LHOY-End RxPD and TxPD Calibration Trends

Table of Contents

About

This document contains the Pcal PD (TxPD and RxPD) Calibration trends. The first six sections contain the six ratios measured at the end-station labeled as m1, m2 .....m6. The section that follows contains the relevant information calculated from these measurements which include Optical Efficiency, Power Imbalance, TX/WS and RX/WS ratio.

Understanding Each Section

Each section contains a list of measurements with Magnitude, Standard Error (Std Err) and Relative Error (Rel Err) for each measurement. The list is followed by two plot figures with Magnitude on the first plot and the the Normalized Magnitude on the second. Each section ends with a summary that contains the weighted mean of all the measurement along with their Standard Deviation (Std Dev), Std Err and Rel Err where each of

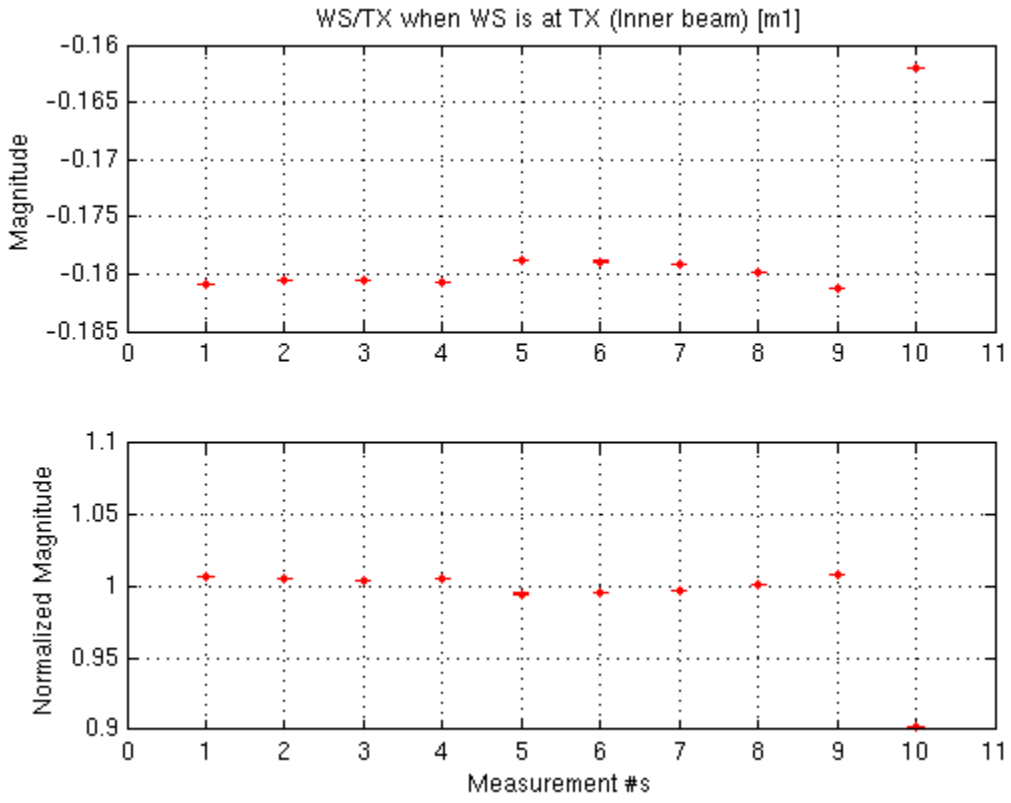
```
Mean = sum(x(i)*w(i))/sum(w(i))
Std Dev = sqrt(sum(w(i)*(x(i)-x_mean)^2)/((n-1)/n*sum(w(i))))
Std Err = Std Dev/sqrt(n)
Rel Err = Std Err/Mean
```

Report created on 08-Nov-2016

WS/TX Ratio when WS is at TX (Inner Beam)

List of Measurements

Date	*m1 ± SE_{m1}*	*Normalized*
D20150811	*-0.180846 ± 0.000008*	*(1 ± 0.000044)*
D20150827	*-0.180614 ± 0.000007*	*(1 ± 0.000037)*
D20151013	*-0.180474 ± 0.000006*	*(1 ± 0.000034)*
D20151222	*-0.180696 ± 0.000008*	*(1 ± 0.000044)*
D20160505	*-0.178817 ± 0.000008*	*(1 ± 0.000043)*
D20160628	*-0.178884 ± 0.000007*	*(1 ± 0.000041)*
D20160927	*-0.179158 ± 0.000008*	*(1 ± 0.000046)*
D20161011	*-0.179883 ± 0.000010*	*(1 ± 0.000054)*
D20161031	*-0.181175 ± 0.000007*	*(1 ± 0.000040)*
D20161109	*-0.162027 ± 0.000016*	*(1 ± 0.000102)*

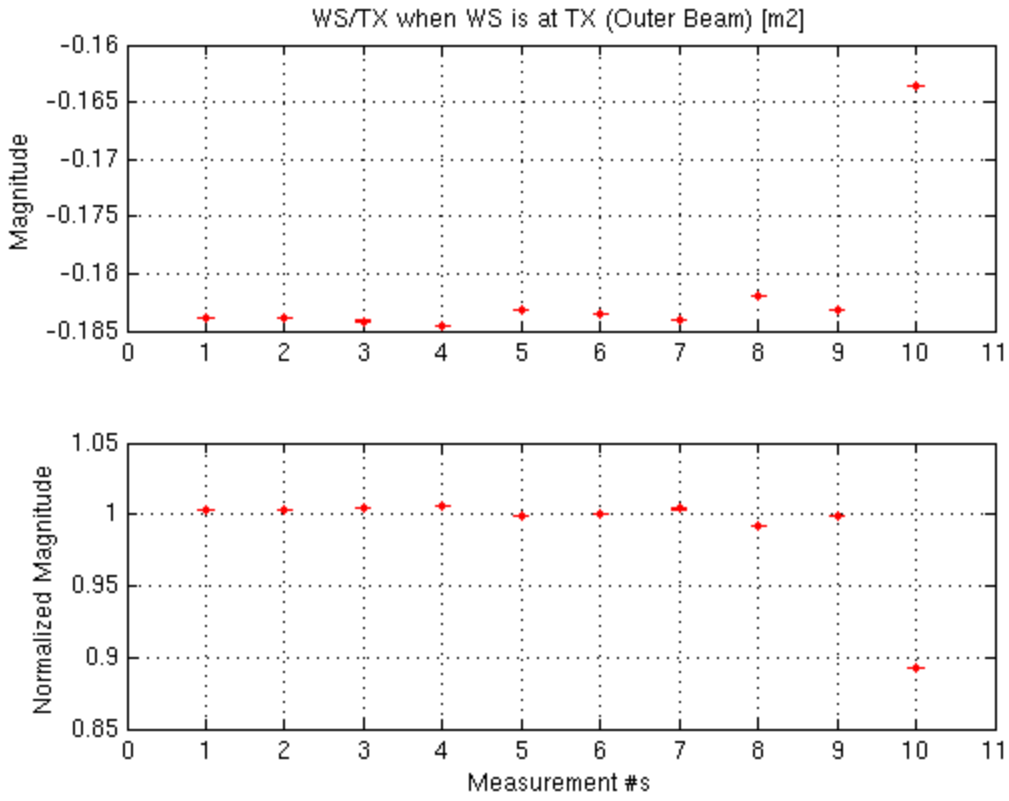


Summary of WS/TX when WS is at TX (Inner beam) [m1]:
Mean value: -0.179704
Standard deviation: 0.002966
Standard Error: 0.000987
Relative Standard Error: 0.005494

