System-10 BTU Meter
LonWorks Network Interface Installation Guide

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TABLE OF CONTENTS

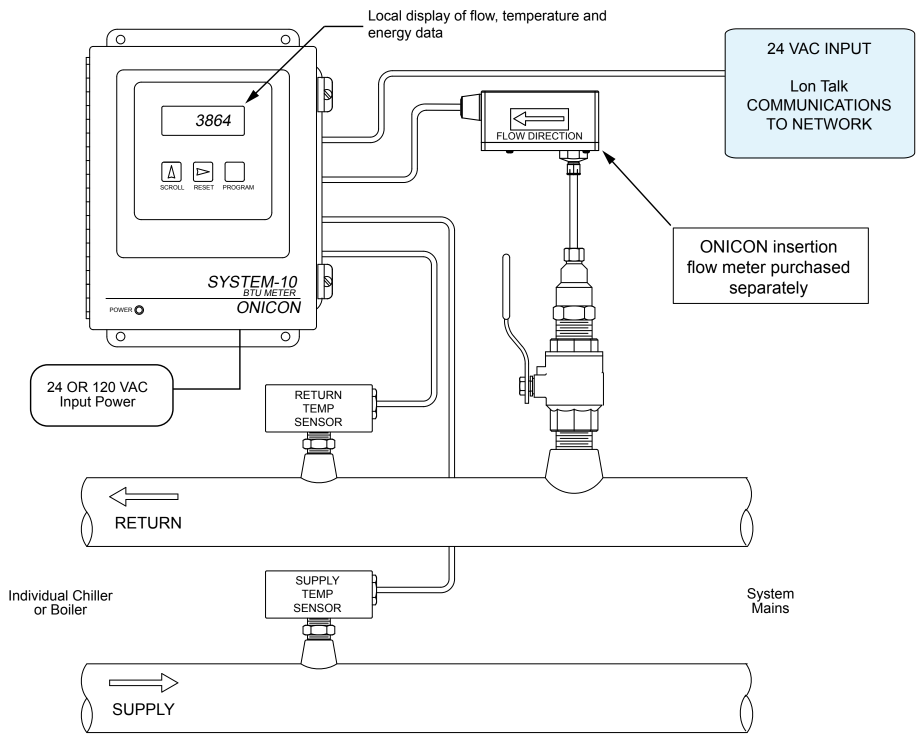
SECTION 1: INTRODUCTION

1.1 PURPOSE OF THIS GUIDE

The purpose of this guide is to provide installation and commissioning procedures and basic operating and servicing instructions for the ONICON System-10 BTU Meter.

1.2 TYPICAL SYSTEM-10 BTU METER

ONICON'S System-10 is a true heat (Btu) computer which accepts data from several sensors, performs a series of computations with that data, and displays and/or transmits the results as an indication of the amount of heat (Btu's) being transferred per unit time or as a totalized amount.



1.3 SPECIFICATIONS

LON TALK NETWORK INTERFACE

Twisted Pair / Free Topology

Transceiver: TP/FT-10F, 2-wire, non-polarized, transformer isolated connection
Device Address: 48-bit Neuron ID
Communications Rate: 78 kbps
Termination: None provided
Maximum Lead Length: 1640 ft (500m) free topology

