P	Calibration signal (all channels)
				R	Calibration enable (all channels)
				U	Acc/Vel
				V	N/S centring motor (remote centring option)
				W	E/W centring motor (remote centring option)
				X	Vertical centring motor (remote centring option)
				Y	Motor return (remote centring option)
			09	b	Power ground
			07	c	+ 12 V DC supply

This sensor generates a **bipolar differential signal output**, be sure the digitizer/recorder is set to work in bipolar mode.

WARNING! PLEASE REFER TO THE ORIGINAL SENSOR MANUAL AND CHECK IF OUR LIST CORRESPOND TO WHAT THE MANUFACTURER REPORT IN THE MANUAL. WE HAVE CHECKED THREE TIMES THE LIST BUT WE CANNOT TAKE ANY RESPONSIBILITY IF YOUR EQUIPMENT IS DAMAGED DUE AN OUR MISTAKE THAT IS ALWAYS POSSIBLE AND BECAUSE THE MANUFACTURER COULD CHANGE THE SENSOR PINOUT WITHOUT ANNOUNCEMENT!

NANOMETRICS TRILLIUM

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		TRILLIUM	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	01	L	Z+ / W+
2	ch2 + North-South sensor	03	02	M	Z- / W-
3	ch3 + East-West sensor	05	03	N	Y+ / V+
4	ch1 - Vertical sensor	02	04	A	Y- / V-
5	ch2 - North-South sensor	04	05	P	X+ / U+
6	ch3 - East-West sensor	06	06	B	X- / U-
7	+12V service power	07		T	CAL_SIG
8	shield / ground	09		K	U_CALEN
9	shield / ground	09		J	V_CALEN
10	service power return	08		U	W_CALEN
				E	U_MP
				F	V_MP
				S	W_MP
				V	analog ground
			07	H	power input
			08	G	power return
				D	UVW/TX
				C	SP/RX
				R	DGND
			09	shell	CHASSIS

This sensor generates a **bipolar differential signal output**, be sure the digitizer/recorder is set to work in bipolar mode.

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LENNARTZ 3D 1s / 5s / 20s

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		LENNARTZ 3D 1s / 5s / 20s	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	01	A	Z+
2	ch2 + North-South sensor	03	02	B	Z-
3	ch3 + East-West sensor	05	03	C	X+
4	ch1 - Vertical sensor	02	04	D	X-
5	ch2 - North-South sensor	04	05	E	Y+
6	ch3 - East-West sensor	06	06	F	Y-
7	+12V service power	07	07	G	+12V SUPPLY VOLTAGE
8	shield / ground	09	08	K	0V SUPPLY VOLTAGE
9	shield / ground	09		H	n.c.
10	service power return	08	09	J	SHIELD

This sensor generates a **bipolar differential signal output**, be sure the digitizer/recorder is set to work in bipolar mode.

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KINEMETRICS EPISENSOR

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		EPISENSOR	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	05	L	X +
2	ch2 + North-South sensor	03	06	M	X -
3	ch3 + East-West sensor	05		N	X SHIELD
4	ch1 - Vertical sensor	02	03	A	Y +
5	ch2 - North-South sensor	04	04	B	Y -
6	ch3 - East-West sensor	06		P	Y SHIELD
7	+12V service power	07	01	C	Z +
8	shield / ground	09	02	D	Z -
9	shield / ground	09		R	Z SHIELD
10	service power return	08		E	CAL
				F	CCE
			07	J	+12V
				H	-12V
			08	K	power common (0V)
			09	U	PGP ground (case ground)
				G	ground
				S	ground
				T	ground
				V	ground

This sensor generates a **bipolar differential signal output**, be sure the digitizer/recorder is set to work in bipolar mode.

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STRECKEISEN STS-2

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		STRECKESEIN STS-2	
Pin ID	**Function**			**Pin ID**	**Function of HOST BOX connector S1**
1	ch1 + Vertical sensor	01	08	A	CASE
2	ch2 + North-South sensor	02	01	B	Z+
3	ch3 + East-West sensor	03	02	C	Y+
4	ch1 - Vertical sensor	04	03	D	X+
5	ch2 - North-South sensor	05		E	AUTZ
6	ch3 - East-West sensor	06	09	F	GNDS
7	+12V service power	07	04	G	Z-
8	shield / ground	08	05	H	Y-
9	shield / ground	09	06	J	X-
10	service power return	10		K	CALSW
				L	SIGSW
				M	CCOM
				N	VCAL
				P	WCAL
				Q	UCAL
				R	PERSW
				S	RET
				T	UPOS / U+
				U	WPOS / W+
				V	VPOS / V+
			07	W	+VIN
			10	X	-VIN
				Y	
				Z	

This sensor generates a **bipolar differential signal output**, be sure the digitizer/recorder is set to work in bipolar mode.

