
Digital compression load cell



General Description:

- Self restoring rocker pin (20t, 30t, 40t, 60t)
 - Digital output signal (17 ¹/₂ bits, up to 100mes/sec)
 - Serial interface RS485 (2 wire / half duplex)
 - Proprietary protocol with efficient in sequence addressing.
 - Zero, span and corner adjustment calculations (PIN code optionally locked)
 - Operating voltage 7.5 ... 16 VDC
 - Low current consumption 35mA typ.
 - Simple field installation and replacement
 - Stainless steel material, IP68
 - Legal for trade certified according to OIML R60 up to 5000d
 - Meets EMC/ESD requirements according to EN 45501
-
- Specially designed junction box including lightning protection (10kA - 8/20µs)

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Technical Data:

Specifications CB50X-DL

METROLOGICAL	C4 10e	
Rated capacity (Cn)	20, 30, 40, 60	t
Combined error	0.013	%Cn/°C
Temperature effect on zero	0.0014	%Cn/°C
Temperature effect on sensitivity	0.0014	%Cn/°C
Creep error (30 min.)	0.018	%Cn
Zero balance	+/-2.5	%Cn

LEGAL METROLOGY OIML R60		
Accuracy class	C4	
Maximum capacity (E _{max})	20, 30, 40, 60	t
Minimum capacity (E _{min})	0	kg
Max. number of LC intervals (n _{max})	4 000	d OIML
Minimum verification interval (v _{min})	2, 3, 4, 6	kg
Z=E _{max} /(2xDR)	4000	
Apportionment factor (p _{LC})	0.8	


ELECTRICAL		
Range of excitation voltage	+7.5 ... +16	V DC
Rated output, at Cn	200000	counts
Current consumption	35	mA
Transmission rate	up to 100	/ s
Asynchrone interface	RS485	Half Duplex / 2-wire up to 1200m
Baud rate	2400 ... 19200	Baud
Number of bus addresses	32	

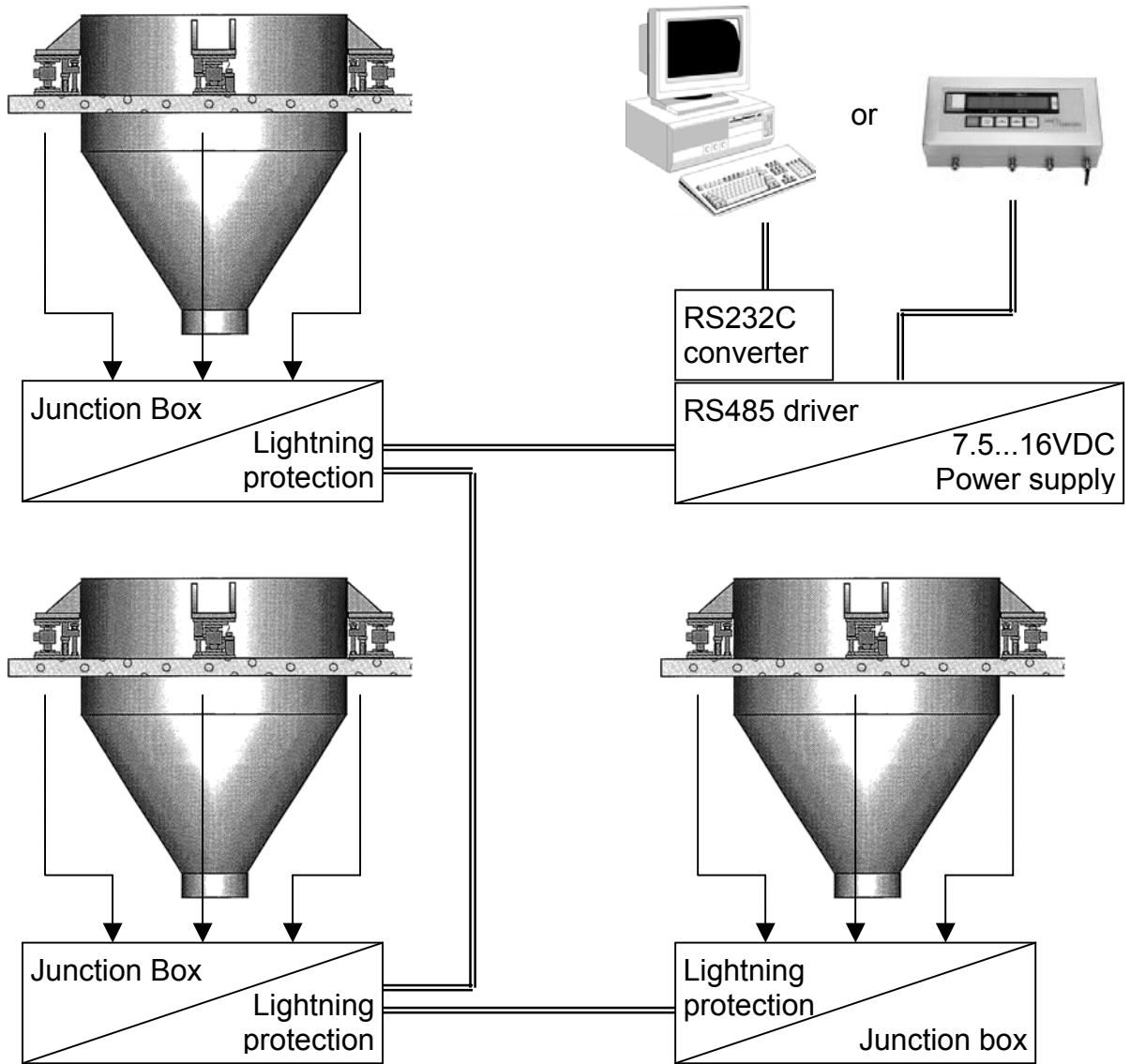
GENERAL		
Nominal temperature range	-10 ... +40	°C
Service temperature range	-20 ... +60	°C
Safe load limit	150	%E _{MAX}
Ultimate breaking load	200	%E _{MAX}
Protection class	IP68	according to EN60529
Material	Stainless steel	
Cable length	15	m
Net weight	6	kg

Junction Box

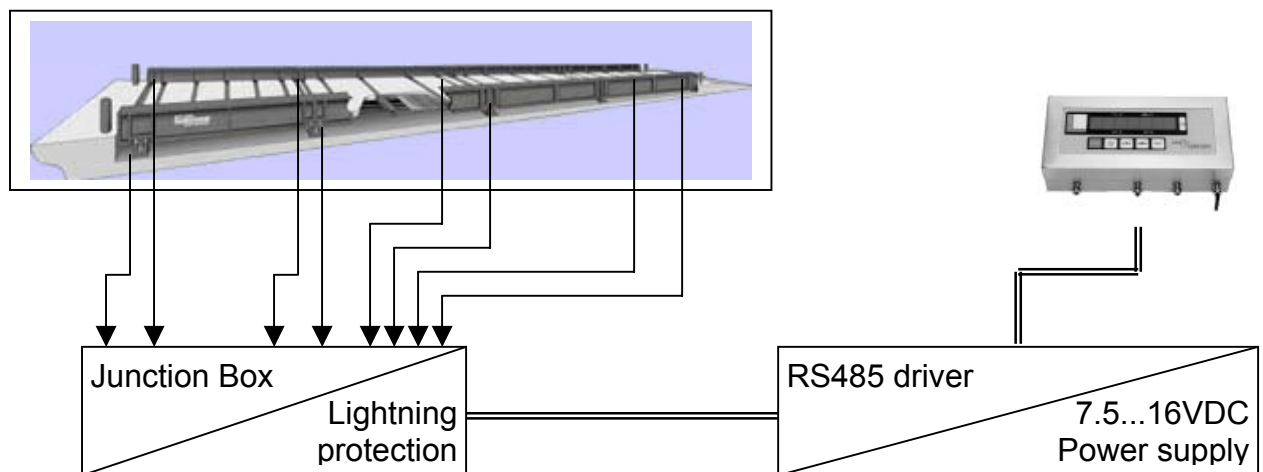
Number of load cells	up to 8	
Terminations and biasing resistors	included	
Lightning protection	10kA (8/20μs)	according to IEC 61000-4-5