WS/TX Ratio when WS is at TX (Outer Beam)

List of Measurements

Date	*m2 ± SE_{m2}*	*Normalized*
D20150811	*-0.183815 ± 0.000007*	*(1 ± 0.000039)*
D20150827	*-0.183788 ± 0.000006*	*(1 ± 0.000035)*
D20151013	*-0.184127 ± 0.000007*	*(1 ± 0.000036)*
D20151222	*-0.184502 ± 0.000005*	*(1 ± 0.000027)*
D20160505	*-0.183087 ± 0.000008*	*(1 ± 0.000044)*
D20160628	*-0.183461 ± 0.000008*	*(1 ± 0.000042)*
D20160927	*-0.184007 ± 0.000008*	*(1 ± 0.000044)*
D20161011	*-0.181887 ± 0.000010*	*(1 ± 0.000053)*
D20161031	*-0.183163 ± 0.000008*	*(1 ± 0.000041)*
D20161109	*-0.163651 ± 0.000015*	*(1 ± 0.000094)*



Summary of WS/TX when WS is at TX (Outer Beam) [m2]:

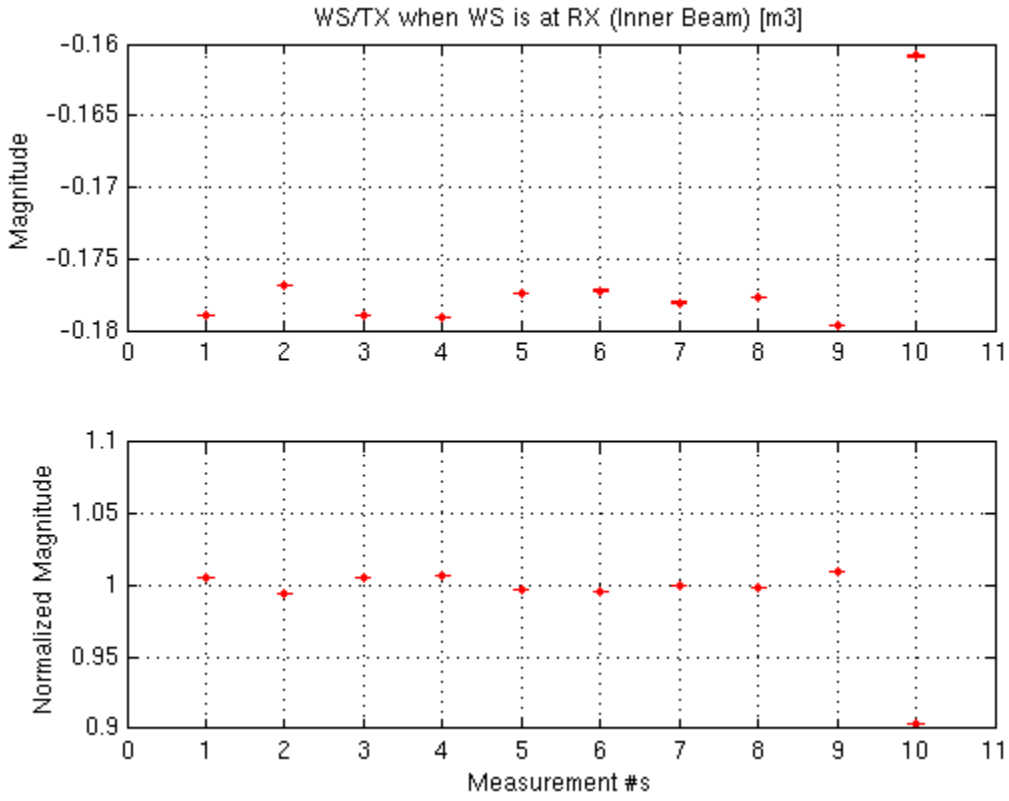
Mean value:	*-0.183295*
Standard deviation:	*0.003228*
Standard Error:	*0.001074*
Relative Standard Error:	*0.005862*

WS/TX Ratio when WS is at RX (Inner Beam)

List of Measurements

Date	*m3 ± SE_{m3}*	*Normalized*
D20150811	*-0.179002 ± 0.000008*	*(1 ± 0.000043)*
D20150827	*-0.176861 ± 0.000006*	*(1 ± 0.000036)*
D20151013	*-0.178931 ± 0.000006*	*(1 ± 0.000035)*
D20151222	*-0.179098 ± 0.000007*	*(1 ± 0.000037)*
D20160505	*-0.177402 ± 0.000008*	*(1 ± 0.000043)*
D20160628	*-0.177210 ± 0.000008*	*(1 ± 0.000043)*
D20160927	*-0.178050 ± 0.000008*	*(1 ± 0.000046)*

D20161011	*-0.177663 ± 0.000009*	*(1 ± 0.000050)*
D20161031	*-0.179651 ± 0.000008*	*(1 ± 0.000044)*
D20161109	*-0.160833 ± 0.000019*	*(1 ± 0.000120)*



Summary of WS/TX when WS is at RX (Inner Beam) [m3]:

