This Application Note applies to UnidriveSP Series Drives

Basic CTNet Practices and Checkout

Scope – Control Techniques has developed and sells a number of solutions to recurring industry needs worldwide, based on embedded software and a SM-Applications (Plus) module.

A number these solutions depend on a functional CTNet backbone to connect one section to another section. One popular example is the CTNet based Multiplex Pump solution.

Technical Support has found that not all users have a solid understanding of the basics for connecting two or more drives together via the CTNet ports available on the SM-Applications and SM-Applications Plus modules (which have replaced the SM-Applications Module).

On one or more occasion, we have discovered that a user attempting to commission a solution, did not have everything on hand, and required a resolution of this need immediately (if not sooner).

This application note will provide the means to address these needs.

Conceptual Outline – CTNet is an high-performance industrial process bus, and requires the selection and use of suitable media to link the individual SM-Application Plus modules together, as well as proper configuration of these same modules to attain proper and reliable operation.. Once assembled and configured, one can verify proper operation by inspecting key monitoring/diagnostic parameters provided by the SM-Application Plus module.

Media Selection

Control Techniques recommends the use of genuine CT Net Cable for use with CTNet Systems. This is a very high quality two conductor shielded cable with a green jacket. This shielded cable is prepared and then connected in a “multi-drop” fashion, with the shield prepared and connected to the center terminal of the CTNet RevD port.

Control Techniques has experienced too many CTNet field reports of intermittent CTNet problems only to find upon field examination that the CTNet media being used was not to specification. As a result they will not warrant a CTNet communication system that is not using the officially approved CTNet Cable (Green Hose)

Part # CTNet – xxx) where xxx is the length of cable you wish in feet.

Media selection emergency specification: Technical Support has fielded calls from solution users that were using unsuitable shielded media, and needed a solution that would allow them to ship a machine that day. For those users, Belden Cable 9772 has electrical specifications similar to CTNet Cable. The electrical losses are higher, but for connecting from two to six CTNet nodes together, it is similar and found to be usable in most cases.

Termination Resistors: In addition, two terminating resistors of the correct value are needed to complete the CTNet interconnection. CT recommends using two 82 ohm 5% ¼ watt carbon film resistors.

Media Preparation and Module Interconnection:
The first thing to do is to cut the CTNet cable into individual lengths long enough to reach between the SM-Application (plus) CTNet ports. One less segment than the number of nodes to be connected is required. For example, to connect three nodes, two segments will be needed. A suggested minimum length for the individual lengths is 18 inches.

CTNet cable reel (bulk)

The next block of steps involve preparation of the ends of the shielded cables so they are suitable to connect into a multi-drop fashion to the CTNet ports on the SM-Applications Plus modules. Suitable techniques to accomplish this are less obvious that one might first estimate, even with a good deal of experience in this industry. An illustrated step by step is provided in **Appendix A** at the rear of this App Note.

Begin with this

End with this

Once all the segments are prepared, one is ready to fasten the individual CTNet cable lengths to the individual CTNet connectors, forming a multi-drop connection between the SM-Application Plus CTNet ports.

Final results, terminating resistors fitted as well

1. It is suggested that one does the middle nodes that require two CTNet cable lengths fitted (and no terminator resistors) first.
2. For these middle nodes with two CTNet cable lengths connected, it is useful to tie-wrap the two lengths together on the insulation and secure the shield pigtails onto the middle connection and then connect the signal conductors.
3. Fasten the outside (single connection) connections to the CTNet port last. These same nodes will require the addition of terminating resistors in the next step.

Cut two terminator resistor ends to lengths to fit and fasten them to the outside CTNet connectors. Note that these nodes only have a CTnet single shielded conductor landed.