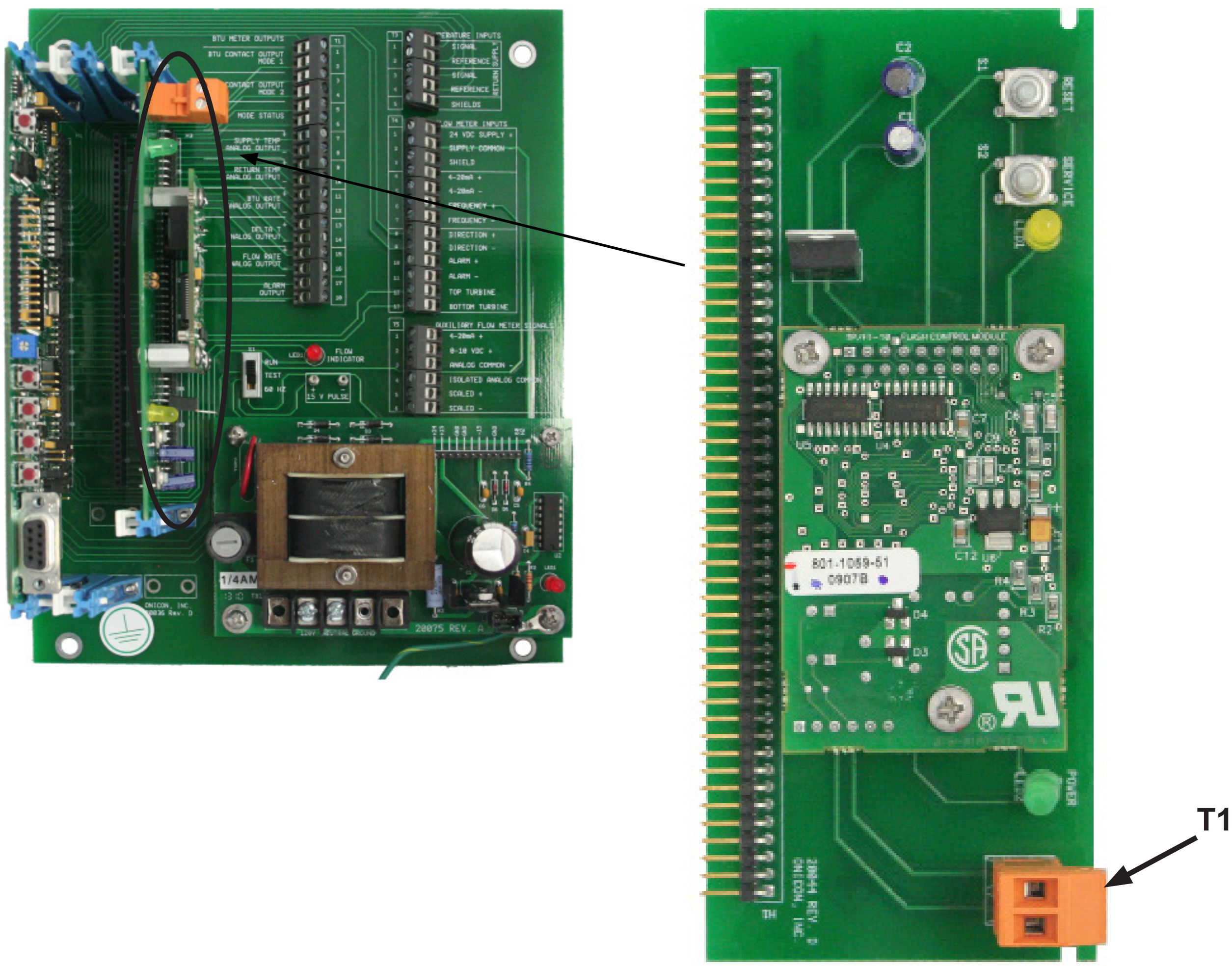
1.4 NETWORK SIGNAL CONNECTIONS

1.4.1 Lon Talk

Lon Talk, 2-wire serial output connections are connected to terminal T1 as shown. Do not exceed 4.4 in-lb (0.5 Nm) of torque when tightening.

CAUTION

Only qualified service personnel should make connections between the System-10 BTU Meter and the user's external equipment. ONICON assumes no responsibility for damage caused to the external equipment as a result of an improper installation.



CAUTION

Incoming and outgoing cable shield wires should be connected together, but must not be connected to the System-10.

1.4.2 Optional Network Interface With Isolated Digital Pulse Input (Di3)

The System-10 BTU Meter can be provided with an auxiliary pulse input for totalizing pulse outputs from external devices such as water or gas meters. Pulses are accumulated in an internal register, and the totalized value is available on the network. This register can be zeroed via the network. The maximum register total is 9,999,999. The register will rollover to zero when this value is exceeded.

If the auxiliary pulse input option was ordered at the same time the Btu meter was ordered, it will arrive fully configured and ready to use. If it was ordered after the Btu meter was delivered and is being installed as a field upgrade, it may be necessary to configure the pulse input. The information is required to configure the input provided below and on the following pages:

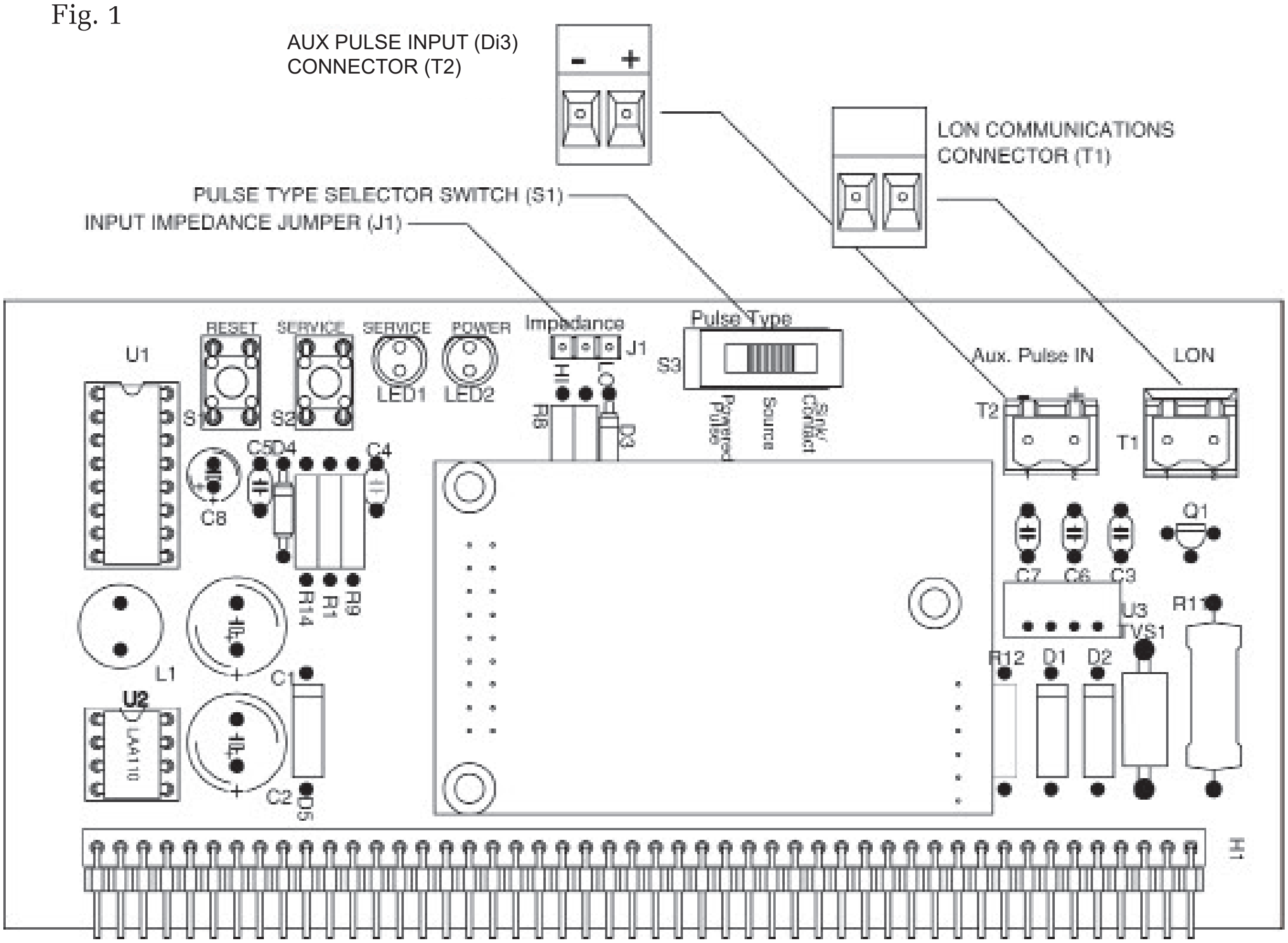
The input pulse must meet the following criteria:

1. Frequency input range, 50 Hz maximum
2. 10 millisecond minimum pulse duration

Input Pulse Definition:

In order to configure the communications card auxiliary pulse input, you must first determine which type of pulse your meter produces. The allowable types of input pulses are described on the following pages. Based on the type of pulse, set the selector switch (S1) on the communications circuit board (Fig. 1) to the correct setting.

