ENGINEERING MEMO

Initiated by:	David Kenney
Project Manager:	Tom Booler

Proposed Priority: ☐ Fast Track ☒ Normal

Title: LNA Coax Phase Measurement

Affected item(s):

All LNA coaxial cables.

Technical description of change:

Based on CIRA laboratory measurement, none of the LNA sample batches (new and old) truly meet spec. Sample testing of cables (new/used) should be done to ensure phase consistency. Given that new cables are outside the specified range we should consider:

- requesting test data from the manufacturer
- broadening/changing the spec
- rejecting cables which do not meet spec
- periodically replacing cables as part of regular maintenance

Reason for change and expected benefits:

The MWA drawing number MWA-014 provides the specification for the LNA cables which connect the dipoles to the Beamformer. This physical length is specified in the range 7000 – 7100mm and the electrical spec is phase matched to 10 cycles + 141 degrees ° ± 3° @ 300MHz.

Initial interpretation of the spec was that the acceptable phase range was 10*360 + 141 ± 3 (ie 3738 – 3744 °). However the physical length for this phase range is 6853 – 6864mm (velocity factor for KSR100 is 0.66). This does not match the physical length spec and implies an incorrect spec interpretation.

The format of the specification is consistent with a wrapped phase measurement where phase is bound to the range –pi:pi (anticlockwise rotation). The total phase requires a wrapped to unwrapped phase calculation. Unwrapping this specification gives (10*360 + 180 + 180 – 141) ° ± 3° or 3816 – 3822°. This implies a physical length of theoretical length of 6996 – 7007 mm, which is more consistent with the physical length spec.

The phase delay of various condition LNA cables have been measured using a calibrated Fieldfox. The statistics of which is summarized below:

Curtin University

Cable Pair	20171213 (used/bare)		20180221			20180302		
	X	Y	X	Y		X	Y	
1	-3827	-3828	-3815	-3814	bare	-3812	-3813	bare
2	-3830	-3829	-3813	-3813	bare	-3815	-3816	bare
3	-3826	-3832	-3817	-3814	in-hub	-3813	-3814	in-hub
4	-3835	-3832	-3816	-3814	in-hub	-3813	-3814	in-hub
5	-3825	-3824						
6	-3832	-3829						
7	-3830	-3824						
8	-3831	-3825						
9	-3828	-3830						
10	-3826	-3825						
11	-3823	-3826						
12	-3832	-3833						
13	-3822	-3826						
14	-3828	-3825						
15	-3825	-3823						
16	-3830	-3827						
17	-3826	-3824						
18	-3820	-3826						
19	-3829	-3832						
20	-3826	-3827						
21	-3826	-3826						
22	-3825	-3824						
mean	-3827.363636	-3827.136364	-3815.25	-3813.75		-3813.25	-3814.25	
std	3.566316688	3.059652245	1.707825128	0.5		1.258305739	1.258305739	
min	-3835	-3833	-3817	-3814		-3815	-3816	
max	-3820	-3823	-3813	-3813		-3812	-3813	
delta	15	10	4	1		3	3	

Comparing these results against the spec (mean ± std = 3819 ± 3).

The spread of the new cables are within spec however the mean is approximately 5° shorter than spec. The used batch are 8° longer than spec and 13° longer than the new cables. The spread of the used cables exceed spec, which may be a result of ageing/use.

Effective Date: (dd-mm-yyyy)	
Reason for given effective date:	
Expected impact on cost ($AUD):	
Impact on schedule:	
Other impacts:	

Attached Document(s):

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