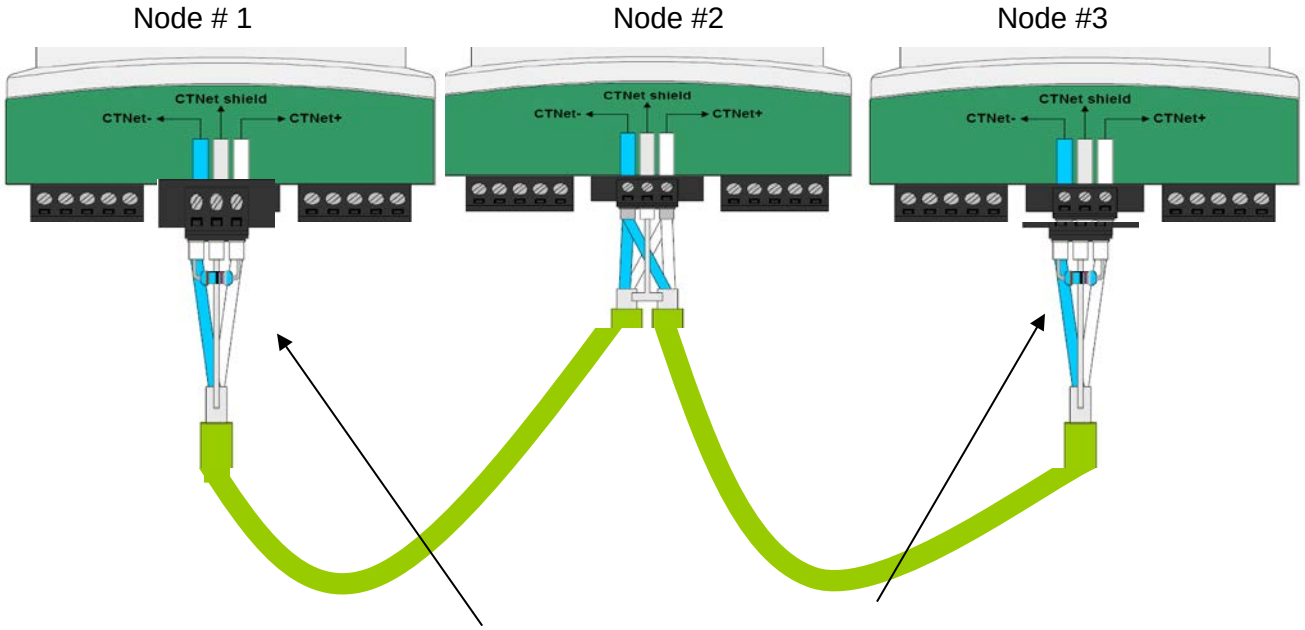
The final step is to inspect the interconnections and insure all interconnections are tight and as-described. An ohm-meter should read about **41 ohms** across the outside signal connections, and the middle terminals should all show nearly zero ohms at any point to any point on this assembly.

Module Configuration Basics

The strategy is to power up the SP(s) one by one, set each node ID from the default value of zero (0) to a unique value. A value of 1 is suggested for the first node, and assigning the others nodes in a contiguous block, is recommended.

Additionally, one and only one node must be assigned a non-zero value for the CT Sync telegram, and all other nodes must be at zero for this parameter. Node 1 is recommended for this function and a value of 510 is a good all-around value for most applications.

CTNet configuration of three nodes with Node #1 being the Sync Master of the segment



Node #1	Node #2	Node #3
Auto-run enable:		
xx.13 = Off (0)	xx.13 = Off (0)	xx.13 = Off (0)
Address:		
xx.23 = 1	xx.23 = 2	xx.23 = 3
Baud Rate:		
xx.24 = 1	xx.24 = 1	xx.24 = 1
CTNet Sync Rate		
xx.25 = 510	xx.25 = 0	xx.25 = 0

Reset and re-initialize

#0.00 = 1070, then press Stop/Enter (red button on SM-Keypad (Plus)

Note that xx is conditional, and read 15 for slot 1, 16 for slot 2 and 17 for slot 3.
So, for the case of a SM-App Plus in slot 3:

Address is set in #17.23,
Baud rate is set in #17.24
CTSync rate is set in #17.25

CTNet Basic Operational Verification

Initial verification begins once all nodes are configured and re-initialized. At this point, there should not be any DPL logic running (if present).

Node #1	Node #2	Node #3
DPL Program status		
xx.03 = 0 (not present) or xx.03 = 1 (stopped)	xx.03 = 0 or 1	xx.03 = 0 or 1
SM-Apps (Plus) Error code:		
xx.50 = 0 expected	xx.50 = 0 expected	xx.50 = 0 expected
CTNet Diagnostic		
xx.36 = > 0 Positive, value in 100(s) expected	xx.36 = > 0	xx.36 = > 0

Observe the CTNet diagnostic parameter for a while. This is expected to remain positive, and at a steady value.