Available options

ATEX 94/9/CE version	 II 1 G/D EEx ia IIC T6 -20°C ≤ Tamb ≤ +60°C	
(to be developed)		



Example 1: Hooper application



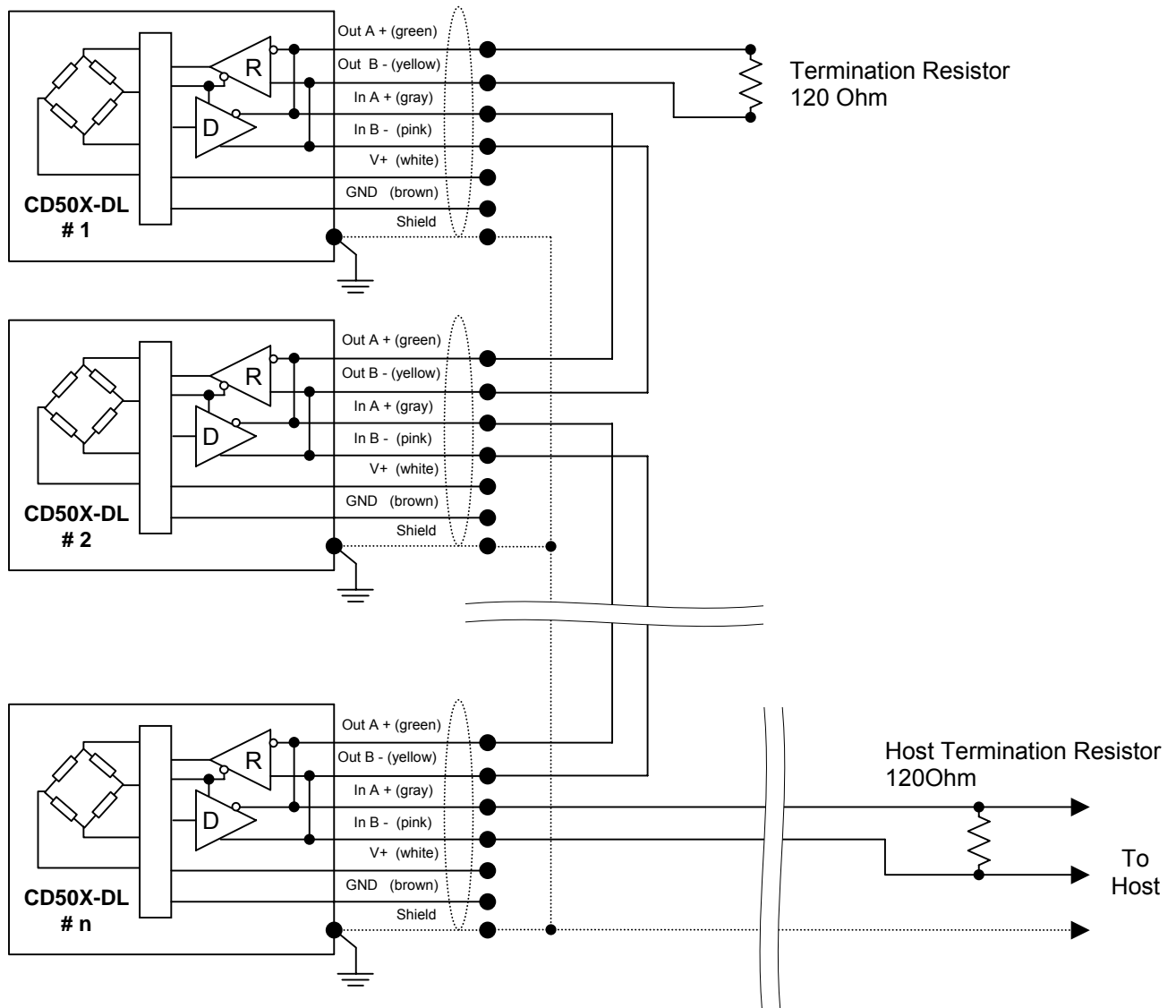
Example 2: weighbridge application

Serial interface RS485 (2 wire, half duplex):

Electrical connections:

The CB50X-DL load cell offers a half duplex output (RS485). Data signals are both transmitted and received on a single wire pair Rx/Tx+ and Rx/Tx-. To avoid star mounting, each load cell has an input and an output wire pair.

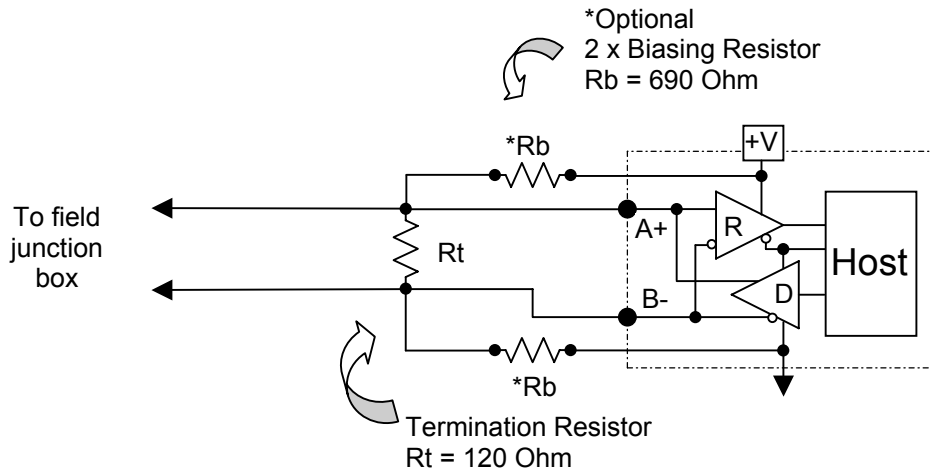
Wire function	Wire color code
Supply (+7.5...+16VDC)	White
GND	Brown
Out A + (Output pair)	Green
Out B - (Output pair)	Yellow
In A+ (Input pair)	Gray
In B - (Input pair)	Pink
Shield	Braid shield, tinned



Typical RS485 two wire multidrop

Biasing an RS485 network:

When an RS485 network is in an idle state, all the CD50X-DL are in listen (receive) mode. As all drivers are tristated, the state of the line is unknown. In order to maintain the proper idle voltage state, bias resistors must be applied to force the data lines to the idle condition.



Tristate control:

The bus mode operates on a so called "Master/Slave" program control, which designates one device (the computer or indicator) on the network as Master, and this device supervises all transmissions with each of the Slaves (CB50X-DL load cells) in a polling mode.