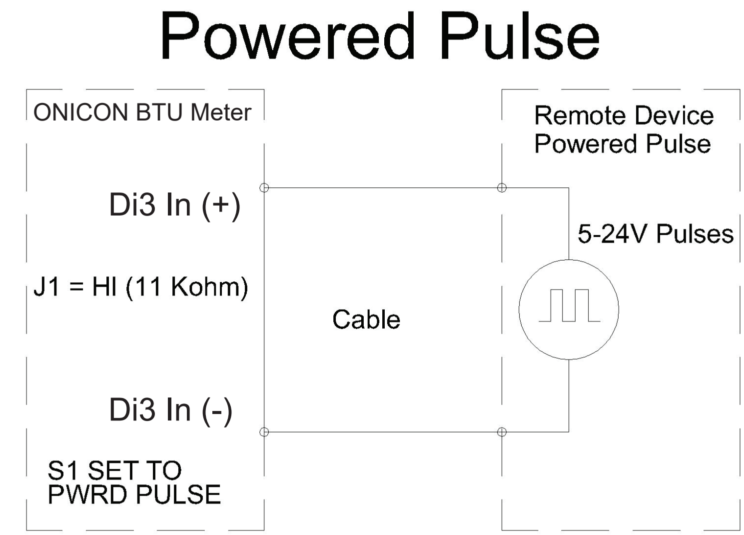
Fig. 1



Powered Pulse:

This type of output refers to a pulse which has an associated voltage with it (see Fig. 2). Set the selector switch, S1 to Pwrd Pulse. The allowable voltage range is 5-24 VDC. The input impedance is set at the factory to be 11 KOHM via the impedance selector jumper (J1, see Fig. 1). A lower impedance, 3 KOHM can be selected if required by the instrument providing the pulse output. Consult the instrument manufacturer or ONICON if you are uncertain as to the proper jumper selection.

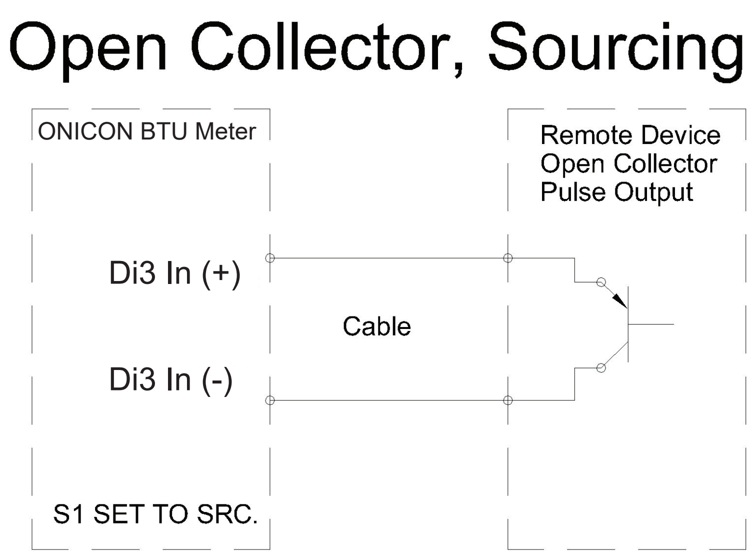
Fig. 2



Open Collector (Sourcing):

This type of output refers to an open Collector Switch configured for a sourcing function (see Fig. 3). Set the selector switch, S1 to SRC. The switch must be rated for at least 20mA at 20VDC.

Fig. 3



Open Collector Sinking or Dry Contact:

This type of output refers to an open collector switch configured in a current sinking arrangement or a dry contact switch (see Fig. 4 and 5). Set the selector switch, S1 to Sink. In either case, the switch must be rated for at least 20mA at 20 VDC.

