

***Johnson Controls  
ComBus Quick Tester***

*pn#6550*



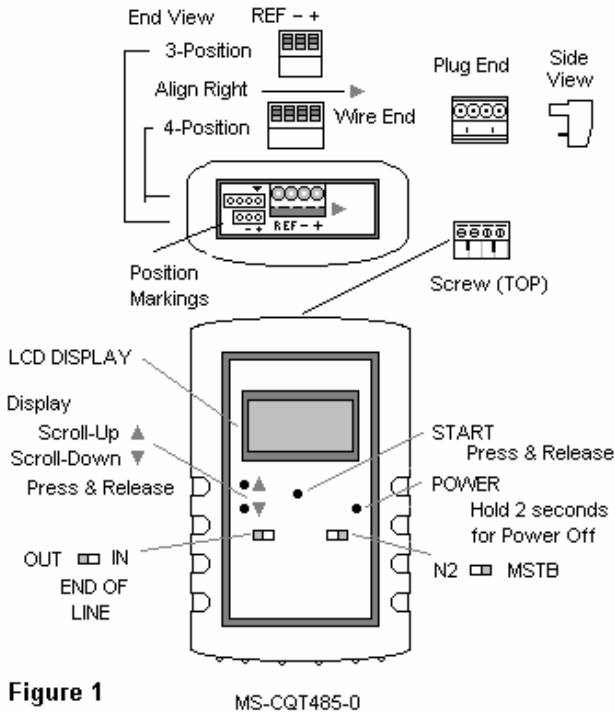


# Contents

- Section 1: *Introduction - Controls & Features* ..... 1**
  - ComBus Quick Tester..... 1
  - Figure 1 - End & Front View..... 2
  - Features..... 1
  - Introduction ..... 2
  
- Section 2: *Operation* ..... 3**
  - Initial Operation ..... 3
  - Flow Chart 1 - Tester & User Operations ..... 4
  - Table 1 - Voltage Pass Display Sequence ..... 5
  
- Section 3: *Troubleshooting - Failure Messages* ..... 7**
  - 3.1 24VAC Found ..... 7
  - 3.2 Master Found..... 7
  - 3.3 Voltage Fail ..... 7
    - Table 2 - Voltage Fail Display Sequence ..... 7
    - Table 3 - Voltage Pass Limits..... 8
    - Voltage Fail Checks..... 8
    - Example Voltage Fail Profiles ..... 9
  - Table 4 - Profiles ..... 9
  - 3.4 Troubleshooting Missing or Bad Devices ..... 10
  - Figure 2 - Split Half Problem Isolation ..... 10
  - Table 5 - Device Type Display..... 11
  
- Section 4: *Battery Installation* ..... 12**
  - Figure 3 - Battery Installation ..... 12
  
- Section 5: *Specifications*..... 13**
  - Accessories..... 14

### Introduction – Controls & Features

#### ComBus Quick Tester



#### Features

- Pluggable 4-Position N2 Bus Connector can accept 3-Position or 4-Position terminal blocks used on Johnson Controls Controllers
- 2-Line by 8-Character LCD Display with Power On Backlighting
- Display Scroll-up and Scroll-down buttons
- End of Line Slide Switch for Termination Out/In
- Start button Starts or Stops Automatic Testing
- Power button for On/Off with 5 Minute inactivity timer for Auto Power Off. Press ½ second for On. Press & Hold for Off.

## **Section 1: Introduction**

- N2/MSTP Slide Switch Selects Test Mode (for future MSTP upgrade)
- Self protected from accidental connection to 24VAC
- Rugged drop resistant case with bright orange color protective boot uses only 5.5 x 3.4 x 1.4 inches of space.
- Uses two AA alkaline batteries

### **Introduction**

The ComBus Quick Tester is designed to plug into the Johnson Controls N2 or MSTP bus as a Master Controller. It will test using the following sequence:

#### **Instrument Test Sequence**

1. Check for bus activity, abnormal data state duration such as 24VAC/50/60Hz on data bus or Ref.
2. Check for other Master Controllers on the bus. Only one Master Controller can be present at a time.
  - 2.1 Master Controllers can be a NCM, Companion, N30 (N2 bus) or NAE (MSTP bus)
3. Check data bus DC voltages, and retain values for review or troubleshooting at test end.
4. Poll all device addresses (1 to 255) using N2/Sys91 or MSTP commands, make internal list of addresses which respond and identify as either an invalid response or the appropriate N2 or Sys91 device. (MSTP test mode may vary)
5. Total the number of device addresses which respond and calculate the sum of all responding addresses for a crosscheck.

