DataBus Extension Cables

ICT Proprietary 3-wire Databus

The ICT Proprietary 3-wire Databus protocol operates on a three wire bus giving the customer maximum flexibility in the layout of their data logging system. The three wires of the Databus provide power and communication for all Smart sensors connected to the SL5 data logger. Due to the simplicity of this bus system, sensors and extension cables can be connected anywhere on the Databus. The Databus system uses the following wiring for all connected Smart sensors and extension cables:

Connector	Function	Sensor Cable Wire Colour	ICT Extension Cable Wire Colour
Pin 1	Power Supply Positive	Red	Red
Pin 2	Serial Data	Yellow	Yellow
Pin 3	Ground (Power and Data)	White	Blue and Green

ICT DataBus Extension cables

ICT International offers a range of factory made and guaranteed extension cables for use with smart sensors connected to a Smart Logger. These cables are compatible with any and all smart sensors. The extension cables connect between Databus hubs but can also be used to connect between the end of a smart sensor cable (typically 5m long and terminated with a 3-Pin female connector, see Figure 1) and a Databus hub.

Standard sizes include the following part numbers. Custom sizes are available on request:

CBEX01 1 metre extension cable	**CBEX02** 2 metre extension cable
CBEX05 5 metre extension cable	**CBEX10** 10 metre extension cable
CBEX15 15 metre extension cable	**CBEX20** 20 metre extension cable
CBEX25 25 metre extension cable	**CBEX30** 30 metre extension cable
CBEX40 40 metre extension cable	**CBEX50** 50 metre extension cable
CBEX75 75 metre extension cable	**CBEX100** 100 metre extension cable

For the construction of extension cables, ICT uses Hartland HCG304 cable that is a 4-core cable with 16 strand 20 AWG conductors. Standard insulation colours of the conductors are Red, Yellow, Green, and Blue.

Figure 1 below shows a typical example of the connector on a standard extension cable and is identical at both ends of the cable.

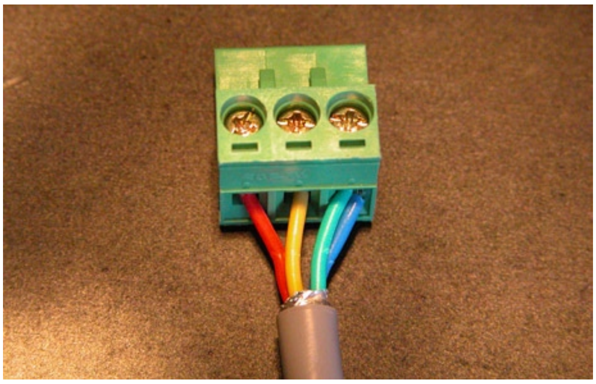

Figure 1

Most ICT sensors can have cables extended up to 4km however some high peak current sensors such as those which have heaters incorporated into their design are limited in the length of extension cable due to voltage drops in the cable when the heater coil is energised. If there is too much voltage drop caused by the resistance of the extension cable, the sensor interface may not function properly.

The sensor current and cable resistance determines the voltage drop on the cable and if the resultant voltage drop is greater than 1 volt then the reduced operating voltage at the sensor interface may impact the operation of the sensor. This is discussed in further detail in the Considerations for Customer Made Extension Cables section.

Because both Power and Serial Data share the Ground line, ICT has found that better signal integrity is achieved by combining two of the cores of the Hartland HCG304 cable for the Ground line when making extension cables. Doubling the cores effectively halves the resistance of the Ground line and therefore increases the distance the signal can operate over.

Considerations for Customer-Made Extension Cables.

As a general rule, if a customer is to construct their own extension cables, the system should be designed to limit any voltage drops in the extension cable from the voltage supply to the sensor interface to no more than 2 volts from end to end. For a measured 2V drop in an extension cable, there will be 1 Volt lost on the supply wire and 1 Volt lost on the ground wire.

Using Ohms law of V = I R, the customer can calculate a maximum cable resistance from a known sensor current and the maximum allowed voltage drop of 1V with the equation:

$$R_{max} = V_{max\ drop} / I_{sensor\ current}$$

As an example, an HRM sensor interface draws 667mA of current when the heater is energised, this means that the maximum resistance of the extension cable should be;

$$R_{max} = 1V / 0.667 = 1.5\Omega$$

Once the maximum cable resistance is known, the maximum cable length can be derived from the cable manufactures specified resistance relative to distance. Cable resistances are usually expressed as Ohms per Kilometre. The maximum cable length is determined with the formula:

$$L_{max\ cable\ length} = R_{max} / R_{per\ kilometre}$$

For example, at 39Ω per km, a 20AWG cable (cross-sectional area = 0.5 sq mm) as used in ICT extension cables can be calculated as:

$L_{max\ cable\ length} = 1.5\ \Omega / 39 = 0.038\ km\ or\ 38m$

The above calculations are based on the current required for a single sensor. If a system is designed to use a large number of any type of sensor, to minimise the consequences of too many high load sensors operating at the same time, ICT sensors have a staggered order of operation based on the serial number of the sensor.