Fig. 4

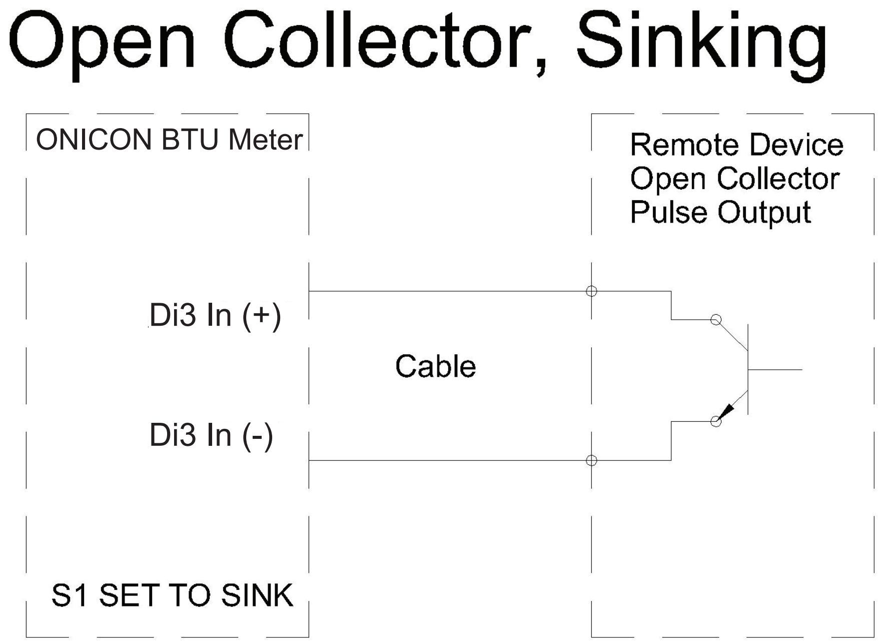
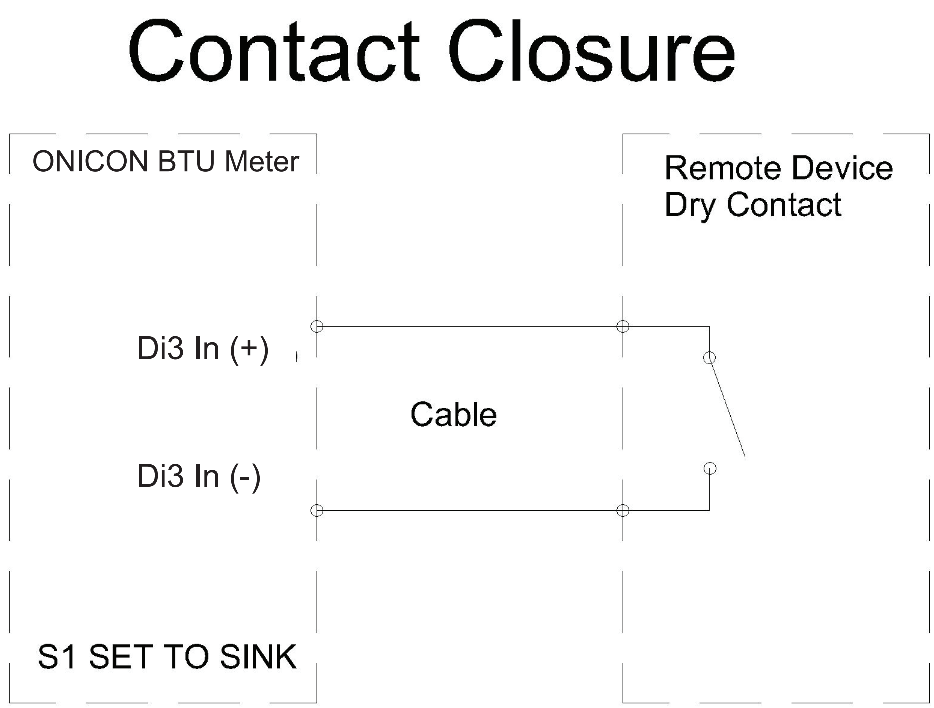


Fig. 5



1.5 NETWORK ADDRESSING

The Btu meter contains two microprocessors, the heat computer board processor and the Echelon TP/FT-10F transceiver with its Neuron processor. The TP/FT-10F transceiver is located on the LON board. The two processors communicate with each other using a serial channel. This serial channel device address is fixed at 017 and cannot be changed.

1.5.1 LonWorks Network Addressing

Every Neuron processor has a unique 48 bit address kown as the Neuron ID. This address is generally used as the Node ID. It is combined with the Domain ID and Subnet ID to form the device address. In most installations, the device address is created dynamically by the network.

1.6 COMMISSIONING THE SYSTEM-10-LON

Pressing the Service Pin on the LON board (see Appendix 2) generates a service pin message on the network. The message contains the Neuron ID and the standard program identifier (SPID). The network configuration tool then maps the System-10-LON Neuron ID into the domain/subnet/node ID addressing scheme for the network, creating the device address.

1.6.1 Service Pin LED States

The yellow service pin LED indicates the status of the Lon Talk network connection.

- LED blinking at ½ Hz rate indicates that the meter is in an decommissioned state.
- LED off indicates that the meter is commissioned and operating normally.

1.7 LONWORKS XIF FILES

Each System-10-LON BTU Meter is shipped with a diskette or CD containing the XIF file. It also contains the Neuron executable file in various formats and documentation describing the network variables in detail.

1.7.1 Output Network Variables

The System-10-LON BTU Meter transmits data to the network using Standard Network Variable Types (SNVTs). Volume flow rate, and volume total are provided in floating point format.

Display operating mode and mode status information is provided in ASCII character format.

The floating point output network variables are described in the table on the next page. Column 1 contains a brief description of the network variables. Column 2 contains the network variable names. Column 3 contains the Lon SNVTs used for each variable.

FLOATING POINT OUTPUT NETWORK VARIABLES

Description	Variable Name	SNVT Name	Engineering Units	Valid Range
Flow (volume) rate	nvoVolRateLf	SNVT_flow_f	Liters/Sec	0 to 10^{12}
Flow (volume) total -1	nvoVol1Lf	SNVT_vol_f	Liters	0 to 10^{12}
Flow (volume) total -2	nvoVol2Lf	SNVT_vol_f	Liters	0 to 10^{12}
Supply temperature	nvoSupplyTempf	SNVT_temp_f	° C	-17.778 to 148.889
Return temperature	nvoReturnTempf	SNVT_temp_f	° C	-17.778 to 148.889
Energy rate	nvoEnrRateWf	SNVT_power_f	Watts	0 to 10^{12}
*Displayed energy rate	nvoDispEnrRatef	SNVT_count_f	*See note	0 to 10^{12}
Energy total -1	nvoBTU1f	SNVT_BTU_f	Btu	0 to 10^{12}
*Displayed energy total-1	nvoDispEnergy1f	SNVT_count_f	*See note	0 to 10^{12}
Energy total-2	nvoBTU2f	SNVT_BTU_f	Btu	0 to 10^{12}
*Displayed energy total-2	nvoDispEnergy2f	SNVT_count_f	*See note	0 to 10^{12}
Auxiliary pulse input (Di3)	nvoAuxIn1	SNVT_count_f	None	0 to 10^{12}

* These network variables transmit energy rate and total data exactly as it is displayed on the System-10 front panel display. The value transmitted will not include any multiplier associated with displayed total.

The ASCII character status output network variables are described in the table below. Column 1 contains a brief description of the network variables. Column 2 contains the network variable names. Column 3 contains the Lon SNVT used for each variable. Column 4 contains the ASCII single characters that may be transmitted by the meter along with a description of what they indicate.