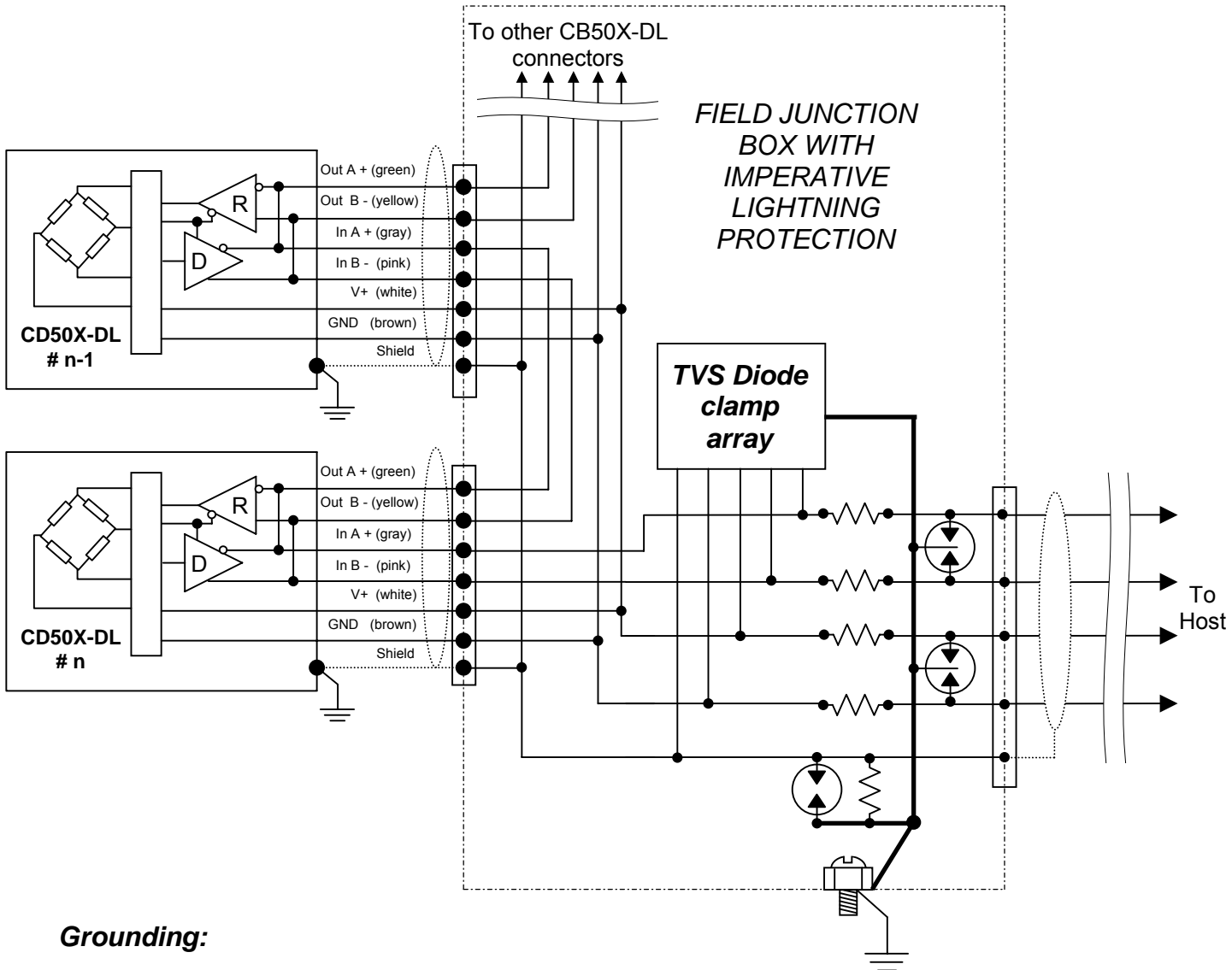
When a Slave (CB50X-DL) answers to a request of the Master (Host), it is important to note that the data line need to be "disabled" at a fixed interval after the last bit transmitted by the Master. Typically a Slave (CB50X-DL) will answer **one character length later** after receiving the complete command, to let enough time to the Host to pilot the RS485 driver (by RTS line handshaking or Automatic Send Data Control methods).

This will avoid to several drivers trying to control the lines simultaneously, a condition called line contention.

EIA Standard	RS485
Mode of Operation	Differential
Number of Drivers and Receivers on line	32 Drivers / Receivers
Max cable length	1200 m
Receiver common mode voltage	-7V, +12V
Driver output voltage	+/-1.5V min
Minimum Driver load	60 Ω
Driver output short circuit	<150mA to Gnd <250mA to -7V/ +12V
Receiver input resistance	12k Ω
Receiver sensitivity	+/-200mV

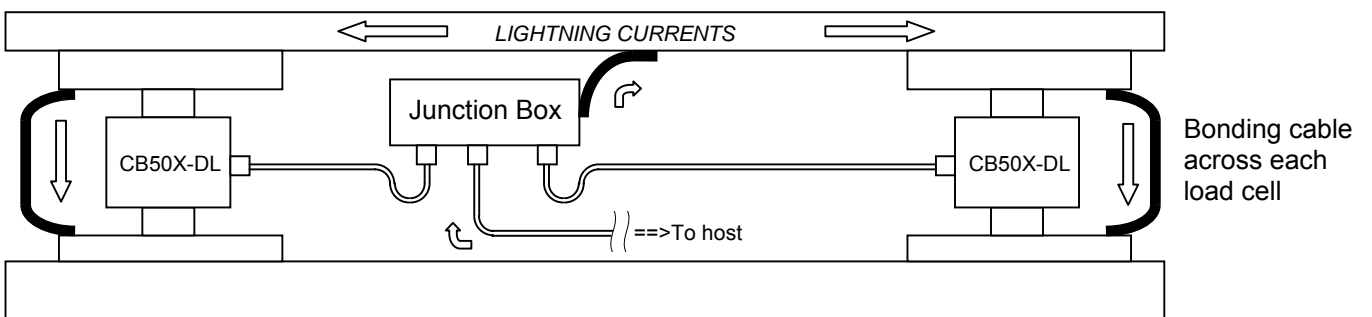
Lightning protection:

The field junction box for wiring together any of the CB50X-DL of a same weighing platform, requires imperatively lightning protection. Scaime has specially designed a junction box including a multistage lightning protection. Screen connections are maintained and also protected.



Grounding:

The aim is to prevent any breakdown through the load cells due to voltage gradients. As weighbridge platforms are usually metallic, it is better to let any lightning current flow through the structure and find a way to earth crossing any individual load cell bonding. In addition, isolating plates can be used.



Protocol specifications:

The CB50X-DL exchanges only 7 bits coded ASCII characters with the master device.

ASCII characters of value lower than 20Hexa are field separators or frame delimiters. All other ASCII characters have a value comprised between 20Hexa and 7Fhexa. This applies also to status and checksum characters.

To secure exchanges an even parity bit is added to each character.

A bit of silence (mark space) follows any character sent by the CB50XDL.

Interface Characteristics:

Each character is transmitted with LSB first.

Transmission format	
Start bit	1
Word length	7
parity	even
Stop bit	1
Handshake	Not implemented

Protocol main features:

Two sets of commands:

1. The **Command communication set** is dedicated to parameter the CB50X-DL load cells. Each command is composed of an **address field** (that can be a telegram address, a programmed short address, the serial number of the load cell or a factory password), a **command field** of 3 characters length and a **statements field**, if required by the function. Each field is delimited by specific control characters. Each command includes a **checksum character** for secure exchanges.
Some commands can be locked by user defined PIN code. If one PIN code is lost, the locked CB50X-DL can only be factory unlocked.
2. The **Field Communication Set** is dedicated to the field requests. Only short addressing is allowed and an exchange of measure needs only 14 characters length for a single address. Load cell response message is always protected by a checksum.
In sequence addresses measure request is a smart and efficient way of addressing groups of load cells.