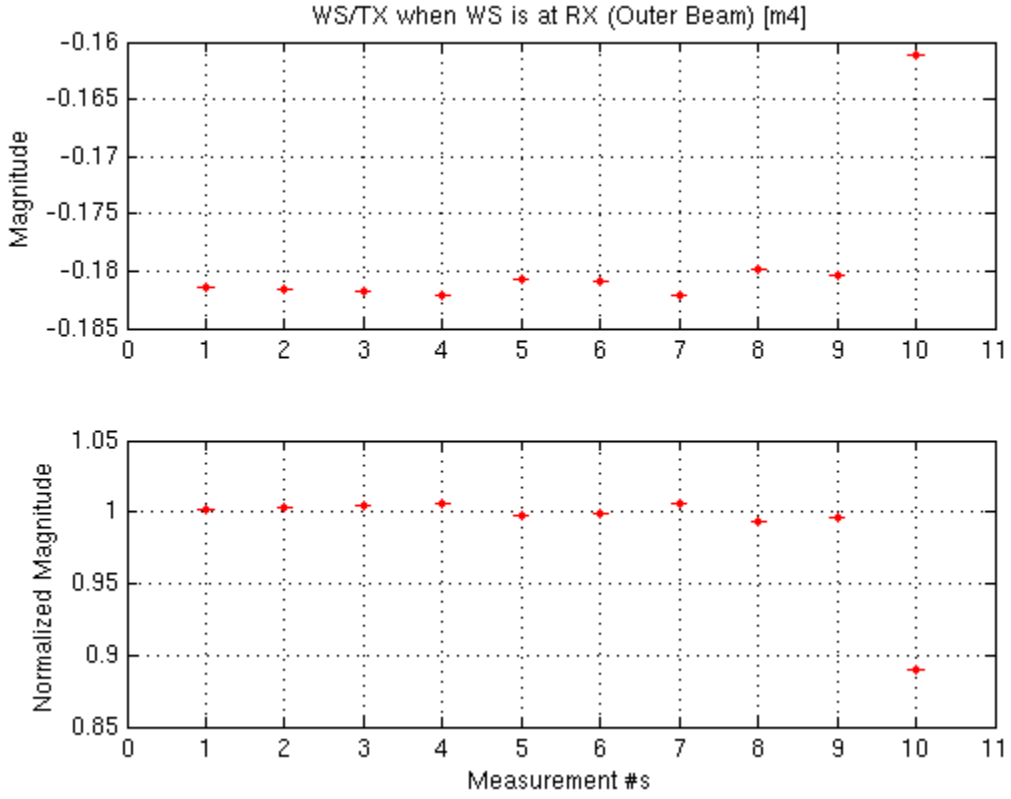
Mean value:	*-0.177952*
Standard deviation:	*0.002489*
Standard Error:	*0.000828*
Relative Standard Error:	*0.004655*

WS/TX Ratio when WS is at RX (Outer Beam)

List of Measurements

Date	*m4 ± SE_{m4}*	*Normalized*
D20150811	*-0.181381 ± 0.000008*	*(1 ± 0.000046)*
D20150827	*-0.181640 ± 0.000006*	*(1 ± 0.000031)*
D20151013	*-0.181781 ± 0.000006*	*(1 ± 0.000034)*

D20151222	*-0.182083 ± 0.000006*	*(1 ± 0.000031)*
D20160505	*-0.180668 ± 0.000007*	*(1 ± 0.000040)*
D20160628	*-0.180940 ± 0.000007*	*(1 ± 0.000040)*
D20160927	*-0.182118 ± 0.000009*	*(1 ± 0.000048)*
D20161011	*-0.179869 ± 0.000008*	*(1 ± 0.000046)*
D20161031	*-0.180443 ± 0.000008*	*(1 ± 0.000045)*
D20161109	*-0.161159 ± 0.000019*	*(1 ± 0.000118)*



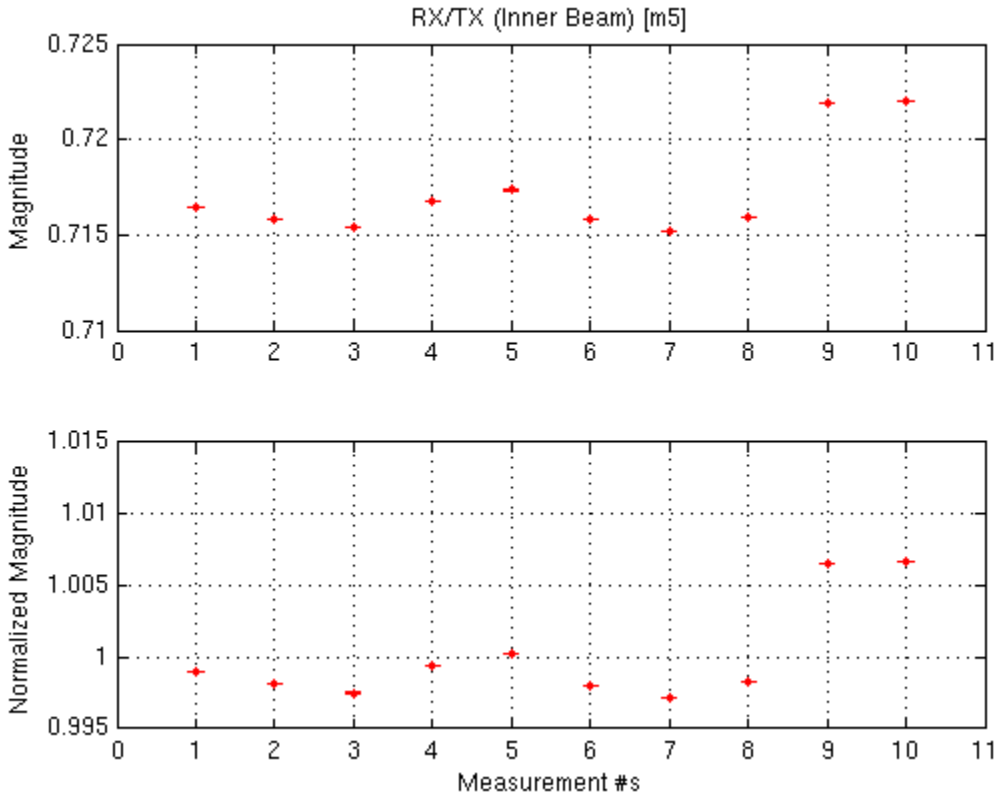
Summary of WS/TX when WS is at RX (Outer Beam) [m4]:

Mean value:	*-0.181048*
Standard deviation:	*0.002664*
Standard Error:	*0.000887*
Relative Standard Error:	*0.004897*

RX/TX Ratio (Inner Beam)

List of Measurements

Date	m5 ± SE_{m5}	Normalized
D20150811	0.716408 ± 0.000003	(1 ± 0.000005)
D20150827	0.715858 ± 0.000003	(1 ± 0.000004)
D20151013	0.715399 ± 0.000002	(1 ± 0.000003)
D20151222	0.716771 ± 0.000002	(1 ± 0.000003)
D20160505	0.717343 ± 0.000002	(1 ± 0.000003)
D20160628	0.715799 ± 0.000002	(1 ± 0.000003)
D20160927	0.715156 ± 0.000003	(1 ± 0.000004)
D20161011	0.715926 ± 0.000004	(1 ± 0.000006)
D20161031	0.721892 ± 0.000003	(1 ± 0.000004)
D20161109	0.722016 ± 0.000003	(1 ± 0.000004)



Summary of RX/TX (Inner Beam) [m5]:

