



# FIELD PERFORMANCE TESTING OF COPPER PERMANENT LINKS AND CHANNEL Class D, Class E, Class E<sub>A</sub> (10GBE)

Changes from Version 21;

TIA/EIA 568-B standards changed to ANSI/TIA 568-C standards	P 2
Fluke DSP4300 is not acceptable to ADC KRONE as a Warranty Tester	P 4
Runs <15m will show a PASS even if they have bad terminations; These must be fixed.	P 6
Cat 6 <sub>A</sub> included in Adaptor Lead requirements, Table 8	P 7
Cat 6 <sub>A</sub> test limit for Permanent Link added for DTX1800 - ISO ClassEa PL2 (PL3 with CP)	P 9

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This is a living document and is subject to change.

This document is available as a free download from the ADC KRONE web site:-

[www.adckrone.com/au](http://www.adckrone.com/au)

Document Downloads, Technical,  
"Field Performance Testing of Copper Permanent Links"

**ADC KRONE (Asia Pacific)  
Ver. 22**

## Performance Testing of Permanent Links and Channels

There are three classifications of testing;

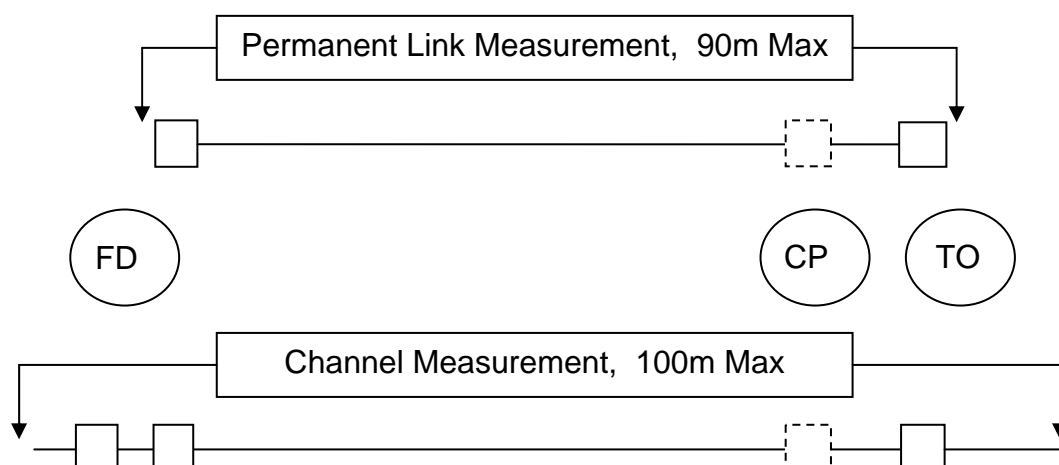
1. **Reference** - done in test laboratories to prove that components and systems meet international standards requirements
2. **Compliance** - done in the field on installed cabling comprising of known or unknown components
3. **Acceptance** - done in the field on installed cabling. Only wiremap and continuity are mandated. All other test parameters are for information only.

**Compliance** is the most rigorous of all cable testing and uses the "Pass/Fail" criteria in one of the AS/NZS 3080, ISO/IEC 11801 or **ANSI/TIA 568-C** standards. The remainder of this document deals with Compliance Testing and it is a requirement for an ADC KRONE Warranty.

### 1. Permanent Links And Channels

The fundamental building blocks for a telecommunications data system are the permanent links (PL) and channels (Ch). Good quality test leads have to be used with the hand-held testers to obtain accurate PL test results. Channel testing still uses the Vendor's patch cords, which are to be left in place after testing.

The configuration of the Permanent Link and Channel is shown below.





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## 2. Passive Testing With Hand-Held Field Testers

There are currently three levels of hand-held field tester:

**Level 2e** – for testing up to Class D

**Level 3** – for testing up to Class E

**Level 3e** – for testing up to Class E<sub>A</sub> and the new 10GBE Standard

### Level 2e Testers

Level 2e testers have no support from their manufacturers.

**ADC KRONE no longer accepts level 2e testers for full Class D performance testing.**

### Level 3 Testers

This accuracy level is necessary for Class E testing. Software upgrades are the mechanism used to keep the tester up to date with accuracy and performance requirements. These testers are complicated instruments and each manufacturer uses different complex mathematical algorithms in their software to achieve the necessary accuracy and performance measurements. These testers can be used on any of the lower Class installations and still perform at the high Level 3 accuracy

**ADC KRONE accepts the following Level 3 testers for testing Class E performance, using Cat 6 components:**

1. Agilent WireScope WS350 & FrameScope FS350 (& Pro Series)
2. FLUKE DTX-1800 and DTX-1200
3. LANTEK 6 and 7 - for up to Class E, Cat 6 (250 MHz) at present.