ASCII STATUS OUTPUT NETWORK VARIABLES

Description	Variable Name	SNVT Name	Valid ASCII Characters*
Meter operating mode indicator	nvoMeterMode	SNVT_char_ascii	S = Single mode (83) D = Dual mode (68) B = Bidirectional mode (66)
Mode status indicator	nvoModeStatus	SNVT_char_ascii	N = Communication lost (78) Z = Communication restored waiting for update (90) H = Heating mode (mode 1) (72) C = Cooling mode (mode 2) (67) F = Forward flow (mode 1) (70) R = Reverse flow (mode 2) (82)

* Systems that are not set to decode ASCII characters will display the decimal equivalent. These values are shown in parentheses.

1.7.2 Integer Format Output Network Variables

ONICON provides rate and total data to the network in integer format for systems that cannot accept the floating point data. Refer to Appendices 4 and 5 for information on the use of integer format SNVTs.

1.7.3 Input Network Variables

The System-10-LON BTU Meter receives remote commands to reset totals from the network using Standard Network Variable Types (SNVTs). The input network variables are in ASCII format. They are used to zero the flow, energy and auxiliary pulse totals transmitted in the output variables listed in section 1.7.1.

The ASCII character reset input network variables are described in the table below. Column 1 contains a brief description of the network variables. Column 2 contains the network variable names. Column 3 contains the Lon SNVT used for each variable. Column 4 contains the ASCII single characters that must be transmitted to the meter along with a description of what they indicate.

ASCII RESET INPUT VARIABLES

Description	Variable Name	SNVT Name	Valid Characters*
Reset Energy-1	nviResetBTU1a	SNVT_char_ascii	Write an ASCII 1 (49) to reset the selected total. Once the total has reset, change the value to back to ASCII 0 (48).
Reset Volume-1	nviResetVol1a	SNVT_char_ascii	
Reset Energy-2	nviResetBTU2a	SNVT_char_ascii	
Reset Volume-2	nnviResetVol2a	SNVT_char_ascii	
Reset Auxin1 (Di3)	nviResetAuxIn1a	SNVT_char_ascii	

*Systems that are not set to decode ASCII characters will use and display the decimal equivalent. These values are shown in parentheses.

1.7.4 Node Object Network Variables

The System-10 LON BTU Meter node object utilizes one output network variable and one input network variable. These are described in the table below.

NODE OBJECT NETWORK VARIABLES

Description	Variable Name	SNVT Name
Node object control input	nviRequest	SNVT_obj_request
Node object response output	nvoStatus	SNVT_obj_status

1.7.4.1 nviRequest

Five input variable requests have been implemented. These are listed in the table on the next page. Three of the requests are mandatory functions. They are Normal, Update Mask and Report Mask. The other two are used to reset totals in the Btu meter. They are Reset and Clear Reset.

The requests can be used on the node object or on selected function blocks. The tables on the next page describe the requests and the function blocks associated with totals in the Btu meter.

NODE OBJECT REQUESTS

Node Object Requests	Function Blocks Affected	Comments
RQ_NORMAL	0-27	This request clears the status registers. Function block 0 clears all function block status registers. Selecting function blocks 1- 27 only clears the selected status register.
RQ_UPDATE_MASK	0-27	This request updates the selected status register.
RQ_REPORT_MASK	0-27	This request displays the available Object Status functions.
RQ_RESET	0, 3, 6, 17, 21, 27	This request zeroes the various flow, energy and auxiliary pulse totals. If the Object ID 0 request RQ_RESET is selected then all totals are cleared. If the Object ID of 3, 6, 17, 21 or 27 RQ_RESET is selected then only the appropriate total is cleared.
RQ_CLEAR_RESET	0, 3, 6, 17, 21, 27	This request clears reset status flags. Object ID of 0 clears all “reset_complete” flags. Object IDs 3, 6, 17, 21, 27: Clears the selected “reset_complete” flags.

SELECT FUNCTION BLOCKS, BTU METER TOTALS & BTU METER OPERATING MODES

Functional Block	Btu Meter Total	Btu Meter Operating Mode		
		Single	Dual	Bidirectional
3	Flow (volume) - 1	Heat or Cool	Heating	Forward Flow
6	Flow (volume) - 2	Inactive	Cooling	Reverse Flow
17	Energy-1	Heat or Cool	Heating	Forward Flow
21	Energy-2	Inactive	Cooling	Reverse Flow
27	Auxiliary Pulse (Di3)	Active	Active	Active

1.7.4.2 nvoStatus

Six status object functions are mechanized to report status information to the network. These are listed in the table below. The table also lists function blocks associated with each status flag.

nvoStatus Object Functions	Functional Blocks
object_id	All
invalid_id	All
invalid_request	All
comm_failure	0
report_mask	All
reset_complete	0, 3, 6, 17, 21, 27

1.7.5 Resetting Totals via the Network

Totals are held in non-volatile memory within the Btu meter. Each total (flow, energy or auxiliary input) has a corresponding output variable that transmits the information from the meter to the network. There are two ways to remotely reset totals in the display. This can be done using individual input variables to command the display to reset specific totals or it can be done using the nviRequest variable. Using nviRequest allows you to reset each total individually or all totals simultaneously with one command. See sections 1.7.3 and 1.7.4.1 for specific instructions on how to reset totals.

1.7.6 Rollover of Totals

The totals stored in the flow Btu meter memory will roll over to zero when the maximum count is exceeded. When this occurs, the network totals will also roll over to zero. The point at which the rollover occurs is a function of the displayed engineering units and multipliers programmed into the System-10.

The examples below show the rollover point in the engineering units transmitted by the network variable (SNVT) for common totals shown on the System-10-LON BTU Meter.