If a Fail condition is found during the first 3 tests, testing stops.

Tests 4 and 5 repeat until all addresses have been checked, then the Device Count is displayed. Use the Scroll-up/down buttons to view.

The total of responding Device Addresses can be checked against the number of devices which should be present, and the Sum of responding addresses recorded for future quick checks.

The Device address and Device type can be viewed/checked against your list of devices which are installed and should be found.

Test 4 can be stopped by pressing and holding the START/STOP button until Device Address scanning stops.

## **Section 1: Introduction**

### **Initial Operation**

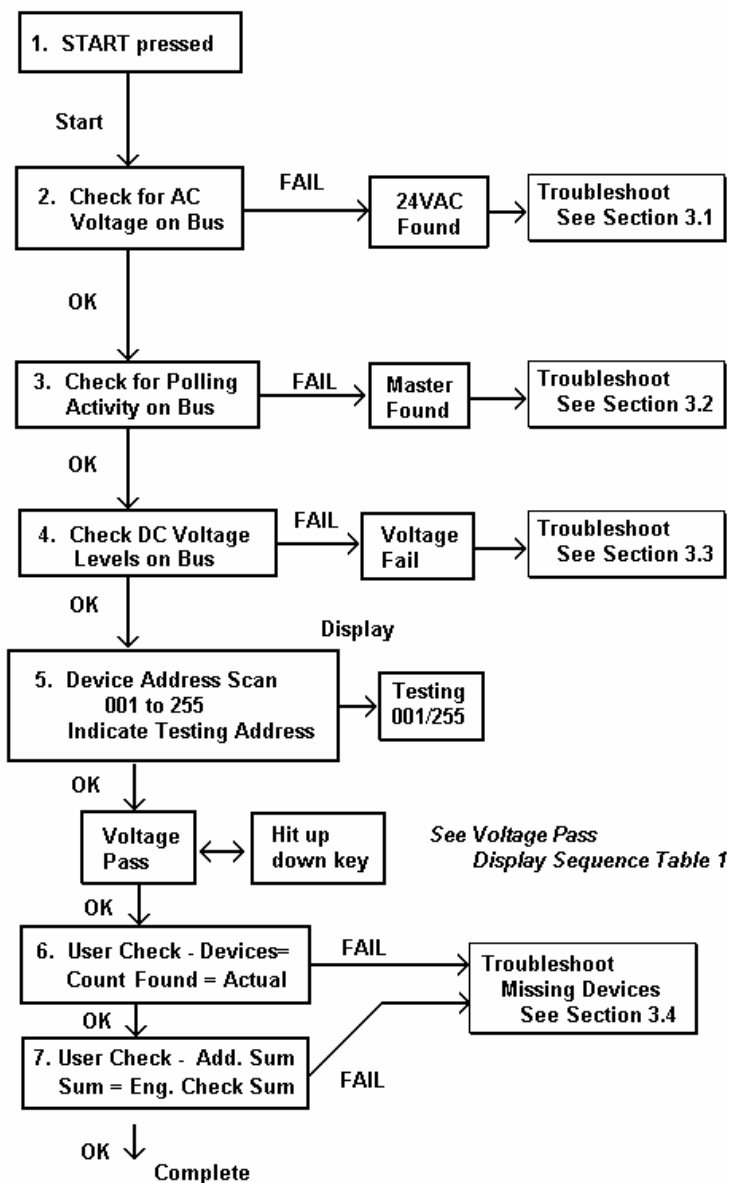
*Before use, install a pair of AA batteries (included) as shown in the Battery Installation section.*