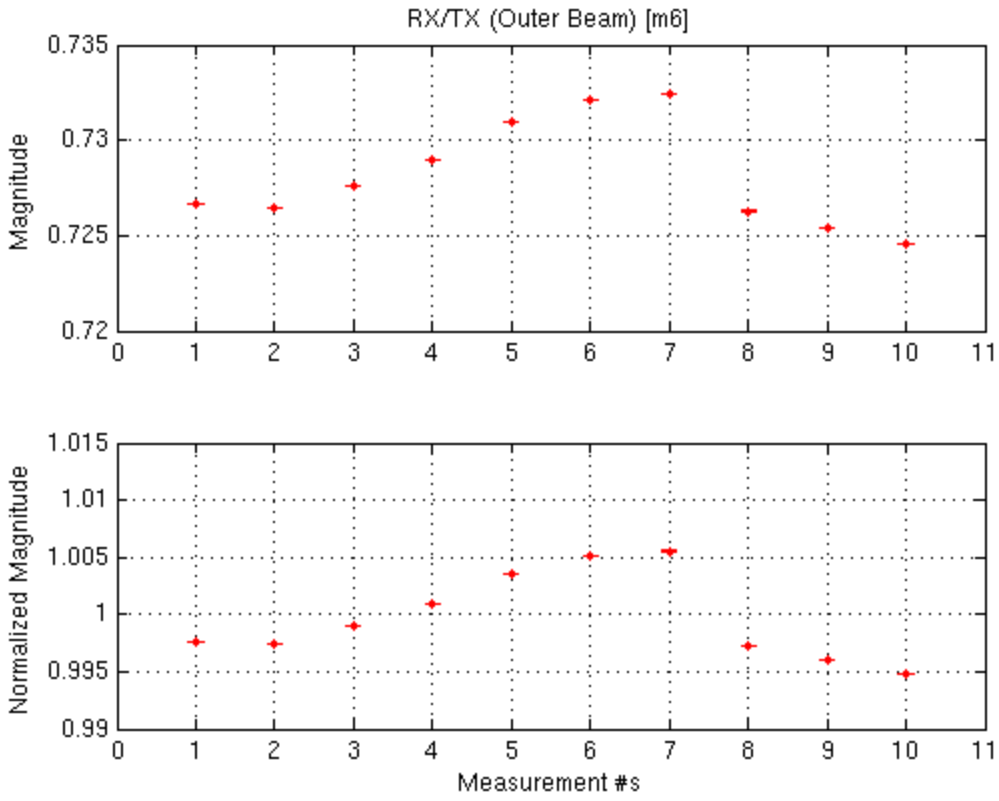
Mean value:	0.717181
Standard deviation:	0.002436

Standard Error: *0.000811*
Relative Standard Error: *0.001131*

RX/TX Ratio (Outer Beam)

List of Measurements

Date	*m6 ± SE_{m6}*	*Normalized*
D20150811	*0.726657 ± 0.000003*	*(1 ± 0.000004)*
D20150827	*0.726468 ± 0.000002*	*(1 ± 0.000003)*
D20151013	*0.727582 ± 0.000002*	*(1 ± 0.000003)*
D20151222	*0.728972 ± 0.000002*	*(1 ± 0.000003)*
D20160505	*0.730960 ± 0.000002*	*(1 ± 0.000003)*
D20160628	*0.732089 ± 0.000003*	*(1 ± 0.000004)*
D20160927	*0.732393 ± 0.000002*	*(1 ± 0.000003)*
D20161011	*0.726292 ± 0.000003*	*(1 ± 0.000004)*
D20161031	*0.725420 ± 0.000002*	*(1 ± 0.000003)*
D20161109	*0.724600 ± 0.000002*	*(1 ± 0.000003)*



Summary of RX/TX (Outer Beam) [m6]:

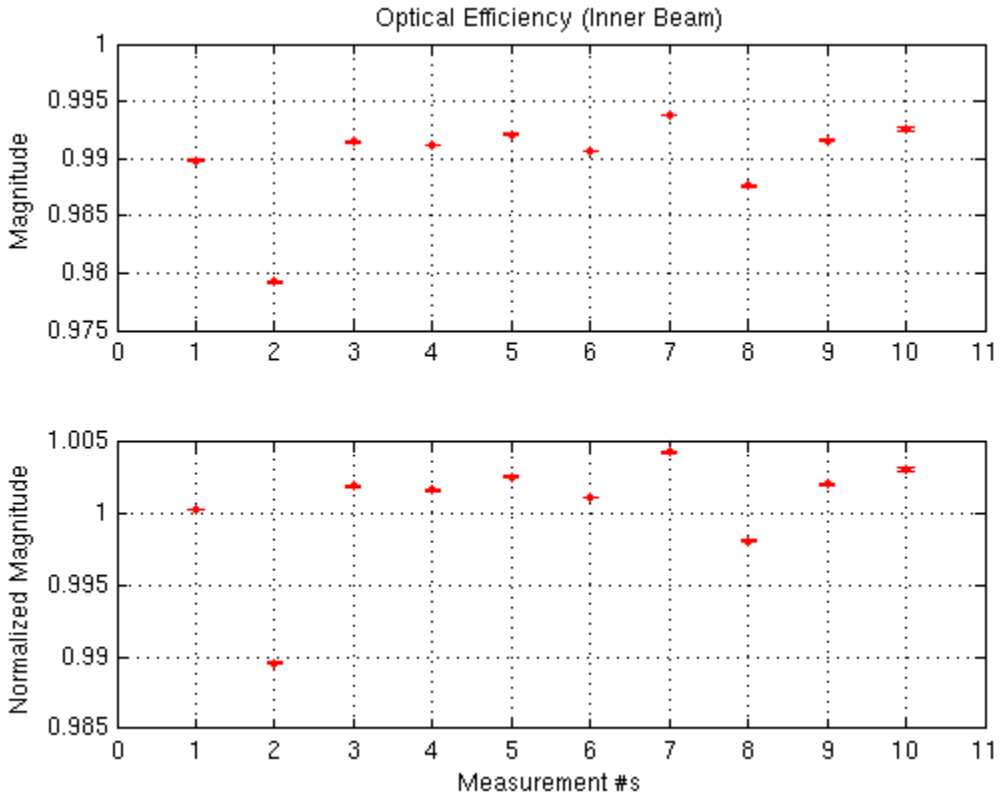
Mean value:	*0.728344*
Standard deviation:	*0.002735*
Standard Error:	*0.000910*
Relative Standard Error:	*0.001250*

Optical Efficiency of Inner Beam

List of Measurements

Date	*e_i ± SE_{e_i}*	*Normalized*
D20150811	*0.989808 ± 0.000062*	*(1 ± 0.000062)*
D20150827	*0.979224 ± 0.000052*	*(1 ± 0.000053)*
D20151013	*0.991448 ± 0.000049*	*(1 ± 0.000049)*
D20151222	*0.991154 ± 0.000057*	*(1 ± 0.000058)*
D20160505	*0.992086 ± 0.000061*	*(1 ± 0.000061)*
D20160628	*0.990643 ± 0.000059*	*(1 ± 0.000060)*
D20160927	*0.993815 ± 0.000065*	*(1 ± 0.000065)*