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SARA SS-20 (HS1-2HZ-3D)

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		SARA SS-20	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	01	1	ch1 + Vertical sensor
2	ch2 + North-South sensor	02	02	2	ch2 + North-South sensor
3	ch3 + East-West sensor	03	03	3	ch3 + East-West sensor
4	ch1 - Vertical sensor	04	04	4	ch1 - Vertical sensor
5	ch2 - North-South sensor	05	05	5	ch2 - North-South sensor
6	ch3 - East-West sensor	06	06	6	ch3 - East-West sensor
7	+12V service power	07		7	
8	shield / ground	08	08	8	shield / ground
9	shield / ground	09	09	9	shield / ground
10	service power return	10		10	

This sensor is an electrodynamic sensor that generates bipolar differential signal output, nevertheless since it is a coil output that electrically can “float” respective to ground the best option is to consider it as **unipolar differential sensor,** consequentially follows the appropriate jumper setting according to the figure.

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SARA SS-45 (GS11D-4.5Hz-3D)

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		SARA SS-45	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	01	1	ch1 + Vertical sensor
2	ch2 + North-South sensor	02	02	2	ch2 + North-South sensor
3	ch3 + East-West sensor	03	03	3	ch3 + East-West sensor
4	ch1 - Vertical sensor	04	04	4	ch1 - Vertical sensor
5	ch2 - North-South sensor	05	05	5	ch2 - North-South sensor
6	ch3 - East-West sensor	06	06	6	ch3 - East-West sensor
7	+12V service power	07		7	
8	shield / ground	08	08	8	shield / ground
9	shield / ground	09	09	9	shield / ground
10	service power return	10		10	

This sensor is an electrodynamic sensor that generates bipolar differential signal output, nevertheless since it is a coil output that electrically can “float” respective to ground the best option is to consider it as **unipolar differential sensor,** consequentially follows the appropriate jumper setting according to the figure 1.

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MARK PRODUCTS L4 SINGLE ELEMENT

This table helps to connect the SR/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		SARA SS-45	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01	04	A	Signal coil - (black)
2	ch2 + North-South sensor	02	01	B	Signal coil + (red)
3	ch3 + East-West sensor	03		C	Calibration coil - (green)
4	ch1 - Vertical sensor	04		D	Calibration coil + (white)
5	ch2 - North-South sensor	05	08	F	Shield
6	ch3 - East-West sensor	06			
7	+12V service power	07			
8	shield / ground	08			
9	shield / ground	09			
10	service power return	10			

This sensor is an electrodynamic sensor that generates bipolar differential signal output, nevertheless since it is a coil output that electrically can “float” respective to ground the best option is to consider it as **unipolar differential sensor,** consequentially follows the appropriate jumper setting according to the figure 1.

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SERCEL / MARK L4C

This table helps to connect the S/SL standard pinout to the specified sensor. The **linking table** provide an ID for each pin in the column left that have to be connected to the corresponding ID on the column right. A pin of one connector sometime have to be connected to two other pins of the other connector so the ID could appears more than one time in a column. An empty cell in the linking table means that pin have to be left not connected.

SR04		LINKING TABLE		L4-C-3D	
Pin ID	**Function**			**Pin ID**	**Function**
1	ch1 + Vertical sensor	01		A	
2	ch2 + North-South sensor	02		B	
3	ch3 + East-West sensor	03	05	C	North-South -
4	ch1 - Vertical sensor	04	02	D	North South +
5	ch2 - North-South sensor	05	04	E	Vertical -
6	ch3 - East-West sensor	06	01	F	Vertical +
7	+12V service power	07	06	G	East-West -
8	shield / ground	08	03	H	East-West +
9	shield / ground	09		J	
10	service power return	10		K	
			08		connector shell

This sensor is an electrodynamic sensor that generates bipolar differential signal output, nevertheless since it is a coil output that electrically can “float” respective to ground the best option is to consider it as **unipolar differential sensor,** consequentially follows the appropriate jumper setting according to the figure 1.

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