VOLUME TOTAL

System-10 BTU Meter Engineering Units	System-10 BTU Meter Multiplier	LonWorks SNVT and Transmitted Engineering Units	Maximum Total Transmitted Over the Network
Gallons	X 100	SNVT_vol_f – Liters	3,785,411,621 Liters
Liters	X 1000	SNVT_vol_f – Liters	9,999,999,000 Liters
M^3	X 1	SNVT_vol_f – Liters	9,999,999,000 Liters

ENERGY TOTAL

System-10 BTU Meter Engineering Units	System-10 BTU Meter Multiplier	LonWorks SNVT and Transmitted Engineering Units	Maximum Total Transmitted Over the Network
Btu	X 10k	SNVT_Btu_f – Btu	99,999,990,000 Btu
kWhr	X 10	SNVT_Btu_f – Btu	341,214,065,900 Btu
Tonhr	X 1	SNVT_Btu_f – Btu	119,999,998,000 Btu

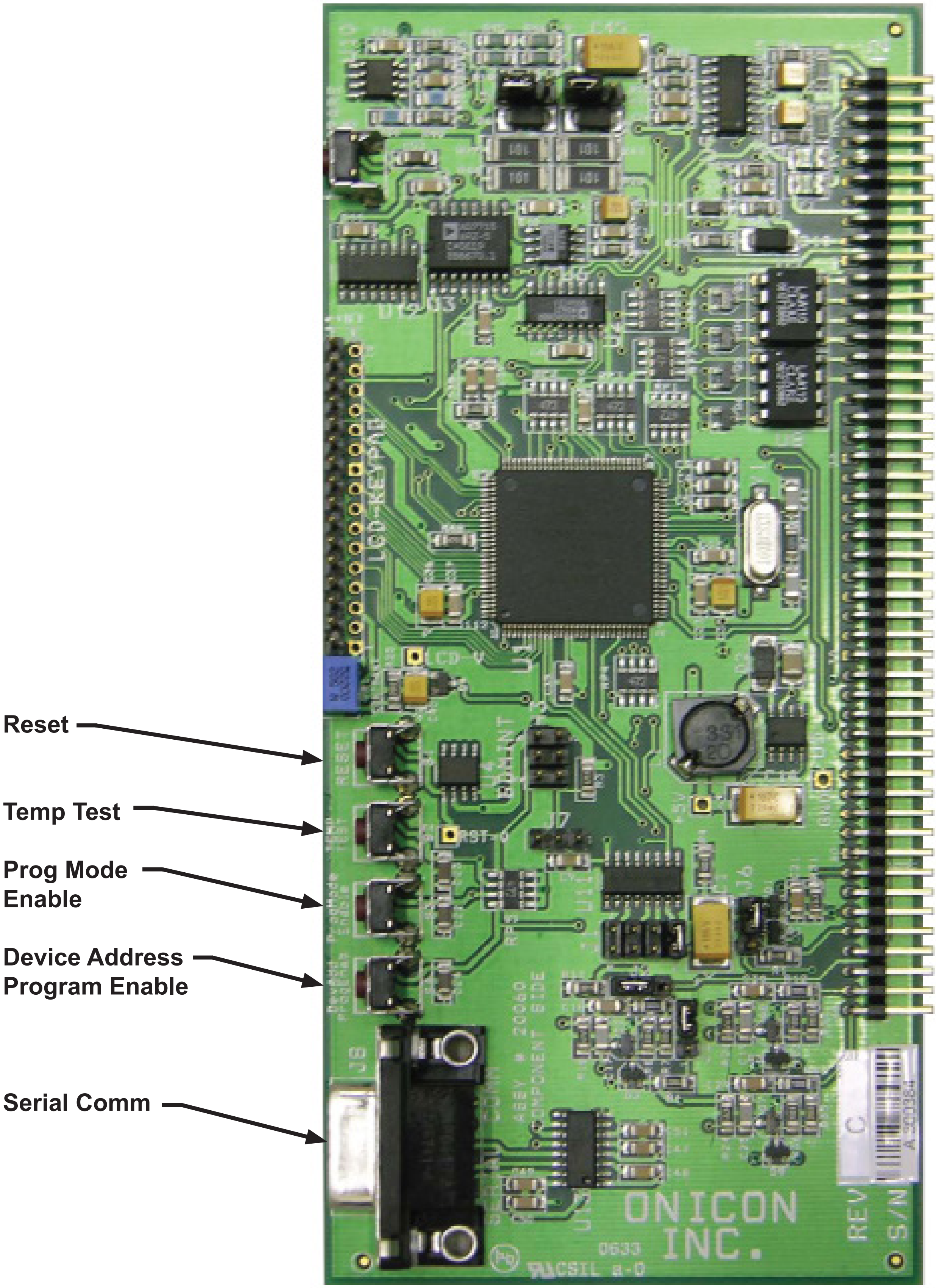
SECTION 2.0: NETWORK TROUBLESHOOTING TIPS