**DSP4000, DSP4100, DSP4300, OmniScanner 1 and 2**

**These are no longer acceptable** to ADC KRONE for Warranty testing because they are not supported or calibrated by the manufacturer.

### Level 3e Testers

This accuracy level is a requirement for Cat 6<sub>A</sub> and Class E<sub>A</sub> testing. These testers can be used on any of the lower Class installations and still perform at the high Level 3e accuracy.

**ADC KRONE accepts the following Level 3e or better testers for testing of Class E (Cat 6) and Class E<sub>A</sub> (Cat 6<sub>A</sub>) performance for 10Gigabit Ethernet.**

- |                                 |  |
|---------------------------------|--|
| 1. Fluke DTX-1200               | - Class E (250 MHz)                        |
| 2. Fluke DTX-1800               | - Class E <sub>A</sub> (500 MHz) and 10GBE |
| 3. Agilent WireScope Pro N2640A | - Class E <sub>A</sub> (500 MHz) and 10GBE |



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#### 4. Tester Comments

##### **Agilent WireScope Pro N2640A and WS350 and FrameScope Pro N2620A350 and FS350**

The WireScope Pro N2640A and WS350 and FrameScope Pro N2620A350 and FS350 all work well and many installers like their ease of use, consistent readings and high accuracy. All units support both Class E Channel and Permanent Link testing as well as other performance analysis capability.

To test installations using HighBand 20 or HighBand 25 modules, obtain the appropriate RJ45 – HB 4pr patch cords and test the installation as a Channel.

##### **LANTEK 6/6a/7/7G**

The LANTEK 7G / 7 / 6a / 6 series testers are approved by ADC KRONE for Warranty testing up to Class E (Cat 6) only.

All LANTEK Series cable certifiers use the IDEAL patented measurement system that allows LANTEK users to use patch cords intended for use on the site to perform both channel as well as permanent link certification.

At this stage, ADC KRONE accepts LANTEK test results for up to Cat 6 Class E installations only.

##### **OmniScanner 1 & 2 - Not Acceptable as a Warranty Tester**

The OmniScanner 1 & 2 models are not supported by the manufacturer. They are not acceptable to ADC KRONE as a Warranty tester.

##### **Fluke DSP4300 - Not Acceptable as a Warranty Tester**

The DSP4000 and 4100 models ended their service life in Dec 2007 and are not acceptable to ADC KRONE as warranty testers. The DSP4300 is at the end of its service life and is no longer supported by Fluke as at January 2010. The DSP4300 is no longer acceptable to ADC KRONE as a warranty tester.

##### **Fluke DTX-1800 and 1200**

The DTX-1800 is a Level 3e tester that tests out to 900 MHz and will meet Cat 6<sub>A</sub> Class E<sub>A</sub> (500 MHz) 10GBE performance requirements. DTX-1200 tests out to 350 MHz and tests for Class E (250 MHz) performance requirements (but not Cat 6<sub>A</sub> / Class E<sub>A</sub>).

Class E and Class E<sub>A</sub> (10GBE) Permanent Link heads must have the right Permanent Link leads fitted to suit the modules, otherwise test the full Channel.

To test permanent links using HighBand 20 or HighBand 25 modules, use the PM15A (the HB20 & HB25 personality module) or a HB20 – RJ45 patch cord.



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## 5. Issues In The Field Common To All Testers

### **Out of Date Calibration**

All testers should be calibrated by the manufacturer's representative on a 1 to 2 year basis. This means they are not available for maybe 10 days.

Periodically do the self-calibration, e.g. before the start of each new job site, then once per week to retain confidence in the tester readings.

### **Batteries Not Fully Charged**

If the battery level drops below 25-30%, there can be false or inconsistent readings.

### **Incorrect NVP Setting on the Tester**

NVP is used to calculating the correct length.

Do not simply use the default NVP. Selecting the correct cable type on the tester will automatically select the correct NVP. See the tables at the back of this document.

If the NVP is set HIGHER than specified for the cable, the tester length reading will be HIGHER than actual, by approx 1.35 m /1%NVP. Eg. If the NVP is 2% HIGHER than specified, the tester length reading is approx 2.7 m HIGHER than the actual length.