D20161011	*0.987658 ± 0.000074*	*(1 ± 0.000075)*
D20161031	*0.991589 ± 0.000060*	*(1 ± 0.000060)*
D20161109	*0.992628 ± 0.000157*	*(1 ± 0.000158)*



Summary of Optical Efficiency (Inner Beam):

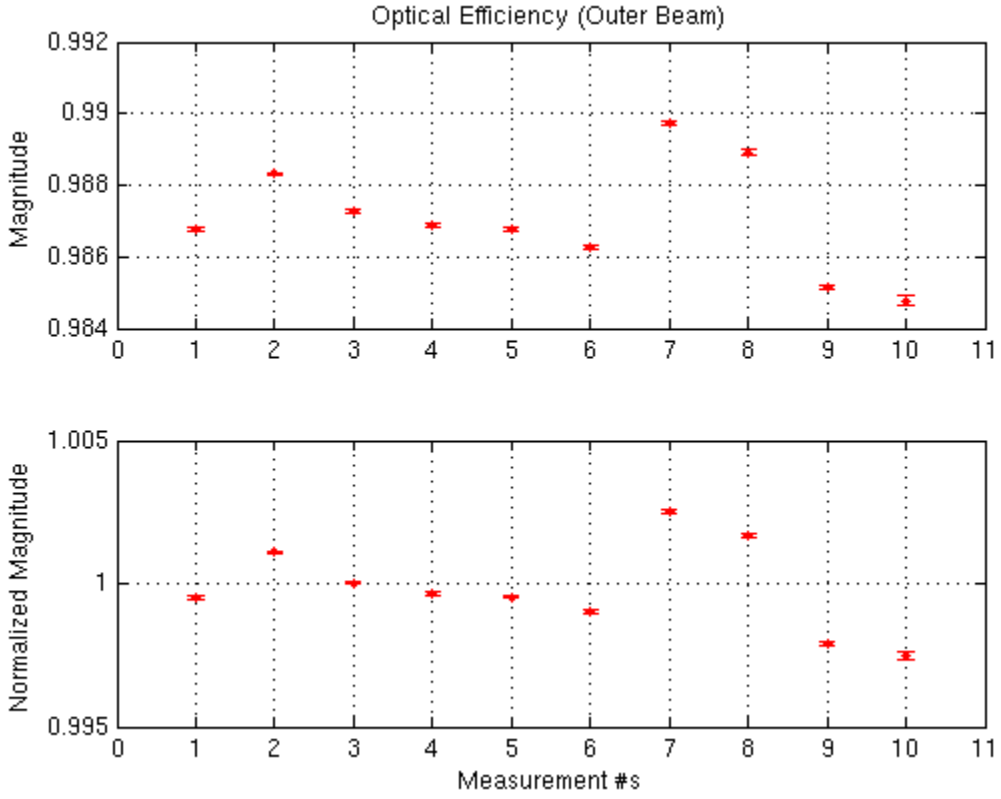
Mean value:	*0.989500*
Standard deviation:	*0.004601*
Standard Error:	*0.001531*
Relative Standard Error:	*0.001548*

Optical Efficiency of Outer Beam

List of Measurements

Date	*e_o ± SE_{e_o}*	*Normalized*
D20150811	*0.986759 ± 0.000061*	*(1 ± 0.000062)*
D20150827	*0.988317 ± 0.000047*	*(1 ± 0.000047)*
D20151013	*0.987256 ± 0.000049*	*(1 ± 0.000050)*

D20151222	*0.986890 ± 0.000041*	*(1 ± 0.000041)*
D20160505	*0.986788 ± 0.000060*	*(1 ± 0.000061)*
D20160628	*0.986257 ± 0.000058*	*(1 ± 0.000059)*
D20160927	*0.989731 ± 0.000065*	*(1 ± 0.000066)*
D20161011	*0.988909 ± 0.000070*	*(1 ± 0.000071)*
D20161031	*0.985153 ± 0.000061*	*(1 ± 0.000062)*
D20161109	*0.984771 ± 0.000150*	*(1 ± 0.000153)*



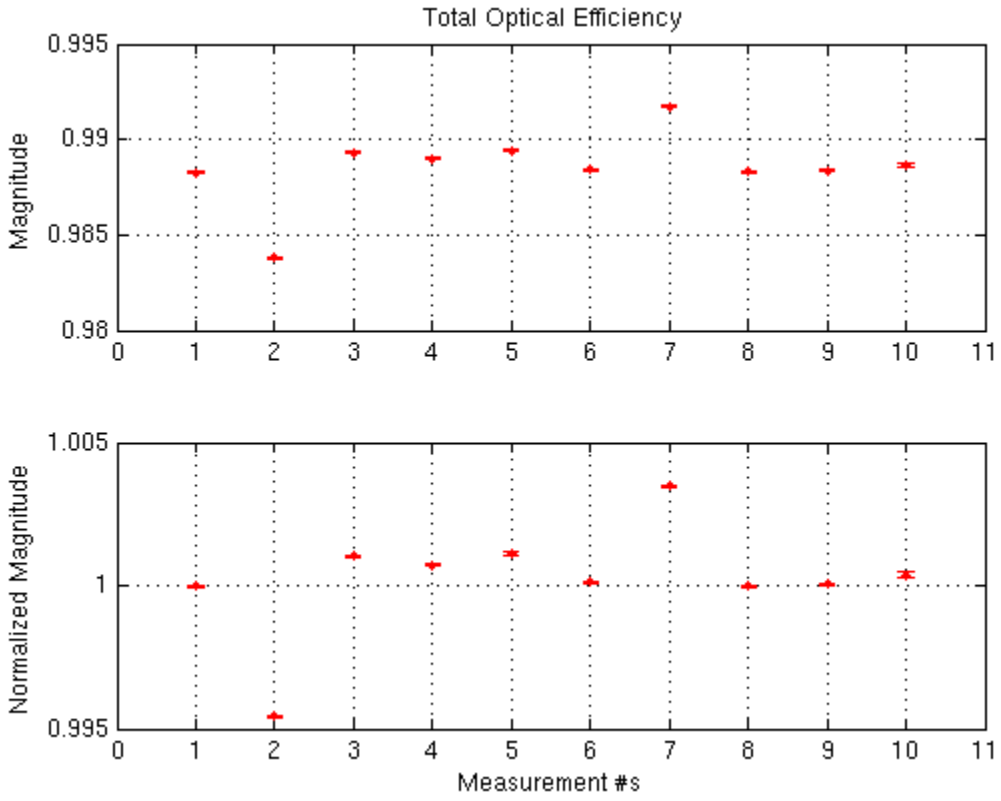
Summary of Optical Efficiency (Outer Beam):