Note: input commands are not buffered.

Checksum calculation:

Checksum calculation are performed by adding all the characters of a frame except the last one (addition with 7bits masked and without carry) and then two complement the result. If the resultant value (7bits masked) is lower to Hex 21 (Dec 33), then the value Hex 21 (Dec 33) is added to it.

This avoids having any undesirable control ASCII character as CKSM character.

For example the following frame sent by a C50X-DL:

SYN	9	;	0	8	2	6	3	7	<	ETB
16h	39h	3Bh	30h	38h	32h	36h	33h	37h	3Ch	17h

The hexa sum of the 9 first hexa values makes **1C4h**.

This result 7 bits masked is **44h**.

The 7 bits masked two complement (negation) is **3Ch**, which is the **<** character.

For this other following frame:

SYN	1	DEL	2	1	7	3	0	4	*	ETB
16h	31h	7Fh	32h	31h	37h	33h	30h	34h	2Ah	17h

The hexa sum of the 9 first hexa values makes **1F7h**.

This result 7 bits masked is **77h**.

The 7 bits masked two complement (negation) is **09h**, which is the **BS** character

As the resultant value is a control character lower than Hex 21, the value of Hex 21 is added to it, so the final value is **2Ah**, which is the ***** character.

Universal checksum:

For any reasons, if you don't want to calculate the checksum, required for any request frame sent to a CB50X-DL, you can use as universal checksum the **CR** character, Hex 0D (ASCII 13).

This will make easier the parametring of several CB50X-DL, especially if you use a terminal program.

However we recommend using standard checksum calculations when the integrity of measures has to be verified in the final field application.

Command Communication Structure: Command set

Host message format:

SOH	ASCII 1 (Hex 01)	Start of command
Address		Address field
ESC	ASCII 27 (Hex 1B)	End of address field and start of command field
Command		Command field (3 car)
Parameter		Parameters field
CKSM		Calculated checksum (1 car) or universal checksum CR - ASCII 13 (Hex 0D)
ETX	ASCII 3 (Hex 03)	End of command

Reply format:

STX		Start of answer
Address		Address field
ESC	ASCII 27 (Hex 1B)	End of address field and start of data field
Data		Data of command reply
CKSM		Calculated checksum (1 car) or universal checksum CR - ASCII 13 (Hex 0D)
ETX	ASCII 3 (Hex 03)	End of data

Address:

One of the address possibilities (6 decimal characters serial number, factory setting or broadcast address Car **0** (ASCII 48 or HEX 30), working address or factory password)

Available user commands: Basic command set and field command set

BASIC COMMAND SET				
Command	Function	Query possible	Data returned	Default value
ADR	Set address	yes	Address	0
BDR	Set baud rate	no	Baud rate	9600
ZER ²⁾	Set offset value	yes	Offset value	0
COF ²⁾	Set corner factor	yes	Corner factor	1
SPF ²⁾	Set span factor	yes	Span factor	1
SDD ^{1) 3)}	Save device data / Metrological lock	yes	Trade counter / CRC	(N/A)
ADJ ¹⁾	Metrological unlock	yes	Trade counter / CRC	locked
RES	Device Reset	(N/A)	No answer expected	(N/A)

¹⁾ This command is PIN code protected (see command **LOC**). If the device is PIN code locked, it will answer a **NACK** acknowledge frame to this command with an error code **04** (locked or illegal PIN code).

²⁾ These commands are secured for legal for trade purpose. The device needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological secured).

³⁾ Any command should be followed by **SDD** to make the results effective definitely. The effect of all the precedent commands and actions can be cancelled by a **RES** command or a power on before executing a **SDD** command.

FIELD COMMAND SET				
SINGLE SHORT ADDRESSING FRAME	ENQ	ASCII 5 (Hex 05)	1 character	Enquiry
	ADR		1 character	user defined device address
	LF	ASCII 10 (Hex 0A)	1character	Line feed
MULTIPLE SHORT ADDRESSING FRAME (IN SEQUENCE ADDRESSING)	ENQ	ASCII 5 (Hex 05)	1character	Enquiry
	ADR		1 character	Start user defined device address
	ADR		1 character	Final user defined device address
	LF	ASCII 10 (Hex 0A)	1 character	Line feed

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**), broadcast address ASCII 48 (Hex 30 or Car **0**), 6 decimal characters serial number (useful to initialize the bus mode with several load cells with the same factory address).

Caution: in bus mode, avoid using command **ADR** with broadcast address to avoid line contention

Parameter : new address to set (one character within the range ASCII 49 to 57, 65 to 90, Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**).

Car **?** (ASCII 63, Hex 3F) if query of the serial number (be careful when using query command with broadcast address)

Function: set the address or query the serial number of the load cell that has the address stated (device address or broadcast factory address). The new address will be effective immediately.

Caution: so that the address remains changed permanently, it must be stored in EEPROM using the **SDD** command.

If the new address is not stored, the previously affected address will be activated after a **RES** command or after power on.

Example 1:

SOH	0	ESC	A	D	R	A	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: output of the new device address and the serial number of the load cell as decimal number

STX	A	ESC	1	2	3	4	5	6	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell of address 0 will return the new address **A** and the serial number 123456 of the load cell.

Example 2:

SOH	6	5	4	3	2	1	ESC	A	D	R	A	CKSM	ETX
-----	---	---	---	---	---	---	-----	---	---	---	---	------	-----

Effect: the device with serial number 654321 will take the new address **A**.

STX	A	ESC	6	5	4	3	2	1	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

Return of the new address **A** followed by the serial number 654321 of the load cell.

Query example:

SOH	9	ESC	A	D	R	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what is the serial number of the load cell that has the address **9** ?

STX	9	ESC	1	2	3	4	5	6	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with the address **9** has the serial number 123456

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),
 broadcast address ASCII 48 (Hex 30 or Car **0**),
 6 decimal characters serial number,

Caution: in bus mode, avoid using command **BDR** with broadcast address to avoid line contention

Parameter: new baud rate to set (2400, 4800, 9600, 19200).

Function: set the baud rate (changing will be effective after **SDD** command).

Caution: so that the baud rate remains changed permanently, it must be stored in EEPROM using the **SDD** command. The host terminal must also be changed over to the newly selected baud rate setting.

If the newly selected baud rate setting is not stored by **SDD** command, the previously selected baud rate will be activated after a **RES** command or after power on.

Example:

SOH	8	ESC	B	D	R	0	9	6	0	0	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	------	-----

Effect: Output of the new baud rate as decimal number

STX	8	ESC	0	9	6	0	0	CKSM	ETX
-----	---	-----	---	---	---	---	---	------	-----

The load cell of address **8** will return this message to the host terminal at the new baud rate 9600 bauds.

Important note: to get a favourable issue and excepted for a query, this command needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological secured).

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),
broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number,

Caution: in bus mode, avoid using command **COF** with broadcast address to avoid any mistake during device's setting operations.

Parameter: load cell offset value to enter in decimal characters. Data is a 6 characters length positive integer.
The internal default value of the offset value is 0.

Caution: when setting and query of offset values, the unit is related to measured values with a corner factor and a span factor equal to 1 and with no previous offset correction with **ZER** command.

If this parameter is missing, zeroing is performed automatically with an internal procedure. As this internal procedure depends on stability of measurement, it is the purpose of the host to verify that zeroing operation has a favourable outcome.