### **"Star-Pass" Not Turned On**

Some testers do not have the \*PASS warning enabled on the tester settings. This results in a false feeling of confidence while testing because no warnings are sounded indicating that the run needs attention. It is better to find & fix these while staff are on site than to find out back in the office 2 weeks later and have to return to site after the end user has moved in.

ADC KRONE can accept \*PASS for a Warranty but only if the tester set-up is correct and full plot data results have been checked by ADC KRONE technical staff .

### **Incorrect Test Set-up & Performance Setting**

Select the Test Set-up and Performance Level to the ADC KRONE Warranty requirements as set out in the Warranty Registration Form and the builder's project specification. If these requirements conflict with each other, contact ADC KRONE to get advice before you spend days of testing time that may have to be repeated.

ADC KRONE requirements are listed in the following tables. They are the latest AS/NZS 3080 PL & Ch requirements for Class D or E performance, or alternatively the ISO 11801 performance standards.



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If the default North American (TIA) Cat 6 and Cat 5e performance standards are selected, then not all the required testing and calculations may be done. (Eg. TIA Cat 6 and 5e standard does not require ACR or PSACR, but Class E and D standard does. Also, TIA settings do not show resistance measurements and high resistance terminations are over-looked, but ISO require all cable pair resistance to be reported.

### **Wear On Test Leads & Test Plugs**

All of the testers have issues with Permanent Link lead and plug wear. The coiling and uncoiling of test leads during their use over time will induce unwanted RL and crosstalk. Tester manufacturers have specifically addressed this issue with better leads like the special round leads on the WireScope, FrameScope and DTX testers. Sometimes the test plug may be damaged and thus cause more damage to sockets as testing continues. So inspect the test plugs regularly during testing.

### **6. 3 dB & 4 dB Rules in Testing**

3 dB Rule is if  $IL < 3$  dB you can ignore any RL failures.

4 dB Rule is if  $IL < 4$  dB you can ignore any NEXT failures.

Both rules were brought into the International Standards to account for short runs typically  $< 15$  m, because of signal reflection problems that have nothing to do with incorrect installation or termination practices.

#### **Memory Aid:**

NEXT has 4 letters  
so it is the 4 dB Rule

Under the 3dB and 4dB rules, the tester will ignore FAIL results for RL & NEXT. A negative result (eg  $-0.5$ dB) for NEXT or RL on short runs is an indication of poor termination even though a PASS is indicated. It is unacceptable to leave these poor terminations. The Installer/Test Tech should check for a negative NEXT or RL result whenever testing short ( $< 15$ m) runs. Use LinkWare or ScopeData Pro to do the fault analysis and find the problem. They will show up in the 'Pair Data' window in LinkWare. There may be a high resistance on one or more pairs, or the HDTDIX will show spikes  $>25$  where poor termination issues occur.

For short runs  $< 15$  m, check the HDTDIX and fix any terminations with spikes  $>25$  by adding twist into the pairs and re-terminating.

### **7. PL-CAL on DTX Testers**

Permanent Link Calibration (PL-CAL) is a calibration technique used on Fluke DTX series testers to 'zero out' the effects of any wear on the permanent link leads. The Return Loss (RL) performance of a PL usually improves after the tester has been calibrated with a PL-CAL module.

The PL-CAL test is done by connecting the tester to the computer and initiating the Fluke LinkWare program. The PL-CAL process is located in the 'Utilities' section. Follow the on-screen prompts to conduct the PL-CAL process.



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## 8. ADC KRONE Adaptors For Current Acceptable Testers

<b>AGILENT WS Pro N2640A and FS Pro N2620A and WS350 AND FS350</b>				
	C6 <sub>A</sub> RJ45 Socket	C6 & C5e RJ45 Socket	HighBand 8pr C6 <sub>A</sub> C6 C5e	HighBand 25 & 20 C6 & C6 <sub>A</sub> Modules
<b>Class D and lower (using Cat 5 components)</b>				
Perm Link	N2604A-101	N2604A-101	N2604A-055A	X
Channel	N2604A-100	N2604A-100	N2604A-100	N2604A-100
<b>Class E and lower (using Cat 6 Components) and Class E<sub>A</sub> (using Cat 6A Components)</b>				
Perm Link	N2604A-101 N2644A-101	N2604A-101 N2644A-101	N2604A-055A X	For HB20, use Ch head + (HB20 – RJ45) P/C
Channel	N2604A-100 N2644A-100	N2604A-100 N2644A-100	N2604A-100 N2644A-100	N2604A-100 N2644A-100

N2604A-055A is for Australian T568A wiring; –056B is for American T568B wiring.