Mean value:	*0.987238*
Standard deviation:	*0.001271*
Standard Error:	*0.000423*
Relative Standard Error:	*0.000428*

Total Optical Efficiency

List of Measurements

Date	e ± SE_{e}	Normalized
D20150811	0.988271 ± 0.000043	(1 ± 0.000043)
D20150827	0.983810 ± 0.000034	(1 ± 0.000035)
D20151013	0.989331 ± 0.000034	(1 ± 0.000035)
D20151222	0.989000 ± 0.000035	(1 ± 0.000035)
D20160505	0.989405 ± 0.000042	(1 ± 0.000043)
D20160628	0.988423 ± 0.000041	(1 ± 0.000041)
D20160927	0.991746 ± 0.000046	(1 ± 0.000046)
D20161011	0.988287 ± 0.000050	(1 ± 0.000051)
D20161031	0.988353 ± 0.000042	(1 ± 0.000043)
D20161109	0.988680 ± 0.000108	(1 ± 0.000109)



Summary of Total Optical Efficiency:

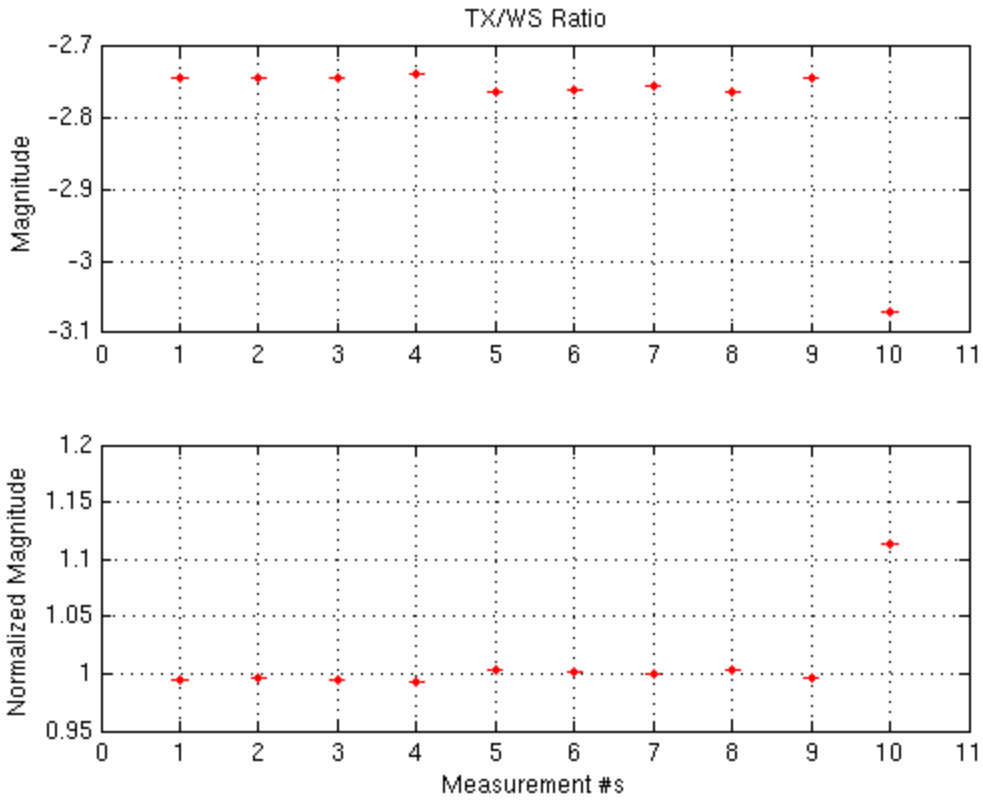
Mean value:	0.988306
Standard deviation:	0.002191

Standard Error: *0.000729*
Relative Standard Error: *0.000738*

TX/WS Ratio

List of Measurements

Date	*R_TW ± SE_{R_TW}*	*Normalized*
D20150811	*-2.742279 ± 0.000011*	*(1 ± 0.000004)*
D20150827	*-2.744228 ± 0.000009*	*(1 ± 0.000003)*
D20151013	*-2.742723 ± 0.000009*	*(1 ± 0.000003)*
D20151222	*-2.738239 ± 0.000009*	*(1 ± 0.000003)*
D20160505	*-2.763161 ± 0.000011*	*(1 ± 0.000004)*
D20160628	*-2.759803 ± 0.000011*	*(1 ± 0.000004)*
D20160927	*-2.753569 ± 0.000011*	*(1 ± 0.000004)*
D20161011	*-2.764191 ± 0.000014*	*(1 ± 0.000005)*
D20161031	*-2.744705 ± 0.000010*	*(1 ± 0.000004)*
D20161109	*-3.070510 ± 0.000023*	*(1 ± 0.000007)*



Summary of TX/WS Ratio:

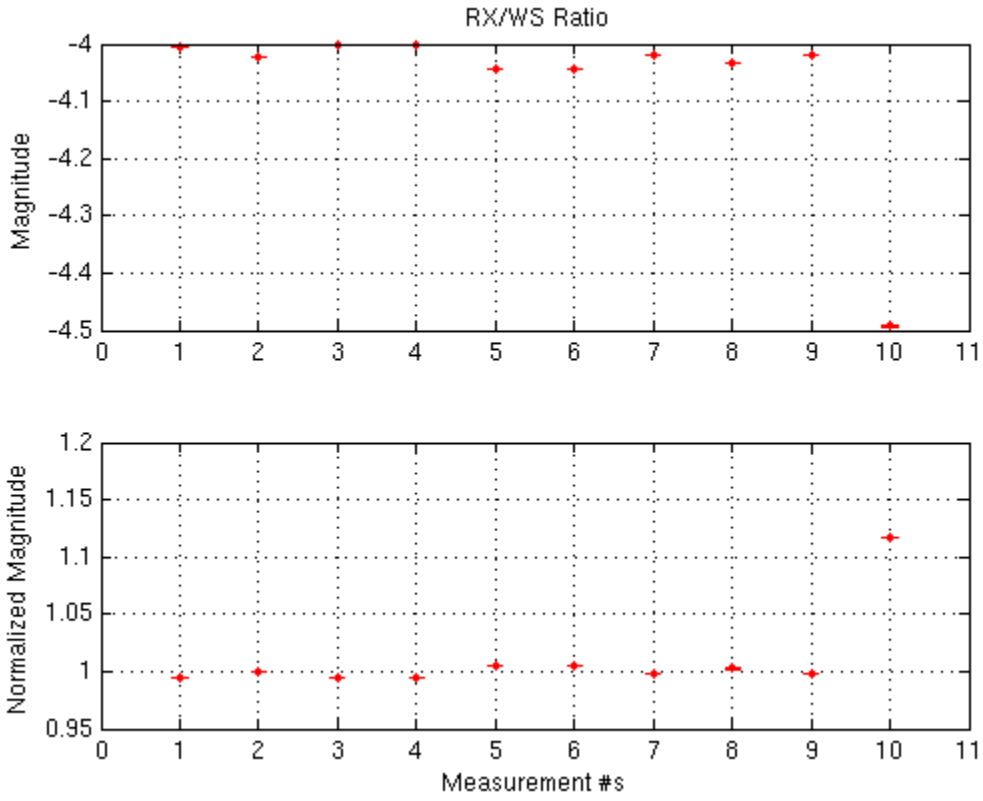
Mean value:	*-2.756176*
Standard deviation:	*0.052033*
Standard Error:	*0.017319*
Relative Standard Error:	*0.006284*