Caution: so that zeroing remains changed permanently, offset value must be stored in EEPROM using the **SDD** command.
If the new offset value is not stored, the previous value will be activated after a **RES** command or after power on.

Car ? (ASCII 63, Hex 3F) if query of the offset value.

Function: set the offset value of the load cell. Changing will be effective immediately but has to be stored in EEPROM using the **SDD** command.

Example 1:

SOH	9	ESC	Z	E	R	CKSM	ETX
-----	---	-----	---	---	---	------	-----

Effect: automatic zeroing is requested automatically for the load cells that has the address **9**.

STX	9	ESC	0	0	0	5	3	7	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with address **C** returns the new offset value 537.

Caution: It is the purpose of the host to verify that zeroing operation has a favourable outcome. In addition, remember offset value must be stored in EEPROM using individual **SDD** commands.

Example 2:

SOH	C	ESC	Z	E	R	0	0	5	4	7	9	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	------	-----

Effect: the offset value 5479 has to be entered in the device with address **C**.

STX	C	ESC	0	0	5	4	7	9	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with address **C** returns the new offset value 5479. Zeroing is immediate but must be stored in EEPROM using **SDD** command be definitive.

Query example :

SOH	9	ESC	Z	E	R	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what is the offset value of the load cell that has the address **9** ?

STX	9	ESC	0	1	0	5	8	8	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with the address **9** has the offset value 10588

Important note: to get a favourable issue and excepted for a query, this command needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological securing).

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),
broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number,

Caution: in bus mode, avoid using command **COF** with broadcast address to avoid any mistake during device's setting operations.

Parameter: when entered, the load cell corner factor has to be multiplied by 100,000 and formatted to 6 decimal characters in length. For example, to have an internal corner factor of 0.058, the parameter to enter should be 005800.
The internal default value of the corner factor is 1.

Caution: so that corner factor remains changed permanently, corner factor must be stored in EEPROM using the **SDD** command.
If the new corner factor is not stored, the previous value will be activated after a **RES** command or after power on.

Car ? (ASCII 63, Hex 3F) if query of the corner factor.

Function: set the corner factor value of the load cell. Changing will be effective immediately but has to be stored in EEPROM using the **SDD** command.

Example 1:

SOH	7	ESC	C	O	F	0	9	7	9	0	0	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	------	-----

Effect: the corner factor value 0.979 has to be entered in the device with address **7**.

STX	7	ESC	0	9	7	9	0	0	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with address **7** returns the new corner factor value 0.979.

Caution: Remember corner factor value must be stored in EEPROM using the **SDD** command.

Query example:

SOH	9	ESC	C	O	F	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what is the offset value of the load cell that has the address **9** ?

STX	9	ESC	1	0	5	8	7	8	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with the address **9** has the offset value 1.05878.

Important note: to get a favourable issue and excepted for a query, this command needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological securing).

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**).

Broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number,

Caution: in bus mode, avoid using command **COF** with broadcast address to avoid any mistake during device's setting operations.

Parameter: when entered, the load cell span factor has to be multiplied by 100,000 and formatted to 6 decimal characters in length. For example, to have an internal span factor of 1.20581, the parameter to enter should be 120581.
The internal default value of the corner factor is 1.

Caution: so that corner factor remains changed permanently, corner factor must be stored in EEPROM using the **SDD** command.

If the new corner factor is not stored, the previous value will be activated after a **RES** command or after power on.

Car ? (ASCII 63, Hex 3F) if query of the span factor.

Function: set the corner factor value of the load cell. Changing will be effective immediately but has to be stored in EEPROM using the **SDD** command.

Example 1:

SOH	K	ESC	S	P	F	1	2	0	5	8	1	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	------	-----

Effect: the span factor value 1.20581 has to be entered in the device with address **K**.

STX	K	ESC	1	2	0	5	8	1	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with address **K** returns the new corner factor value 1.20581.

Caution: Remember span factor value must be stored in EEPROM using the **SDD** command.

Query example:

SOH	4	ESC	S	P	F	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what is the offset value of the load cell that has the address **4**?

STX	4	ESC	0	0	0	7	9	8	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The load cell with the address **4** has the span factor value 0.00798.

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),

Broadcast address ASCII 48 (Hex 30 or Car **0**),

6 decimal characters serial number.

Caution: in bus mode, avoid using command **SDD** with broadcast address to avoid any mistake during device's setting operations.

Parameter: no parameter to enter for saving the settings of a device.

Car ? (ASCII 63, Hex 3F) if query of the current trade counter and checksum values.

Function: If the device is not PIN code locked, save all the device data in EEPROM. All the previous settings are lost. The trader counter is incremented (excepted for query command) and its new value is returned.

Settings affected:

ADR	Address
BDR	Baud rate
ZER	Offset value
COF	Corner factor
SPF	Span factor
LOC	PIN locked state
CAL	internal parameters
RDV	Reload default values

Example 1:

SOH	A	ESC	S	D	D	CKSM	ETX
-----	---	-----	---	---	---	------	-----

Effect: All the current parameters of the device with address **A** are stored in EEPROM.

STX	A	ESC	0	0	0	0	1	4	;	7	F	8	1	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	---	---	------	-----

The load cell with address **A** returns the new trade counter value that has just been incremented by this command and the new checksum value.

Important note: this command is PIN code protected (see command **LOC**). If the device is PIN code locked, it will answer a **NACK** acknowledge frame to this command with an error code **04** and no setting is saved in the device

Query example:

SOH	4	ESC	S	D	D	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what is the trade counter value of the load cell that has the address **4** ?

STX	4	ESC	0	0	0	0	1	8	;	F	4	8	0	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	---	---	------	-----

The load cell with the address **4** has the new trade counter value 18 and the checksum value **F480**.

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),
Broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number.

Caution: **ADJ** command will first save current data's of the device in EEPROM and then increment the trade counter. So that it is impossible to modify a metrological parameter without evolution of the not resettable trade counter (legal for trade application).

Parameter: no parameter required.

Car ? (ASCII 63, Hex 3F) if query of both trade counter number and CRC value.

Function: unlock the device for access to metrological parameter modifying (and increments the trade counter).

Initial state is locked.

When a device is unlocked after running this command, it will come back to a locked state after a save data device **SDD** command, a **RES** command or after power on.

Example 1:

SOH	7	ESC	A	D	J	CKSM	ETX
-----	---	-----	---	---	---	------	-----

Effect:

STX	7	ESC	0	0	0	0	1	8	;	E	7	8	2	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	---	---	------	-----

The CB50X-DL with the address **7** is unlocked, the trade counter is incremented, the new value is **18** and the new checksum value is **E782**. Access to metrological commands is possible.

Query example 1:

SOH	E	ESC	A	D	J	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what are the values of the trade counter and CRC of the load cell that has the address **E**?

STX	E	ESC	0	0	0	0	2	2	;	E	5	F	0	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	---	---	------	-----

The load cell with address **E** returns its current trade counter value **000022** and its current checksum value **E5F0**.

Query example 2: particular behaviour of the command **ADJ** when using broadcast address.

In bus mode and when short addresses have been entered in each device, this command allows the host to query all the devices ready on the bus, each device answering its own trade counter and checksum values successively at time intervals of some tenth of milliseconds.

SOH	0	ESC	A	D	J	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: successive output of the checksum of each device from the lowest short address **1** to the highest **Z**.