N2604A-055A is used for PL testing of HighBand 8pr modules if PL testing is selected on tester.

N2604A-101 and N2644A-101 are the Universal Link Probe/Adaptors for C6 and C6<sub>A</sub>.

<b>LANTEK 6/6a/7/7G</b>				
	C6 <sub>A</sub> <sup>1</sup> RJ45 Socket	C6 & C5e RJ45 Socket	HighBand 8pr C6 <sub>A</sub> C6 C5e	HighBand 25 C6 Modules
<b>Class D and lower (using Cat 5 components)</b>				
Perm Link	X	Cat6 Adapters# + RJ45 P/Cord	Cat6 Adapters# RJ45 – HB P/C*	Cat6 Adapters# RJ45 – HB P/C*
Channel	X	Cat6 Adapters#	Cat6 Adapters#	Cat6 Adapters#
<b>Class E and lower (using Cat 6 components)<sup>1</sup></b>				
Perm Link	X	Cat6 Adapters# + RJ45 P/Cord*	Cat6 Adapters# RJ45 – HB P/C*	Cat6 Adapters# RJ45 – HB P/C*
Channel	X	Cat6 Adapters#	Cat6 Adapters#	Cat6 Adapters#

# Cat6 Adapter is Lantek P/N 0012-00-0656 A.

\* Use high quality RJ45 – RJ45 patch cord for calibration prior to testing.

<sup>1</sup> Lantek is ADC approved for Cat 6 only at present, not Cat 6<sub>A</sub>.

<b>FLUKE DTX-1800, DTX-1200</b>				
	C6 <sub>A</sub> RJ45 Socket	C6 & C5e RJ45 Socket	HighBand 8pr C6 <sub>A</sub> C6 C5e	HighBand 25 & 20 C6 & C6 <sub>A</sub> Modules
<b>Class D and lower (using Cat 5 components)</b>				
Perm Link	PLA002	PLA002 or PLA001 + PM06	PLA001+PM14A	PLA001 + PM15A or (HB20 – RJ45) P/C
Channel	CHA001	CHA001 or LIA012	CHA001 or LIA012	CHA001 or LIA012
<b>Class E and lower (using Cat 6 Components)</b>				
Perm Link	PLA002	PLA002 or PLA001 + PM06	PLA001+PM14A or (HB20 – RJ45) P/C	PLA001 + PM15A or (HB20 – RJ45) P/C
Channel	CHA001	CHA001 or LIA012	CHA001 or LIA012	CHA001 or LIA012
<b>Class E<sub>A</sub> (using Cat 6A Components)</b>				
Perm Link	PLA002	X	(HB20 – RJ45) P/C + CHA001	(HB20 – RJ45) P/C + CHA001
Channel	CHA001	X	CHA001	CHA001

LIA101 + PM06 are the DTX1800 & DTX1200 test leads for C5e & C6 RJ45.

LIA101 + PM06 are not acceptable for C6<sub>A</sub> RJ45 sockets. Use a PLA002



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## 9. Guideline For In-Built Cable And Test Specifications

The cable specifications that are built into the testers allow for automatic set up.

<b>AGILENT WS350 and FS350 and WireScope Pro and FrameScope Pro</b>		
	Cat 6	Cat 5e
Data Base / Cable Spec. / KRONE	C6TR TrueNet ADC KRONE NVP = 69%	C5eTR TrueNet ADC KRONE NVP = 69%
Data Base / Hardware	KRONE / TrueNet C6T	KRONE / TrueNet C5eT
Profile Settings / Perm Link	Default Class E	Default Class D
Profile Settings / Channel	Default Class E	Default Class D

For all Profiles in the tester under the 'Measurements Setting' set 'Margin Checking' to ON. For testing to Cat 6<sub>A</sub> set up a new Profile in the tester and call it "ADC Cat 6A". See Item 11.

<b>LANTEK 6/6a/7/7G</b>		
	Cat 6	Cat 5e
Cable Spec.	Cat 6-250 UTP	Cat 5E UTP
Permanent Link	Cable Type / Twisted Pair Perm / Cat 6-250 UTP Perm / [Don't press Enter or Escape] Press NVP and set to 69% / Save	Cable Type / Twisted Pair Perm / Cat 5E UTP Perm / [Don't press Enter or Escape] Press NVP, set to 69% / Save
Channel	Cable Type / Twisted Pair Channel / Cat 6-250 UTP Chan. [Don't press Enter or Escape] Press NVP and set to 69% / Save	Cable Type / Twisted Pair Channel / Cat 5E UTP Chan / [Don't press Enter or Escape] Press NVP, set to 69% / Save