One of the first indications of marginal CTNet network operation is an excessive number of and -1 values that remain visible for a prolonged period. This application note does not discuss how to deal with this situation, the assumption of this note is that accurately following the techniques and recommendations in this application note will avoid having to deal with this state of affairs.

CTNet Basic Transmission-activity Verification (Easy mode)

Configure the nodes present to take the network diagnostic parameter at node 1 (sync maser) and send it to the next node on CTNet Easy mode link 1 to a suitable parameter. Parameter #20.40 is suggested. Configure all the other links to send out #20.40 to the next node. Finally, configure the last node to send its value of #20.40 to the master's #20.40.

Node #1	Node #2	Node #3
Easy mode link 1 destination node :		
xx.26 = 201 1 -> 2 (via slot 1)	xx.26 = 301 2 -> 3 (via slot 1)	xx.26 = 101 3 -> 1 (via slot 1)
Easy mode link 1 source parameter :		
xx.27= 8136 1.17.36 (out slot 1)	xx.27= 2040 2.20.40 (out slot 1)	xx.27= 2040 3.20.40 (out slot 1)
Easy mode slot 1 destination parameter:		
xx.32 = 2040 1.17.36 -> 2.20.40 (via slot 1)	xx.32 = 2040 2.20.40 -> 3.20.40 (via slot 1)	xx.32 = 2040 3.20.40 -> 1.20.40 (via slot 1)

Reset and re-init all three nodes (#0.00 = 1070, then press Stop/Enter), and observe that all #20.40 values are the same as the value of 17.36 on node 1 (the sync master).

Re-initialize, and observe a positive value at #20.40 on all the nodes

CTNet verification is now complete.

Clean Up

Reset xx.26, xx.27 and xx.32 back to zero, and reset parameter xx.13 (Auto-run enable) back to On (1).

Save parameters (#0.00 = 1000, then press Stop/Enter), and then begin configuring the SM-Apps and the Unidrive SP(s) for the actual solution logic within the SM-Applications (Plus).

Resources: can be found on our website: www.controltechniques.com
For help contact techsupport.cta@mail.nidec.com, or
call Technical Support at 952-995-8000, 24/7/365

Appendix A

CTNet shielded cable end preparation – "Pigtail" technique.

Properly preparing the ends of the individual CTNet segments so that they are suitable for connection in to the CTNet port screw terminals is a bit "non-obvious. The following recommendations represent a balanced between ease of connection, and electrical performance.

This technique of forming the braid on the individual ends of the CTNet cabling into a pigtail for a connection to a common terminal is suitable for a small system consisting of two to six nodes. In such a network segment (up to) four of the nodes will have two CTNet shielded cables connecting to the terminal strip, and two nodes will only have a single CTNet shielded cable and a terminating resistor connecting to the terminal strip.

The following technique is somewhat labor-intensive, but offers the advantage of no special tools, fasteners or sleeves being required.

Tools required:

1. Utility knife w/ short blade mounted on a pen-like aluminum body. X-Acto® brand is typical and is illustrated.

2. Wire stripper suitable for stripping #20 wire-gauge stranded wire.

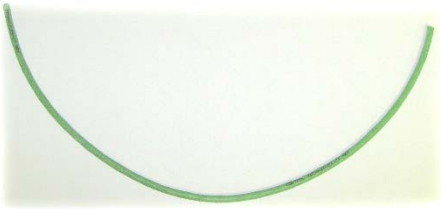
3. 4 1/2 inch diagonal cutting pliers

4. Soldering iron and small gage multi-core rosin solder, for "tinning" the ends of the prepared conductors. The temperature/wattage controlled versions are preferred, and a damp sponge is useful to keep the iron tip clean and from oxidizing too quickly.