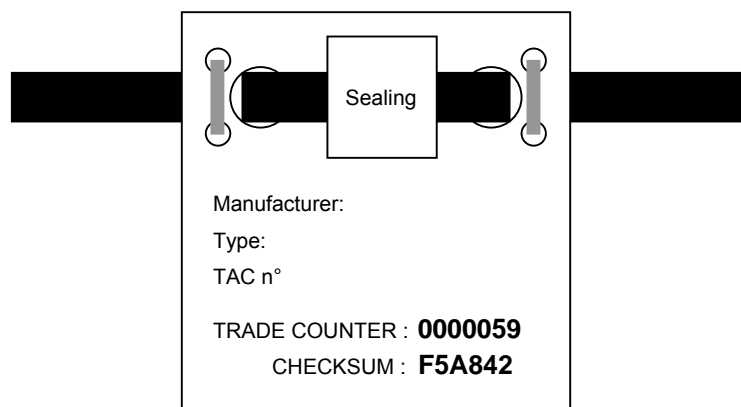
This is particularly useful to secure the complete instrument without any sealing of the CB50X-DL connections.

Suppose this command is performed each time the indicator is started up, and the indicator adds the values of each trade counter, also adds the values of the individual checksum values.

Let display those two resulting numbers on the indicator for the following operator checking.

The two numbers shall correspond to those reported on a physical plate fixed and sealed on the cable. If the results do not match, sealing has been corrupted (because of a new calibration for example) and the instrument has to be re-stamped.

Checking has to be done regularly.



Example of cable sealed plate

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**).

Broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number.

Parameter: no parameter required.

Function: Device start (warm start).

Working EEPROM values are transferred into the RAM.
The trade counter is not incremented.

Example 1:

SOH	0	ESC	R	E	S	CKSM	ETX
-----	---	-----	---	---	---	------	-----

Effect: causes automatic resetting operation for all the load cells on the bus
(broadcast addressing)

No response is expected.

Caution: before using **RES** command, be sure all the parameters of each device
have been stored in EEPROM using **SDD** command before.
If not, all the currents settings will be lost.

ADDITIONAL COMMAND SET				
Command	Function	Query possible	Data returned	Default value
VAL	Read current measure	exclusively	Current measure	(N/A)
STA	Read status (advanced)	exclusively	Status data's	(N/A)
IDN	Identification	exclusively	Identification data's	factory set
LOC ¹⁾	Unlock the device / Enter PIN code	yes	acknowledge frame	Unlocked
CAL ²⁾	Upload device parameters	yes (download)	Users data's	Default data's
RDV ^{2) 3)}	Reload default values	(N/A)	Trade counter / CRC	(N/A)

¹⁾ If the device is PIN code locked, it will answer to a query a **NACK** acknowledge frame to this command with an error code **04**. If the device is unlocked, it will answer an **ACK** acknowledge frame to this command with an error code **00**.

²⁾ These commands are secured for legal for trade purpose. The device needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological secured).

³⁾ Factory metrological settings can be restored by the **RDV** command. This function affects only user **ZER**, **COF** and **SPF** coefficients. The trade counter and checksum are not modified by this command and current values are returned. Current address and baud rate are kept unchanged with this command.

ACK and NACK acknowledge frames:

When a command is not accepted, an **ACK** or **NACK** acknowledge frame is returned. This frame includes an error codification by characters **ER1** and **ER2**:

STX	A	ACQ or NACQ	ER1	ER2	CKSM	ETX
------------	----------	--------------------	------------	------------	-------------	------------

Error codes codification:

ER1	ER2	error type
0	0	no error (ACK)
0	1	Illegal or unknown command
0	2	CRC error
0	3	illegal data or format
0	4	locked or illegal PIN code
0	5	illegal addressing
0	6	metrological locked

Further commands:

Other commands like **STC**, **LIN**, **FIL**, **SOV**, and **SSC**... are commands used internally in SCAIME. The settings are factory set by SCAIME and protected by a password, it may not be changed under any circumstances. The complete factory setting is stored in non-volatile memory and protected against overwriting.

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),

Broadcast address ASCII 48 (Hex 30 or Car **0**),

6 decimal characters serial number.

Caution: see the particular behaviour of this command when using broadcast address

Parameter: Car ? (ASCII 63, Hex 3F) exclusively.

Function: Reads and returns status and current measure.

Data field is 1 character of status (see page 33) followed by 6 decimal characters.

Example 1:

SOH	A	ESC	V	A	L	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: Output of the current measure.

STX	A	ESC	?	0	0	5	6	1	8	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	------	-----

The load cell with address **A** returns the measured value **5618** which is a positive stable weighing result, with no A/D error, and new refreshed.

This command differs of the field command (*single address measure request*) that allows only short addressing.

Serial number addressing may be possible.

The complete transmission exchanges 21 ASCII characters (short addressing), one and half times longer than the field command.

Example 2:

SOH	6	5	4	3	2	1	ESC	V	A	L	?	CKSM	ETX
-----	---	---	---	---	---	---	-----	---	---	---	---	------	-----

Effect: Output of the current measure.

STX	Z	ESC	9	0	2	3	4	3	2	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	------	-----

The device with serial number 654321 (with current address **Z**) returns the measured value **23432** which is a positive, not stable weighing result, with no A/D error, and already sent.

Example 3: particular behaviour of the command **VAL** when using broadcast address.

In bus mode and when short addresses have been entered in each device, this command allows the host to query all the devices ready on the bus, each device answering successively at time intervals of some tenth of milliseconds.

SOH	0	ESC	V	A	L	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: successive output of the current measure of each device from the lowest short address **1** to the highest **Z**.

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9, A** to **Z**).

Broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number.

Parameter: Car ? (ASCII 63, Hex 3F) exclusively.

Function: outputs advanced information if bit Bit2 of status character (incorrect A/D value) is set to **1**, status character is attached to each measurement (see § field communication set).

Successive fields are separated by a Car ; (ASCII 59, Hex 3B).

Successive Fields:

	example	Individual field's length
Supply voltage value ¹⁾	12.136	6 characters
+5V voltage value ¹⁾	4.953	5 characters
Internal conversion rate	041	3 characters
Setting temperature ²⁾	+00.0	5 characters
Current temperature ²⁾	+31.5	5 characters
8 bits error flags	00000000	8 characters

¹⁾ Informative voltage values only for failure analysis purpose

²⁾ Not used

Definition of 8 bits error flags:

Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7	Bit8	Error flag definition
0	0	0						Reserved
			0					1 – Supply voltage < 7V
				0				1 – Supply voltage > 16V
					0			1 – A/D reference problem
						0		1 – A/D over ranging
							0	1 – A/D under ranging

Address: user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),

Broadcast address ASCII 48 (Hex 30 or Car **0**),
6 decimal characters serial number.

Caution: see the particular behaviour of this command when using broadcast address

Parameter: Car ? (ASCII 63, Hex 3F) exclusively.

Function: outputs an identification string. Successive fields separated by a Car ; (ASCII 59, Hex 3B).

Successive Fields:

	example	Individual field's length
Manufacturer	SCAIME	8 alphanumeric characters
Reference number	421892	8 alphanumeric characters
Designation (shorted)	CB50X-DL 20t	16 alphanumeric characters
Serial Number	123456	6 numeric characters
Software Version	V1.5	4 alphanumeric characters

Example 1:

SOH	C	ESC	I	D	N	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect : Output of the device identification

STX	C	ESC	S	C	A	I	M	E			;	4	2	1))	6	;	V	1	.	5	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	--	--	---	---	---	---	---	---	---	---	---	---	---	---	------	-----

The load cell of address C will return the following identification:

“SCAIME ;421892 ;CB50X-DL 20t ;123456;V1.5”

Example 2: particular behaviour of the command **IDN** when using broadcast address.