RX/WS Ratio

List of Measurements

Date	*R_RW ± SE_{R_RW}*	*Normalized*
D20150811	*-4.004239 ± 0.000126*	*(1 ± 0.000032)*
D20150827	*-4.023526 ± 0.000096*	*(1 ± 0.000024)*
D20151013	*-4.000359 ± 0.000097*	*(1 ± 0.000024)*
D20151222	*-4.002816 ± 0.000096*	*(1 ± 0.000024)*
D20160505	*-4.044736 ± 0.000119*	*(1 ± 0.000029)*
D20160628	*-4.042655 ± 0.000118*	*(1 ± 0.000029)*
D20160927	*-4.019073 ± 0.000135*	*(1 ± 0.000033)*

D20161011	*-4.033790 ± 0.000139*	*(1 ± 0.000034)*
D20161031	*-4.019253 ± 0.000127*	*(1 ± 0.000032)*
D20161109	*-4.492703 ± 0.000378*	*(1 ± 0.000084)*



Summary of RX/WS Ratio:

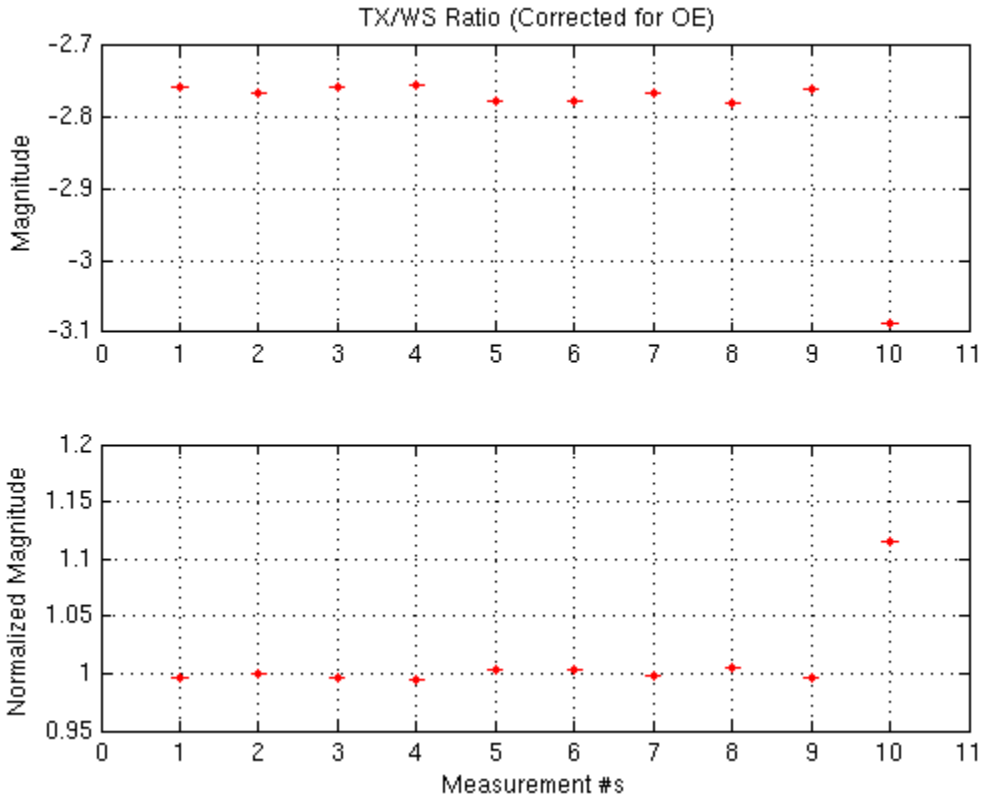
Mean value:	*-4.023908*
Standard deviation:	*0.052436*
Standard Error:	*0.017453*
Relative Standard Error:	*0.004337*

TX/WS Ratio (Corrected for OE)

List of Measurements

Date	*R_TWc ± SE_{R_TWc}*	*Normalized*
D20150811	*-2.758456 ± 0.000060*	*(1 ± 0.000022)*
D20150827	*-2.766624 ± 0.000048*	*(1 ± 0.000017)*
D20151013	*-2.757433 ± 0.000048*	*(1 ± 0.000017)*

D20151222	*-2.753383 ± 0.000048*	*(1 ± 0.000018)*
D20160505	*-2.777877 ± 0.000059*	*(1 ± 0.000021)*
D20160628	*-2.775872 ± 0.000058*	*(1 ± 0.000021)*
D20160927	*-2.764980 ± 0.000064*	*(1 ± 0.000023)*
D20161011	*-2.780474 ± 0.000071*	*(1 ± 0.000025)*
D20161031	*-2.760782 ± 0.000059*	*(1 ± 0.000021)*
D20161109	*-3.087988 ± 0.000168*	*(1 ± 0.000054)*