1. Locate the Master Controller for the communications trunk being tested.
2. Unplug the 4 pin (or 3 pin) Data Bus connection plug from the Master Controller and plug it into the Quick Tester.
3. Set the N2/MSTP slide switch to test N2 or MSTP bus devices. The N2/MSTP switch is only read at Power On. In MSTP mode, initial production units will display "MSTP NO SUPPORT". at Power On.
4. Press & release the Power button to turn On.
5. Set the END OF LINE switch to IN if replacing an End Of Line device (usually only one cable connected to plug), else set to Out (two cables connected to plug).
6. Press the Start button to begin. To stop before completion, press and hold the Start/Stop button until halted.
7. If a failure message is displayed, ""24VAC Found", "Master Found" or "Voltage Fail", troubleshoot as in Section 3.
8. When "Voltage Pass" is displayed, alternating with "Hit up down key", automatic testing is done. Check results.
9. Press & release the scroll-down button to sequence through results. Compare the Device Count found to the number of devices installed. If equal, and the "Add. Sum" matches the value specified for the system, testing is complete except for recording system values for future reference.
10. If not equal, see Troubleshoot Missing or Bad Devices.

*Continued next page.*

## Section 2: Operations

### Tester & User Operations



Flow Chart 1 - Tester & User Operations

## Section 2: Operations

When the Tester stops testing with Voltage Pass, User Checks are needed to complete Testing.

The User must compare the device count found to actual number of devices present, and the Add. Sum to the Engineering Check Sum provided for the installation being tested. See Table 1 for the Display Sequence.

If the Device Count is correct then there are no missing devices.

If the Address Sum is not correct, but the Device Count is correct, then one or more device addresses is not set according to the Engineering Check Sum specified. See Section 3, Troubleshooting Missing or Bad Devices.

**Table 1 – Voltage Pass Display Sequence**

#	Display	Alternating	Comments
1	Voltage Pass	Hit up down key	D = Data Bus
2	Add. Sum XXXXX	XXXXX = Sum	Sum of all addresses found
3	+= $x.xxV$ -= $x.xxV$	$x.xx$ = value	+D Line to REF -D Line to REF
4	Bias = + $X.XX$	$x.xx$ = value	+D to -D
5	XXX ZZZ XXX ZZZ	XXX = Address ZZZ = Dev Type Code	If device count > 0 then show first 2
5	XXX ZZZ XXX ZZZ		Repeat in sets of 2 until all shown
6	Devices= 0000		Show count of devices found
2	Add. Sum	Repeat #2	

+D is Data bus plus (with N2 bus = N2+) *MSTP Future*

-D is Data bus minus (with N2 bus = N2-) *MSTP Future*

## Section 3: Troubleshooting

### Troubleshooting - Failure Messages

#### 3.1 – 24VAC Found

1. Unplug the connector from the Tester verify that the 24VAC power connection and Data bus connections are not swapped.
2. Use a Multimeter and check for 24VAC between the +D line and –D line connection, then between the +D and REF, and between the –D and the REF.
3. If no AC, possibly some device on the bus has the REF line swapped. Split the trunk and troubleshoot each half separately.

#### 3.2 – Master Found

1. Check for a Master (NCM, N30, NAE, Companion) connected and polling.
2. If necessary, split the trunk and troubleshoot each half separately.

#### 3.3 – Voltage Fail

Voltage Fail means that abnormal DC levels on the bus have been measured.

The ComBus Quick Tester checks for normal values on +D and -D to REF (Common Mode Reference), and the difference between +D and -D (known as Bias) and indicates “Voltage Fail” or “Voltage Pass”.

**Table 2 – Voltage Fail Display Sequence**

#	Display	Alternate
1	Voltage Fail	Hit up down key
2	+ = x.xxV - = x.xxV	
3	Bias = +X.XX	

## Section 3: Troubleshooting

Table 3 – Voltage Pass Limits.

#	Voltage Pass	Lower Limit	Upper Limit	Parameter D=Data Bus
2	+ =	2.45V	3.00V	+D to REF
2	- =	1.90V	2.54	-D to REF
3	Bias =	+0.38	+0.92	+D to -D

+D is Data bus plus (with N2 bus = N2+) *MSTP future*

-D is Data bus minus (with N2 bus = N2-)

### Voltage Fail Checks

1. Check that End of Line termination is set correctly.
2. Compare Lower Limit values, low values can indicate a data line shorted to another, or to REF, or reversed at an End of Line device.
3. See Voltage Fail Example Profiles

The DC levels between data transmissions on each line will vary depending on how many devices are on the bus, since each device loads it, changes the bias. The bias voltage for all devices on the bus establishes the no-signal state between data transmissions when all devices are tri-stated. DC bias is needed so all devices on the bus are able to recognize the start of data without errors or retries.