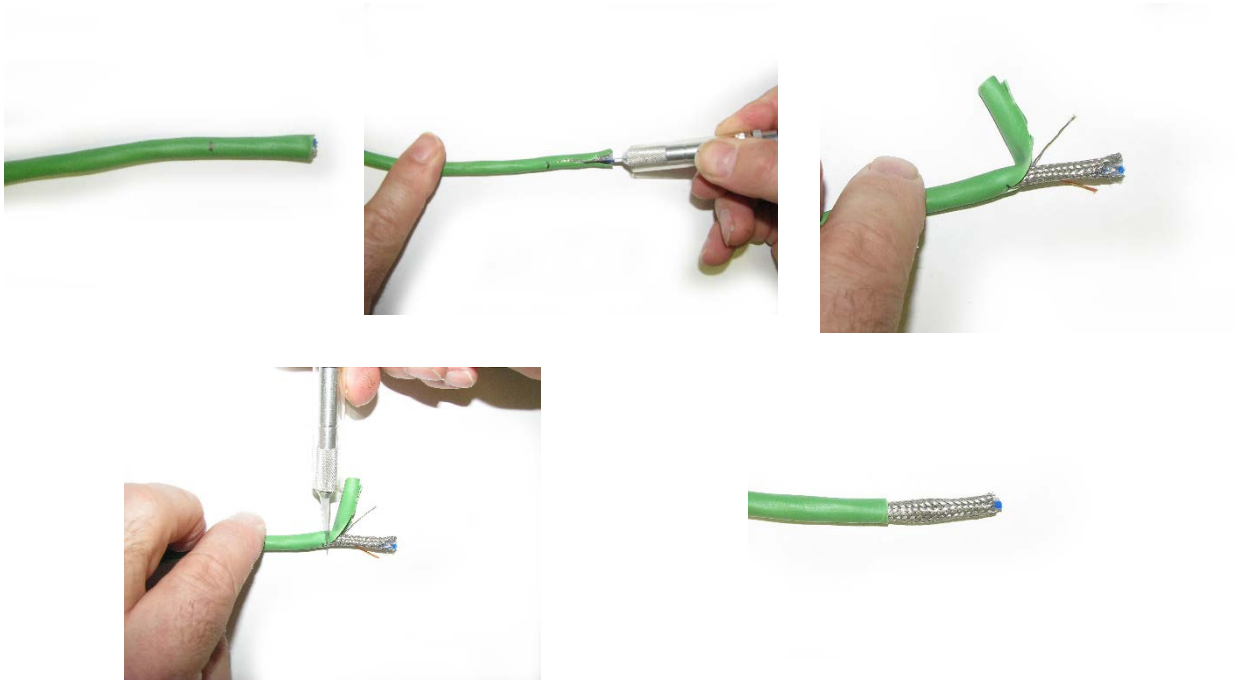
5. Optimal: Heat shrink tubing cut into individual 3/8 inch lengths is recommended to finish each end of the prepared CTNet cable lengths. This will require a heat gun and sufficient 3/8 inch heat shrink tubing

Illustrated Step-by-Step Preparation Instructions

- The first thing to do is to cut the CTNet cable into individual lengths long enough to reach between the SM-Application (plus) CTNet ports, if you have not done so, already.



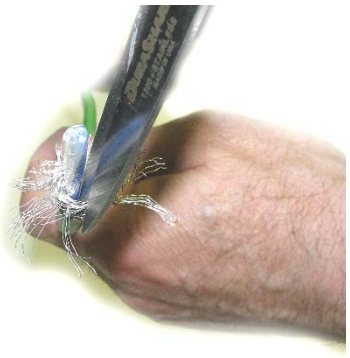
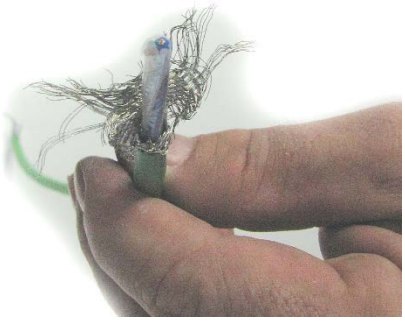
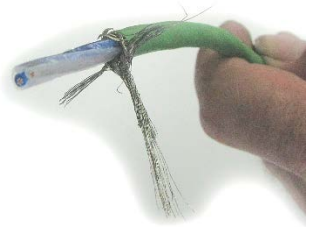
- Step 2 is to mark and strip from 25 mm to 35 mm (1” to 1 ¼ “) of insulation off each end of the individual CTNet lengths.