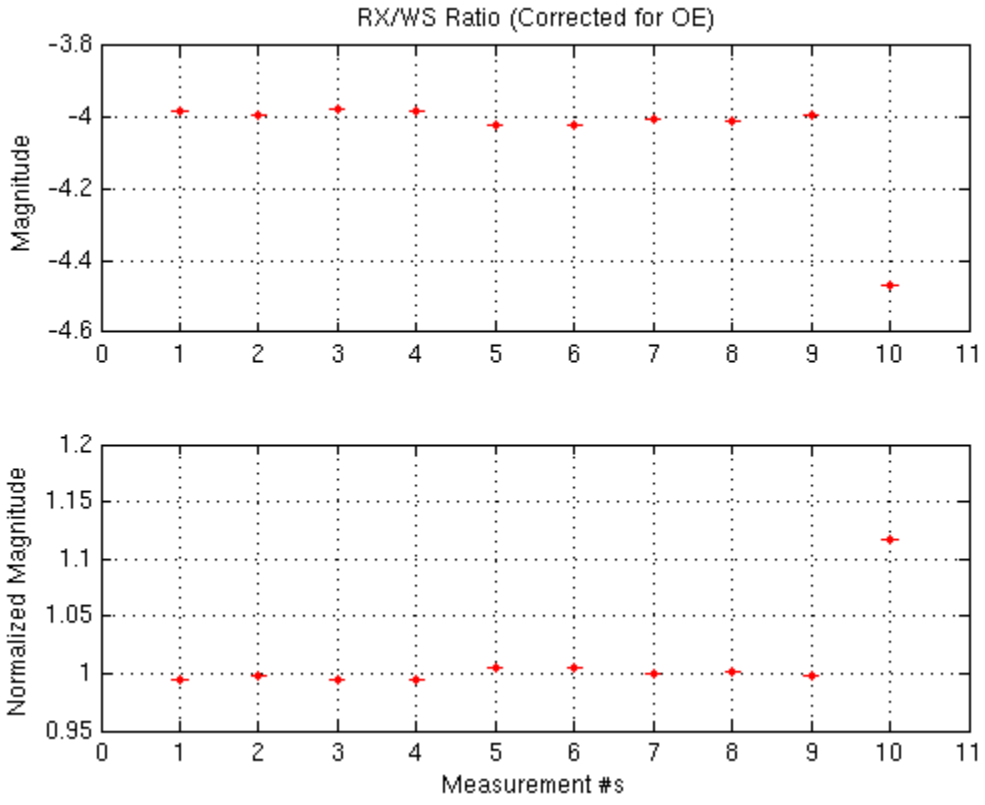
Summary of TX/WS Ratio (Corrected for OE):

Mean value:	*-2.768694*
Standard deviation:	*0.038403*
Standard Error:	*0.012783*
Relative Standard Error:	*0.004617*

RX/WS Ratio (Corrected for OE)

List of Measurements

Date	R_RWc ± SE_{R_RWc}	Normalized
D20150811	-3.980617 ± 0.000087	(1 ± 0.000022)
D20150827	-3.990691 ± 0.000070	(1 ± 0.000018)
D20151013	-3.978905 ± 0.000069	(1 ± 0.000017)
D20151222	-3.980678 ± 0.000070	(1 ± 0.000018)
D20160505	-4.023196 ± 0.000086	(1 ± 0.000021)
D20160628	-4.019117 ± 0.000084	(1 ± 0.000021)
D20160927	-4.002417 ± 0.000092	(1 ± 0.000023)
D20161011	-4.010027 ± 0.000103	(1 ± 0.000026)
D20161031	-3.995710 ± 0.000086	(1 ± 0.000022)
D20161109	-4.467129 ± 0.000243	(1 ± 0.000054)



Summary of RX/WS Ratio (Corrected for OE):

Mean value: -4.001200

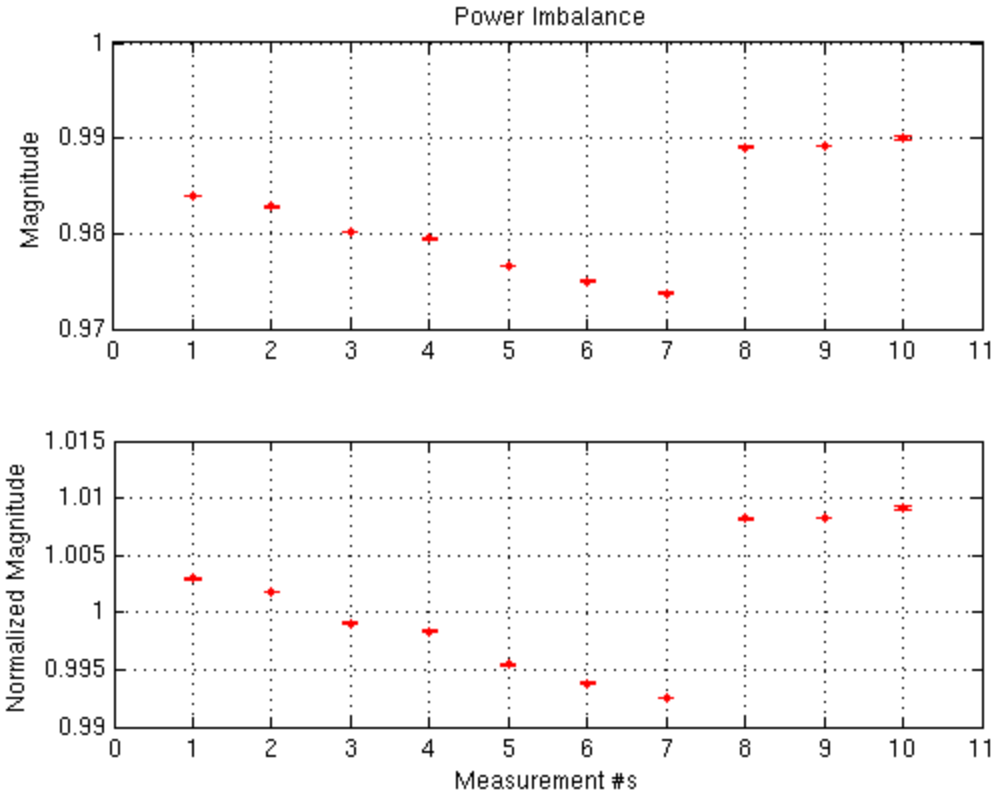
Standard deviation: 0.057136

```
                Standard Error:    0.019018
      Relative Standard Error:    0.004753
```

Power Imbalance

List of Measurements

D20150811	*0.983938 ± 0.000059*	*(1 ± 0.000059)*
D20150827	*0.982844 ± 0.000050*	*(1 ± 0.000051)*
D20151013	*0.980135 ± 0.000048*	*(1 ± 0.000049)*
D20151222	*0.979459 ± 0.000051*	*(1 ± 0.000052)*
D20160505	*0.976585 ± 0.000060*	*(1 ± 0.000062)*
D20160628	*0.974999 ± 0.000057*	*(1 ± 0.000059)*
D20160927	*0.973728 ± 0.000061*	*(1 ± 0.000063)*
D20161011	*0.989087 ± 0.000075*	*(1 ± 0.000075)*
D20161031	*0.989175 ± 0.000057*	*(1 ± 0.000058)*
D20161109	*0.990030 ± 0.000137*	*(1 ± 0.000138)*




```
Summary of  Power Imbalance:
                          Mean value:    0.981045
                  Standard deviation:    0.005261
                      Standard Error:    0.001751
              Relative Standard Error:    0.001785
```

Summary

Description	Value	Std Dev	Std Err	Rel Err:
OE (e)	0.9883	0.0022	0.0007	0.0007
TX/WS (a1a2)	-2.7687	0.0384	0.0128	0.0046
RX/WS (b1b2)	-4.0012	0.0571	0.0190	0.0048
W (a5)	1.0000	----	----	0.0034

Published with MATLAB® 8.0