2.1 TROUBLESHOOTING

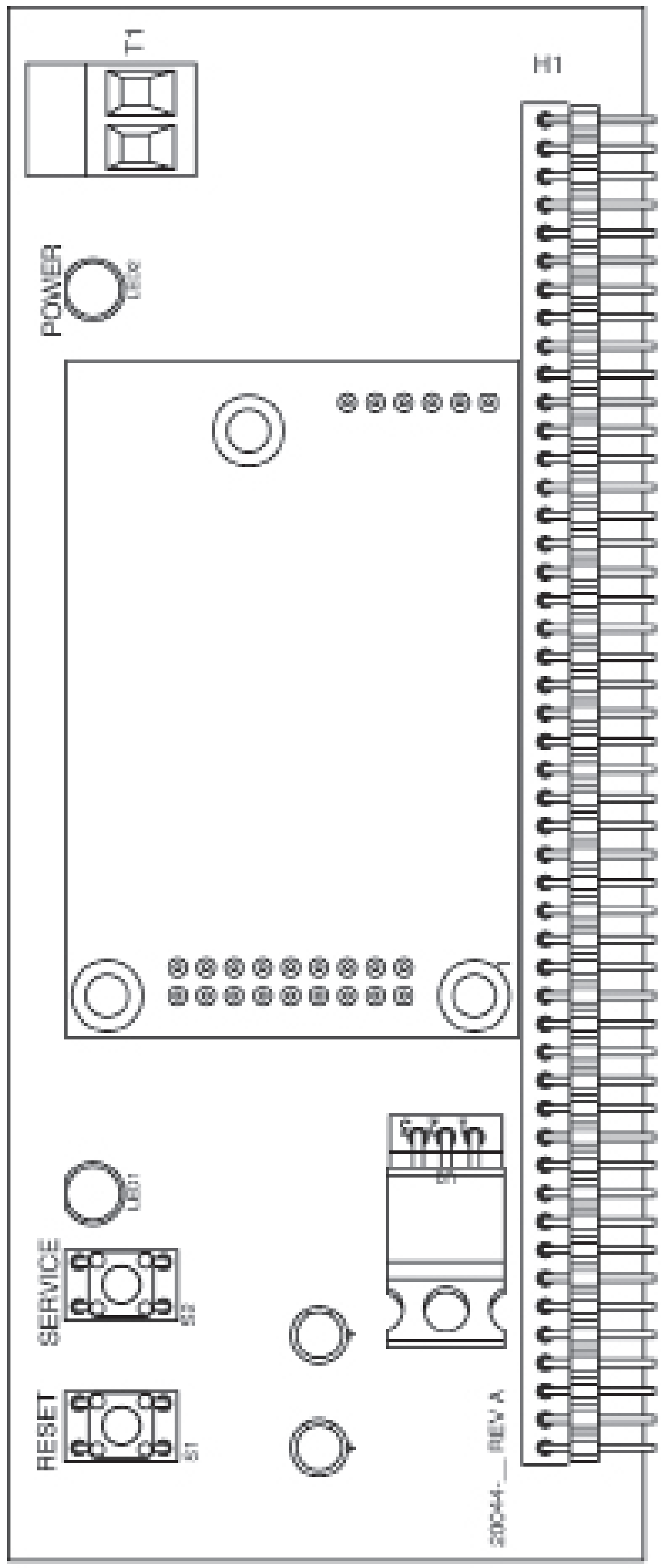
REPORTED PROBLEM	POSSIBLE SOLUTIONS
For turbine meters - No Flow Signal/ Energy Rate (while hydronic system is active)	• Verify 24 VDC supply voltage to the flow meter. • For insertion meters, verify the flow meter is correctly inserted into the pipe (using depth gage). • For insertion meters, verify that the flow meter electronics enclosure is parallel with the pipe. • Verify correct wiring to the flow meter (see wiring diagram). • For turbine meters, check turbine(s) for clogging due to debris. • If none of the above, check hydronic system to ensure that flow is really present in the line. • NOTE: Flow meter function cannot be verified by blowing on the turbine(s). The sensing system requires a conductive liquid to operate. You can test it by swirling it around in a bucket of water and looking for the flow indicator LED to flash at the System-10.
Displayed flow rate too high or too low	• Verify pipe size. Contact ONICON if pipe size is different from calibration tag. • For insertion meters, verify that meter is inserted correctly into the pipe (using depth gage). • For insertion meters, verify that the flow meter electronics enclosure is parallel with the pipe. • For dual turbine meters, confirm that both turbines produce pulses. • For turbine meters, check turbine(s) for debris. • Verify supply voltages (to Btu meter and flow meter).
Displayed temperature(s) too high or too low vs. expected values	• Verify wiring to temperature sensor(s), including polarity. • Verify that thermowells are inserted into the flow stream and that the temperature sensors are completely inserted into the thermowells.
Device is not communicating with the Lon Talk network.	• What is the state of the service pin LED? • Is it flashing? A flashing service pin LED indicates that the Lon module has not been commissioned. • Is it off? A service pin LED that is off indicates that the Lon module is commissioned and operating normally.
Communications with the Lon Talk network is intermittent.	• Is the network properly terminated? The Lon TP/FT bus can be terminated in 2 different ways. • A single RC filter can installed at any point on a free topology network. A dual termination scheme is used with 2 RC filters installed at the ends of bus networks. Refer to the Appendix A-6 for details. • What type of cable is used to wire the network? TP/FT networks should only use twisted shielded pair cable. (Belden 85102 or equiv.)

For technical assistance, contact ONICON at (727) 447-6140.

APPENDIX A – DRAWINGS


Reset
Temp Test
Prog Mode
Enable
Device Address
Program Enable
Serial Comm
ONICON
INC.

SYSTEM-10-LON BTU METER LON BOARD



INTEGER FORMAT OUTPUT NETWORK VARIABLES

Integer format output variables are limited to 2 bytes of data. For this reason, the maximum number that can be transmitted in this format is 65,535. Values for both rate and total data from the Btu meter will often exceed this limit. For this reason, energy rate data is scaled and energy totals are transmitted in segments using multiple variables. This is explained in detail below.

Volume and Energy Rate Variables

The integer output network variables for volume and energy rate are described in the table below. Column 1 contains a brief description of the network variables. Column 2 contains the network variable names. Column 3 contains the Lon SNVTs used for each variable. Column 4 contains the engineering units and column 5, the valid range for each variable. Please note that while the floating point variable for energy rate is transmitted in Watts, the integer network variable is transmitted in kW to ensure that the maximum rate never exceeds the register capacity.

Integer Output Network Variables				
Description	**Variable Name**	**SNVT Name**	**Engineering Units**	**Valid Range**
Flow (volume) rate	nvoVolRateLi	SNVT_flow	Liters/Sec	0 to 65535
Mode status indicator	nvoModeStatus	SNVT_char_ascii		
Supply temperature	nvoSupplyTempi	SNVT_temp_p	° C	-17.778 to 260.0
Return temperature	nvoReturnTempi	SNVT_temp_p	° C	-17.778 to 260.0
Delta temperature	nvoDeltaTempi	SNVT_temp_diff_p	° C	-327.68 to 327.66
Energy rate	nvoEnrRateKWi	SNVT_power_kilo	KWatts	0 to 65535

Volume and Energy Total Variables

The integer output network variables for volume and energy total are described in the table below. Column 1 contains a brief description of the network variables. Column 2 contains the network variable names. Column 3 contains the Lon SNVTs used for each variable. Column 4 contains the engineering units and column 5, the valid range for each variable.