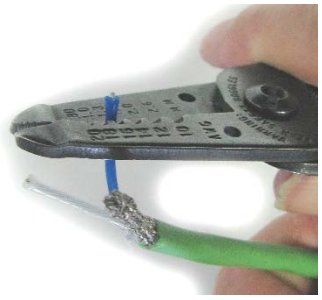
- Step 3 is to form the individual braided ends of the CTNet lengths into a drain connection. The trick here is that the braid is “difficult” to unbraid past the first ½ inch. Additionally, a pigtail made up of all the conductors is too massive to fit two such pigtails onto the CTNet port screw terminal available (one such pigtail will). This author recommends the following:

- Step 4 starts by pushing the braid back, untwisting one half the braid (the easy first half) then cutting the remaining half of the braid to the jacket. Once the braid is cleaned up, one obtains about one third of the braid the full length (1" to 11/4") and two thirds only half as long.
Twist up the full length braid to form a "pigtail" and cut back the shorter lengths to the jacket. Finish by "tinning" the pigtail end along half it's length.



- Step 5 is to strip from and 5 mm to 6 mm from the signal conductors. "Tin" the ends of the signal conductors. Finish up by insulating the end with a length of heat shrinks tubing.




Finished end of the CTNet shield cable illustrated. Note that the pigtail formed from the braid is suitable for two of these ends to fit properly on the terminal strip provided on the SM-Application (Plus) Module's CTNet port.

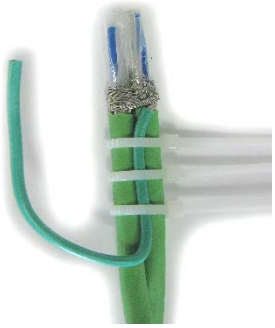
- Repeat steps two through steps four until all the CTNet cable lengths ends are prepared, and ready to be connected to the CTNet ports.

CTNet shielded cable end preparation – Fully encircled braid with drain wire technique.

The CTNet User's guide actually "objects" to the formation of the braid into a "pigtail" using this "pigtail" as the means to join two CTNet shielded cables together and to the middle connection on the CTNet port. This objection is based on the inductance and resistance of the conductor so formed, and that this can result in "significant" noise voltage seen at the CTNet data cores when a large number of such connections are present on a large system.

However, making a better connection between two lengths of CTNet shielded cables with the same assumptions of no special tools, fasteners or sleeves is even MORE labor intensive, and will be demonstrated only for the sake of completeness. The reader can make the final determination for their individual situation.

1. Cut a 6" drain wire. Strip away 2" of insulation at one end.
2. Strip back 1" to 1 ¼ "of the green insulation, exposing the braid (both cables).
3. Cut back and trim up the braid to a length of ½ inch (both cables). Be sure to leave the plastic wrapping on the data cores intact at this step, they will help protect the cores.
4. Align the two CTNet shielded cable lengths to be joined and a drain wire, and secure with plastic tie wraps.
5. Wrap the untwisted conductors from the drain wire fully around the length of the exposed copper braids of the CTNet shielded cables, joining them and encircling them fully.



At this point, the connection should look something like this

6. Using a soldering iron and rosin core solder, solder the entire exposed braid and drain wire together. Try not to use too much heat, to avoid damaging the data core insulation. Trim up the tie wrap ends, if you have not yet done so, and cover the braid with a length of heat shrink.

At this point the connection should look like this

7. Separate the data cores, then strip 5 mm to 6"" of insulation from the data cores and the drain wire, and "tin" the ends. Finish by covering the exposed braid with heat shrink tubing.

At this point the connection should look like this

8. Fasten the assembly to the CTNet terminal strip. Connect the data cores to the outside terminals and the drain wire to the middle terminal.

Finished connection, ready to be plugged into the SM-Application (Plus) CTNet port

This author stands by his recommendation for using the "pigtail" style of preparation of the CTNet shielded cable ends for small CTNet based systems, such as the CTNet based Multiplex Pump solution (usually three nodes).

For small systems such as these, the additional improvement in EMI resistance is not sufficiently justified when weighed against the additional labor and risk associated with getting that drain and the braids properly "wetted" with solder in step 6 without using too much heat.