<b>FLUKE DTX-1800, 1200</b>		
	Cat 6	Cat 5e
Cable Spec. UTP	Go to: Set-up/Twisted Pair/ Cable Type/ UTP/ Cat6 UTP * NVP 69% default, for ADC C6	Go to: Set-up/Twisted Pair/ Cable Type/ UTP/ Cat5e UTP * NVP 69% default, for ADC C5e
Permanent Link	Go to: Set-up/ Twisted Pr/ Test Limit/ ISO 11801 PL max Class E	Set-up / Twisted Pr/ Test Limit/ ISO 11801 PL max Class D
Channel	Go to: Set-up/ Twisted Pr/ Test Limit/ ISO 11801 Channel Class E	Set-up / Twisted Pr/ Test Limit/ ISO 11801 Channel Class D

\* For non-UTP cables see the following summary.

Always ensure that the latest software and test limits are downloaded from the tester manufacturer and stored in the testers.



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**Summary of Cable Library Names and NVP for ADC KRONE Cables**

		<b>C6<sub>A</sub></b>	<b>C6</b>	<b>C5e</b>
UTP	PVC	ADC Cu 10G-A6TR CMR UTP NVP = 65%	Use generic Cat 6 UTP NVP = 69%	Use generic Cat 5e UTP NVP = 69%
UTP	LSZH	ADC Cu 10GA6TZ LSZH UTP NVP = 65%	ADC TN6TZ LSZH UTP NVP = 70%	ADC TN5ETZ LSZH UTP NVP = 70%
F/UTP	PVC	-	TrueNet cat.6 F/UTP NVP = 65%	TrueNet cat.5e F/UTP NVP = 65%
F/UTP	LSZH	Use S/FTP LSZH below	-	-
S/FTP	LSZH	TrueNet Cat7 600MHz S/FTP	Use S/FTP LSZH below	-

<b>Cat 6<sub>A</sub></b>			
<b>For 10 GBE performance, on Cat 6<sub>A</sub> (CopperTen™) Cable and Connectors FLUKE DTX-1800</b>			
	UTP	PVC	UTP LSZH
<b>Tester Limit</b> Permanent Link	Set-up/ Twisted Pr/ Test Limit/ ISO ClassEa PL2 (or PL3 with CP) Default NVP = 65%		Set-up/ Twisted Pr/ Test Limit/ ISO ClassEa PL2 (or PL3 with CP) Default NVP = 65%
<b>Tester Limit</b> Channel	Set-up/ Twisted Pr/ Test Limit/ ISO ClassEa Ch AMD1 Default NVP = 65%		Set-up/ Twisted Pr/ Test Limit/ ISO ClassEa Ch AMD1 Default NVP = 65%
<b>Cable Type</b> ADC	Set-up/Twisted Pair/ Manuf/ ADC/ Cu10G-A6TR CMR UTP Default NVP = 65%		Set-up/Twisted Pair/ Manuf/ ADC/ Cu 10GA6TZ LSZH UTP Default NVP = 65%

Always ensure that the latest software and test limits are downloaded from tester manufacturer and stored in the testers.



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## 10. Guideline For Setting Up A Cat 6A Profile in WireScope Pro

The following guideline helps operators set up a Profile in the WireScope Pro for testing Cat 6<sub>A</sub> (500 MHz) cabling to the tester's top frequency of 1000 MHz.

1. Follow the directions contained on page 51 of the WireScope Pro manual "Creating a New settings profile".
2. When prompted, type in the Profile Name "ADC Cat 6A".
3. On the next screen unlock all the options.
4. On the following screen, select 'Disable password protection'.
5. Select 'Edit Settings' and insert the following when prompted:
  - Limit – Category C6A – TIA Cat 6A – Channel
  - Network Limits – 100Base-T & 1000Base-T
  - Site – (Enter Site Specific Details)
  - Cable - Krone – Add New Description
    - Description – C6A UTP Riser
    - Connector type – Copper Cable
    - 4pair, UTP, 100 ohm Impedance
    - Specify cable NVP – 65%
    - Performance – Cat 6A
  - Connecting Hardware – Krone – Add New Description
    - Description – C6A
    - Connector Type – Copper
    - Shield – No
    - Performance – Cat 6A
  - Cable Pairing – T568A
  - Measurement – select all options on 3 screens
  - Max. frequency – 1000MHz
  - Save Plots – Full data set
6. After completing the above, 'Edit Settings' and 'Edit' the above profile, select 'Update Selected' and lock all options except site.

End