Please note that while the floating point variable for volume total is transmitted in liters, the integer network variable for volume total is transmitted in kLiters. This is done to increase the maximum total that can be transmitted via the integer variable. Total(s) must be reset before the accumulated value exceeds 6553.5 kliters using nviResetVol1a and/or nviResetVol2a. If this is not done, nvoVol1KLi and/or nvoVol2KLi will over range and continue to indicate 6,553.5 kliters (1,731,252 gallons) until the System-10's internal total rolls over to zero.

A separate integer SNVT is also available to transmit flow totals in liters. This variable is only used in special small pipe applications as the maximum total it can accumulate is only 65,535 liters (17,312 gallons) before it must be reset.

Energy totals are handled in a slightly different way. The floating point variable for energy total is transmitted in Btu but the integer network variable for energy total is MBtu. This total will over range at 65,535 MBtu. The internal total stored in the Btu meter will not roll over until it exceeds 99,999.99 MBtu.

In order to prevent the loss of data nvoMegaBTU1i and/or nvoMegaBTU2i must be reset before the accumulated value exceeds 65,535 MBtu.

A second variable is available for energy totals. It is kBtu. This variable will roll over to zero whenever the accumulated value exceeds 65,535 kBtu. This variable has been provided to accommodate small pipe applications where MBtu is not appropriate. The two energy variables (MBtu and KBtu) can be combined to produce a total with resolution to 1000 Btu (1kBtu). Programming for this calculation is given below.

Integer Output Network Variables				
Description	**Variable Name**	**SNVT Name**	**Engineering Units**	**Valid Range**
* Flow (volume) total -1	nvoVol1Li	SNVT_vol	Liters	0 to 65535
Flow (volume) total -1	nvoVol1KLi	SNVT_vol	KLiters	0 to 6553.5
* Flow (volume) total -2	nvoVol2Li	SNVT_vol	Liters	0 to 65535
Flow (volume) total -2	nvoVol2KLi	SNVT_vol	KLiters	0 to 6553.5
Energy total -1	nvoKiloBTU1i	SNVT_btu_kilo	KBtu	0 to 65535
Energy total -1	nvoMegaBTU1i	SNVT_btu_mega	MBtu	0 to 65535
Energy total -2	nvoKiloBTU2i	SNVT_btu_kilo	KBtu	0 to 65535
Energy total -2	nvoMegaBTU2i	SNVT_btu_mega	MBtu	0 to 65535

* Special small pipe volume total variables

Totalizing Using Both the MBtu and KBtu Variables Combined

MBtu (Btu x 1,000,000) is value in nvoMegaBTU1i (or nvoMegaBTU2i)

KBtu (Btu x 1,000,000) is value in nvoKiloBTU1i (or nvoKiloBTU2i)

Combined total = MBtu x 1000 + X

Where X = KBtu - [int (KBtu/1000) x 1000]

Example:

nvoMEGABTU1i present value = 4006 MBtu

nvoKILOBTU!i present value = 6200 KBtu

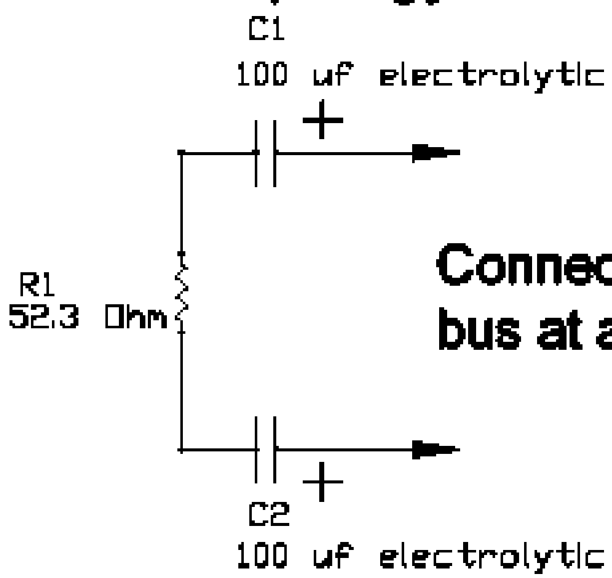
Combined total = (4006 x 1000) + (6200 - [int(6200/1000) x 1000])

Combined total = 4006000 + (6200 - 6000)

Combined total = 4006200 KBtu

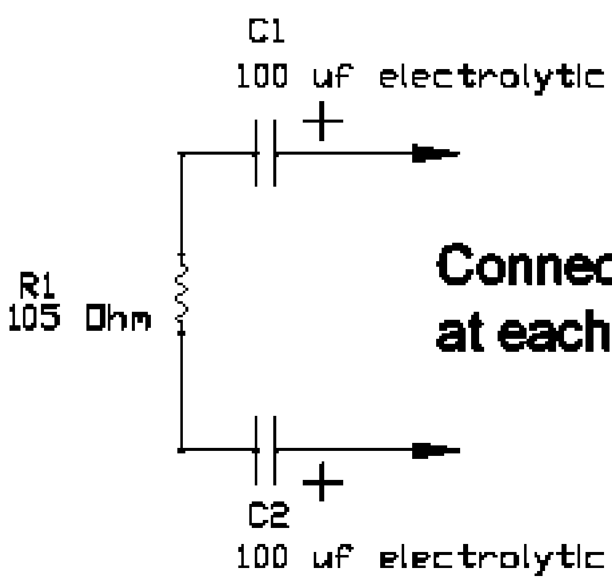
(Recommended Cable: Belden 85102 or equiv.)

Free Topology Network (Single Termination)



Connect across Lon bus at any point.

Bus Network (Dual Termination)



Connect across Lon network at each end of the bus.