*See Example Voltage Fail Profiles – next page.*

## Section 3: Troubleshooting

### Example Voltage Fail Profiles

Possible Voltage Fail Examples if one unit on the bus is misconnected compared to all the others and the REF on all units also connects to a non-isolated Common/Ground.

**Table 4 - Profiles**

Voltage Fail Examples	Example Profile 1	Example Profile 2	Example Profile 3
+ =	1.53	0.00	2.58
- =	0.00	0.70	2.63
<b>Bias</b>	1.53	0.70	0.05
<b>Possible Faults</b>			
(+) & REF Shorted	-	X	-
(+) & REF Swapped causing short	-	X	-
(-) & REF Shorted	X	-	
(-) & REF Swapped causing Short	X	-	-
(+) & (-) Shorted	-	-	X
<b>Voltage Pass</b>			
(+) & (-) Swapped	No failure until address search		

### 3.4 Troubleshooting Missing or Bad Devices

1. When the device code for one address indicates BAD, check the list of addresses found to determine what other address is missing. Two units may be set for the same address.
2. Check for swapped wires for Data + and Data – lines (N2+/N2-) on the device with the missing address, and swapped wires on the next device after the missing device.
3. If many devices are missing, check for swapped or open wiring between the last device prior to the missing address and also the unit set to the missing address.

Check for devices with duplicate addresses.

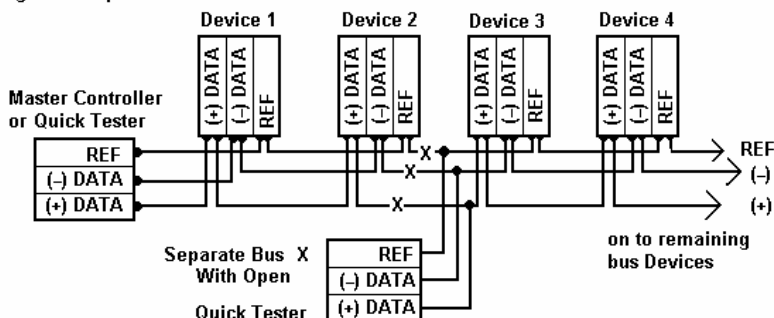
Depending on the type of both devices, and distance from each other and the master, the device code for duplicate addresses may **not** indicate “BAD”, but only one may be found if they are both N2 or Sys91, or if they are different types, either type may be found.

To isolate which device is responding, go to the unit with the assigned address, disconnect it, and try scanning the downstream bus and upstream bus separately to identify what other device is responding at that address. It will be found on only one segment.

For address problems or Voltage Fail problems, Isolate the device by separating the bus into halves, see which half has the problem, and then perform split half troubleshooting on the problem segment. This is usually faster than going through device connections one at a time.

For Devices that use pluggable terminal blocks, unplug the upstream or downstream connector, and then test separately with the device.

Figure 2- Split Half Problem Isolation



### Section 3: Troubleshooting

**Table 5 - Device Type Display**

Dev-Code	Protocol	Device/Controller Type
???	N2	N2 Open Device not listed
AHU	N2	Air Handling Unit Controller
BAD	N2	N2 Device with invalid errors
DC	Sys91	DC-9100 – Plant Controller
DCM	N2	DCM-Digital Control Module
DO	Sys91	DO-9100 – Digital Optimizer
DR	Sys91	DR-9100 Room Controller
DX	Sys91	DX-9100-Digital Controller
IAC	N2	Access Controller
IFC	N2	Fire Controller
ILC	N2	ILC – Intelligent Lighting Control
LCP	Sys91	LCP – Lab & Central Plant Controller
LDT	N2	LDT - User Display
MIG	N2	MIG - Metasys Integrator
NDM	N2	N2 Dialer
PHX	N2	Phoenix Fume Hood
TC	Sys91	TC-9100 – Temperature Controller
UNT	N2	Unitary Controller
VAV	N2	VAV - Variable Air Volume Controller
VMA	N2	VAM – Variable Air Volume Modular
VND	N2	VND – Vendor Device (also FX)
XBN	N2	XM – Baseframe Extension Module
XRE	N2	XM – Baseframe Extension Module
XRL	N2	XM – Baseframe Extension Module
XRM	N2	XM – Baseframe Extension Module
XT	Sys91	XT-9100 Extension Module
XTM	Sys91	XTM-101 Extension Module
WRX	N2	Wireless Receiver

---

## Section 4: Battery Installation

### Battery Installation

1. Unplug 4-Position Terminal. 2. Remove Protective boot from the case with left hand on left corner, or use right hand on opposite.