In bus mode and when short addresses have been entered in each device, this command allows the host to identify all the devices ready on the bus, each device answering its own parameters successively at time intervals of some tenth of milliseconds.

SOH	0	ESC	I	D	N	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: successive output of the identification of each device from the lowest short address **1** to the highest **Z**.

Additional Command Set:unlock the device or enter a
new PIN code (when unlocked)**LOC****Important advice:** take care when using this command not loosing control of the device.**If it is lost, the unit must be returned to the factory to reclaim it.**Nothing is saved in EEPROM until a save device data command **SDD** is issued and previous state will remain unchanged after a **RES** command or after power on.**Address:** user defined device address ASCII 49 to 57, 65 to 90 (Hex 31 to 39, 41 to 5A or Car **1** to **9**, **A** to **Z**),Broadcast address ASCII 48 (Hex 30 or Car **0**),

6 decimal characters serial number.

Caution: in bus mode, avoid using command **LOC** with broadcast address to avoid any mistake during device's setting operations and especially PIN code locking.**Parameter:** PIN code that has to be formatted to 6 decimal characters in length.Initial state is unlocked (factory default PIN code value is **000000**).

Car ? (ASCII 63, Hex 3F) if query of the PIN locking state.

Function: unlock the device with a PIN code number or enter a new PIN code (when unlocked).To change a PIN code number, first unlock the device with the old PIN code if necessary (if PIN code \neq **000000**), enter the new PIN code and run a save device data **SDD** command.

The device will remain locked after.

Example 1:

SOH	7	ESC	L	O	C	2	9	7	9	0	5	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	------	-----

Effect:

- If the load cell with the address **7** was in a precedent state locked and the PIN code is the good one, it will be immediately unlocked.
The answer is an **ACK** acknowledge frame with an error code **00** (default normal state). The device will be kept unlocked until a **RES** command or a power on.

STX	7	ACQ	0	0	CKSM	ETX
-----	---	-----	---	---	------	-----

- If the load cell with the address **7** was in a precedent state locked and the PIN code is wrong, the device keeps locked.
The answer is a **NACK** acknowledge frame with an error code **04** (PIN code locked).

STX	7	NACQ	0	4	CKSM	ETX
-----	---	------	---	---	------	-----

- On the other hand, if the device with the address **7** was in a state unlocked but with another PIN code that need to be changed, it will keep **297905** as new PIN code number and will answer an **ACK** acknowledge frame to this command with an error code **00** (default state).
The entry of this new PIN code will be effective after a **SDD** command and the device will be **definitively** locked with this new PIN code after a **RES** command or after a power on.

STX	7	ACQ	0	0	CKSM	ETX
-----	---	-----	---	---	------	-----

Note: to let the device permanently unlocked (default state), first place the device in an unlocked state, and enter the PIN code number **000000**. The unlocked state will be effective permanently after a **SDD** command.

Query example:

SOH	9	ESC	L	O	C	?	CKSM	ETX
-----	---	-----	---	---	---	---	------	-----

Effect: what is the state of the load cell that has the address **9** ?

- If the load cell with the address **9** was in a precedent state unlocked, the answer is an **ACK** acknowledge frame with an error code **00** (default state).

STX	9	ACQ	0	0	CKSM	ETX
-----	---	-----	---	---	------	-----

- If the load cell with the address **9** was in a precedent state locked, the answer is a **NACK** acknowledge frame with an error code **04** (PIN code locked).

STX	9	NACQ	0	4	CKSM	ETX
-----	---	------	---	---	------	-----

Important note: to get a favourable issue and excepted for a query, this command needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological securing).

Address: user defined device address and broadcast address denied, only accepted 6 decimal characters serial number.

Caution: when short or broadcast address is used, the answer will be a **NACK** acknowledge frame with an error code **05** (illegal addressing).

QUERY (download of parameters) :

Parameter: Car ? (ASCII 63, Hex 3F) exclusively.

Function: returns short address and successive parameters of the device. Successive fields separated by a Car ; (ASCII 59, Hex 3B).

Successive Fields:

Offset value	e.g. 005735
Corner factor	e.g. 098759
Span factor	e.g. 120581
PIN code number	e.g. 752331
Short address	e.g. C

Query example:

SOH	1	6	5	2	2	1	ESC	C	A	L	?	CKSM	ETX
-----	---	---	---	---	---	---	-----	---	---	---	---	------	-----

Effect: Output of the device parameters

STX	C	ESC	0	0	5	7	3	5	;	0	9	8	7))	7	5	2	3	3	1	;	C	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	---	---	---	---	---	----	---	---	---	---	---	---	---	---	------	-----

The load cell with serial number 165221 will download the following parameters (offset value, corner factor, span factor, PIN code number and short address):

“005735;098759;120581;165221;C”

SET (upload of parameters) :

Parameter: Successive Fields :

Offset value	e.g. 005735
Corner factor	e.g. 098759
Span factor	e.g. 120581
PIN code number	e.g. 752331
Short address	e.g. C

Example:

SOH 3 2 1 2 2 2 ESC C A L 0 0 // 5 2 3 3 1 ; C CKSM ETX

Effect: setting of the device parameters to the new device of serial number 321222

STX C ESC 0 0 5 7 3 5 ; 0 9 8 7 // 7 5 2 3 3 1 ; C CKSM ETX

The new CB50X-DL of serial number 321222 takes the new short address **C** and the new following parameters:

Offset value	005735
Corner factor	098759
Span factor	120581
PIN code number	752331
Short address	C

Device parameters are not saved in EEPROM until a save device data command **SDD** is issued and previous state will remain unchanged after a **RES** command or after power on.

Important information: It may be interesting to transfer the device parameters from a product to a new one, for example for after sales purpose. Using serial number addressing, first upload the field parameters from the product in failure (if communication is always operational or if data's are available, for example previously memorised during the initial service step), then download these results to the new device and finally run a save device data **SDD** command. The new product is ready to take the place of the precedent device.

Additional Command Set:Reload default values (and
read the trade counter)**RDV**

Important note: to get a favourable issue and excepted for a query, this command needs to be first unlocked by sending an **ADJ** command. If not the device will answer a **NACK** acknowledge frame with an error code **06** (metrological securing).

Address: user defined device address and broadcast address denied, only accepted 6 decimal characters serial number.

Caution: when short or broadcast address is used, the answer will be a **NACK** acknowledge frame with an error code **05** (illegal addressing).

Parameter: no parameter required.

Function: Factory default values for offset, corner factor and span factor coefficients (**ZER, COF, SPF**) are reinitialized to the default values. The current value of the trade counter is returned.

Factory calibration internal settings and coefficients are kept.

Caution: so that factory default values remains changed permanently, storage in EEPROM using the **SDD** command must be done (the trade counter will be incremented).

Without running a **SDD** command, the previous value will be activated after a **RES** command or after power on.

Example:

SOH	0	1	1	2	8	0	ESC	R	D	V	CKSM	ETX
-----	---	---	---	---	---	---	-----	---	---	---	------	-----

Effect: the device with the serial number 011280 will be reinitialized to factory default values. All the field coefficients are changed to default values.

STX	A	ESC	0	0	0	0	0	4	CKSM	ETX
-----	---	-----	---	---	---	---	---	---	------	-----

The CB50X-DL with the serial number 011280 that has the address **A** reinitialize **ZER, COF** and **SPF** coefficients to the default values and returns the current value of the trade counter which is 4.