The last two digits of the serial number determine the order of operation such that in any 20 sequential serial numbers of the one type of sensor, only one will operate at any one time. The second last digit is ordered based on it being odd or even while the last digit is ordered based on its actual value.

As an example, if a series of sensors fill the serial numbers #500 to #540, the first sensors to operate at a given logging interval will be #500 & #520, then #501 & #521, then #502 & #522 and so on.

Because of this staggering of the sensor operation, the number of sensors operating at any one time is significantly reduced and the cable diameters required to minimise voltage drops is also consequently reduced.

In the above example of calculating a maximum cable length, if the system had 60 sequentially serial numbered HRM sensors, there would be a maximum of three sensors operating at any one time. If all the sensors were situated at the end of the same extension cable, then the cable can only be one third of the calculated length of 38m. If a longer cable run were required, a larger diameter extension cable would have to be installed.

If the customer's system layout requires extension cables to be longer than can be achieved with the standard ICT extension cable, a simple solution is to use household electric wiring cable.

Using the method described above, a $4mm^2$ electric wiring cable will have a resistance of 4.75Ω/km. Therefore, a single HRM sensor can operate reliably on an extension cable with a length:

$L_{max\ cable\ length} = 1.5\ \Omega / 4.75 = 0.315km\ or\ 315m$

Figure 2 below shows a $4mm^2$ cable stripped for insertion into the Databus connector. To fit into the screw terminal of the Databus connector, some of the individual copper strands of the cable need to be cut away first. These strands need to be cut back as close to the insulation as possible so that there is no possibility of a short circuit between the wires when the cable is inserted into the screw terminals of the connector.

Figure 3 shows the cable inserted into the connector. Note that the inner core insulation is only stripped back far enough that the conductors are not visible when inserted into the connector, thereby minimising any risk of a short circuit between the terminals.

As with the ICT Databus Extension cables, the connector wiring is identical at both ends of the cable.

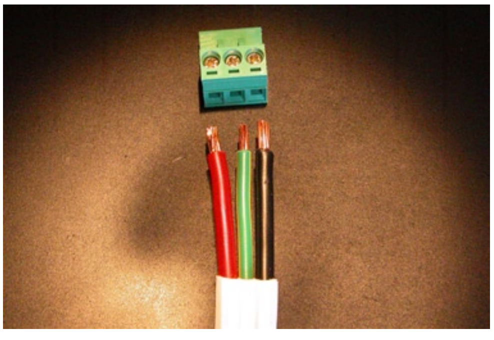

Figure 2

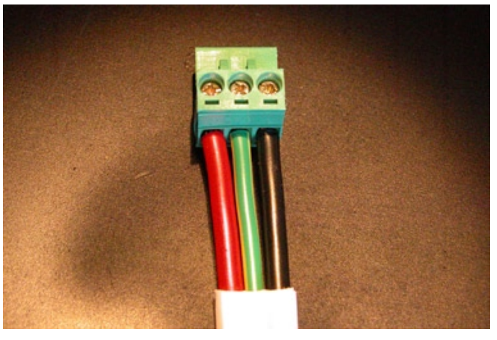

Figure 3

High load ICT sensors

The typical loads of ICT Smart sensors are published on the Internet, but as a quick reference, the table below lists the load currents of some of the more frequently used sensors that, because of their high load demands, warrant careful consideration when extension cables are to be incorporated into a system. Note also that the current drawn by a TDP sensor is continuous and as such does not benefit from the staggered switching of other sensors.

Sensor	Load
HRM30 Sapflow	667mA
TDP30 Sapflow	66mA continuous
SMD4 interface (4 x MP406)	100mA (4 x 25mA)
CS229 Thermal Matric	75mA

SPECIFICATIONS

Extension Cables:

Cable Part Number: HCG304

Supplier: Hartland Cables www.hartland.com.au

Reel/Drum Size: 100 or 500m

Cable Sheath: Grey V75 PVC

Screen: Overall aluminium/polyester laminate with tinned copper drain wire

Wire Gauge: 20AWG

Number of Cores: 4

Number of Conductors: 16

Conductor Diameter: 0.20mm

Insulation Thickness: 0.30mm

Insulation Colours: Red, Yellow, Green, Blue and Shield

Nominal wire to wire capacitance: 150 pf/m

Cable Resistance: 39 Ω/km

Cable Diameter: 5.7mm

Connectors:

Supplier: Soanar www.soanarplus.com

Connector Part Number: ETB41030GO

Pitch: 5.08mm

Housing material: Polyamide 66 (UL 94V-0) resin

Terminals: Tin plated over Brass

Screws: Zinc plated over Steel

Wire cage: Nickel Plated over Zinc Alloy

Dielectric strength: 2000 VAC (Min.)

Wire range: 12 AWG to 24 AWG

Insulation resistance: 500 M , 500 VDC

Rated: 10 Amp, 300 VAC

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