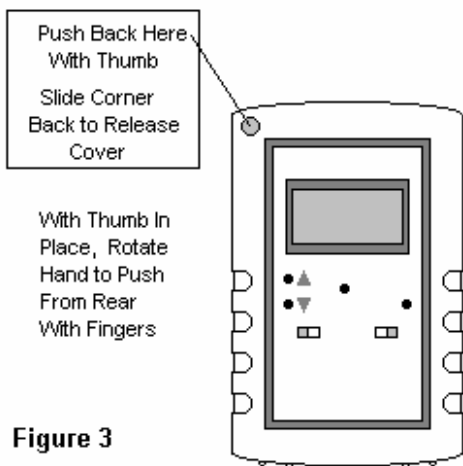
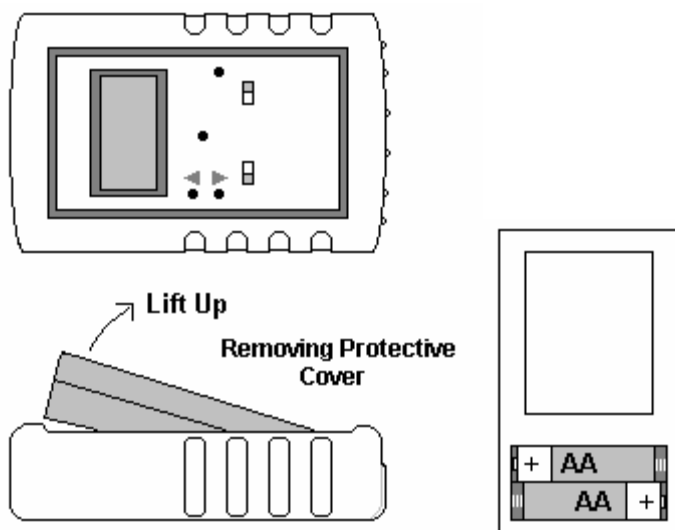


Figure 3

MS-CQT485-0



Install 2 AA alkaline cells as shown at right, and then replace protective cover by reversing the steps shown.

## **Section 5: Specifications**

### **Specifications**

Bus Type: Half Duplex RS-485

+Data, -Data and Common Mode Reference

Bus Connector:

4-Position connector can accept 3-Position or 4-Position pluggable terminal block connectors. Provided with 4-position right angle 5.08mm spacing pluggable Terminal block.

Data Type: Standard (9600, 8, N, 1)

Display Type: 16 Character (2 lines by 8) LCD

Biasing & Termination

+D is N2+ line in N2 bus type – (MSTP bus marking?)

-D is N2- line in N2 bus type – (MSTP bus marking?)

REF is N2 bus Common Mode Reference (bus ground)

Termination: 220 ohms in END OF LINE IN

Biasing: +D 1200 ohm Pull-up

Biasing: -D 1200 ohm Pull-down to Ref. Common/Ground

Termination: None in END OF LINE- OUT

+D Line: 100k ohm Pull-up to +5V

-D Line: 100K ohm Pull-down to Ref Common/Ground

Voltage Scan Test - Pass

+D line to Ref is between 2.45 and 3.00 VDC

-D line to Ref is between 1.90 and 2.54 VDC

+D to -D difference is +0.38 to +0.92 VDC

N2 Address Scan Test (Device Addresses 1 to 255)

Send Sys91 message to address

Check Response for possible N2 device – identify if not.

Send N2 Identify-Self Command

Check for no error – N2 device identify type

If error Identify address with code BAD

MSTP address scan – (Device Addresses 1-255)

- T.B.D. for MSTP support

Dimensions: 5.5 x 3.4 x 1.4 inches (14 x 8.64 x 3.56x cm)

### **Accessories**

#### **Included:**

ComBus Quick Tester with removable orange protective boot

4-POS Pluggable Terminal Block

Manual: Instruction Manual (paper copy of this booklet)

Batteries: Set of two included, replace with AA alkaline