Caution: Remember these coefficients must be stored in EEPROM using the **SDD** command to be effective permanently (the trade counter will be incremented).

Field Communication Set :

The field communication exchange times should be as short as possible to achieve the highest number of updates by second.

In field commands, only short addressing is allowed. User defined device address has to be chosen within the range of characters “1” to “9” and “A” to “Z” (ASCII 49 to 57 and 65 to 90, or Hex 31 to 39 and 41 to 5A). Factory setting or broadcast address is “0” (ASCII 48 or Hex 30) is denied.

Host message command (single address measure request):

This complete transmission exchanges 14 ASCII characters. The response time of the load cell is nearly **one character length** after receiving the complete command, to let enough time to the Host to pilot the RS485 driver (by RTS line handshaking or Automatic Send Data Control methods). This will avoid to several drivers trying to control the lines simultaneously, a condition called line contention.

Transmission duration depends on the baud rate selected (see annex1).

Frame		Number of characters	
ENQ	ASCII 5 (Hex 05)	1	Enquiry
Address		1	User defined device address
LF	ASCII 10 (Hex 0A)	1	Line feed

Load cell reply:

Frame		Number of characters	
SYN	ASCII 22 (Hex 16)	1	Synchro
Address		1	Device address
Status		1	Characterize attached measure
CKSM		1	Checksum*
Data		6	decimal characters
ETB	ASCII 23 (Hex 17)	1	End of block

*See page 9 for checksum calculation.

Status character (definition of bit fields):

b6	b5	b4	b3	b2	b1	b0
0	1	1	X	X	X	X

- b0** → **0** if negative value attached
→ **1** if positive value attached
- b1** → **0** if instable value
→ **1** if stability criteria reached
- b2** → **0** if correct A/D value attached
→ **1** if incorrect A/D value attached
- b3** → **0** if new refreshed weighing result
→ **1** if already sent weighing result
- b4** → **1** Reserved
- b5** → **always 1**
- b6** → **0** Reserved

Host message command (in sequence addresses measure request):

The complete transmission with n load cells exchanges (4+ n x 11) ASCII characters. Each load cell takes a reading at the same time and then responds in sequence. (n-1) request duration time and the corresponding response time are saved compared to n successive single different address measure request.

The response time of the first load cell CB50X-DL is approximately one character transmission time. Each successive other load cell will respond immediately one after each other. Transmission duration depends on the baud rate selected (see annex1).

Frame		Number of characters	
ENQ	ASCII 5 (Hex 05)	1	Enquiry
Start address		1	Start user defined device address
Final address		1	Final user defined device address
LF	ASCII 10 (Hex 0A)	1	Line feed

This command works exclusively with successive addresses between the specified start address and final address.

If there is an address missing, the response will be incomplete.

At any new command, the bus will recover proper operation (the commands are not buffered).

Load cell(s) reply:

Frame		Number of characters	
SYN	ASCII 22 (Hex 16)	1	Synchro
Start address		1	Device address
Status		1	Characterize attached measure
Data		6	Decimal characters
CKSM		1	Checksum
ETB		1	End of block

The load cell(s) with each following character address reply in sequence until the last one that has the final address.

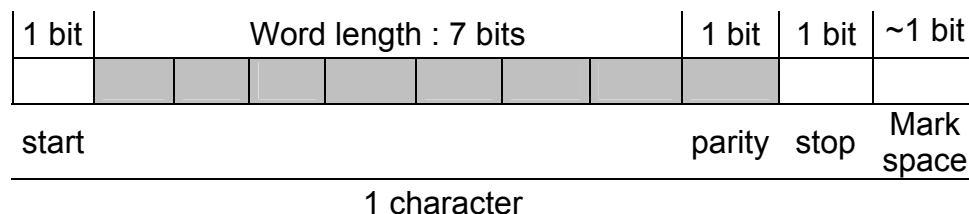
Annex 1

Characteristic data of the asynchronous serial interface:

type: RS485 (2-wire half duplex)
start bit: 1
word length: 7 (ASCII characters only)
parity: even
stop bit: 1
baud rate: 2400, 4800, 9600, 19200 Baud

Control characters lower than 20H are exclusively field separators (header, separator, terminator...). The use one of these characters is forbidden for Address, data's and checksum fields.

When transmitting a character, 10 bits are transferred bit for bit one after the other and asynchronously (without any clock signal). The first bit transferred is the start bit and the last one is the stop bit. A bit of silence (Mark space) follows each character.



Transmission time of a character is directly dependent of the baud rate:

Baud rate	Transmission time for one ASCII character
2400	4.58 ms
4800	2.29 ms
9600	1.14 ms
19200	0.57 ms

Any CB50X-DL on the bus is implemented as slave and all the activities on the line are initiated by the master (host computer or master digital weighing indicator). Device answer can be expected 1 character transmission time later the end of the request from the Host, to let enough time to the Host to pilot the RS485 driver (by RTS line handshaking or Automatic Send Data Control methods).

The transmission duration for an exchange can be calculated roughly with these informations. Select the number of characters in the command and multiply it by the transmission time of one ASCII character. Don't forget to add the respective commutation times after each request of the master (that includes computation times of the slave)

For example, if you address 6 devices using **single addressing measure requests**. This complete transmission exchanges "3 (Master) + 11 (CB50X-DL)" ASCII characters for each polled device.

Two commutation times has to be added for each device.

There is generally no silence bit after each character sent by the master (10 bits instead of 11 bits for the CB50X-DL).

For example, time duration is (3 x 2.08ms + 2 x 2.08ms + 11 x 2.27ms) for addressing one device at 4800 Baud.

The total exchange duration for 3, 6 and 8 devices at different baud rate result approximately:

Baud rate	Complete individual enquiry exchange duration for :		
	3 CB50X-DL	6 CB50X-DL	8 CB50X-DL
2400	213.75 ms (rate 5/s)	427.50 ms (rate 2 /s)	570.00 ms (rate 2 /s)
4800	106.88 ms (rate 9 /s)	213.75 ms (rate 5 /s)	285.00 ms (rate 4 /s)
9600	53.44 ms (rate 19 /s)	106.88 ms (rate 9 /s)	142.50 ms (rate 7 /s)
19200	26.72 ms (rate 37 /s)	53.44 ms (rate 19 /s)	71.25 ms (rate 14 /s)

To optimise the bus occupancy, the CB50X-DL is fitted with an **in sequence addressing** facility.

One request of the master will address a group of devices to get synchronized weighing measurements.

The total exchange duration for 3 and 6 devices at different baud rate result approximately:

Baud rate	Complete in sequence exchange duration for :		
	3 CB50X-DL	6 CB50X-DL	8 CB50X-DL
2400	172.08 ms (rate 6/s)	323.33 ms (rate 3 /s)	424.17 ms (rate 2 /s)
4800	86.04 ms (rate 12 /s)	161.67 ms (rate 6 /s)	212.08 ms (rate 5 /s)
9600	43.02 ms (rate 23 /s)	80.83 ms (rate 12 /s)	106.04 ms (rate 9 /s)
19200	21.51 ms (rate 46 /s)	40.42 ms (rate 25 /s)	53.02 ms (rate 19 /s)

Higher the number of devices on the bus and higher the baud rate will be, higher the bus occupancy will be improved.

Synchronism of measurements for all the devices is also a benefit for the behaviour of the complete weighing system.