IMPLEMENTING A2LA'S NEW BUDGET REQUIREMENTS FOR ELECTRICAL AND RF UNCERTAINTIES IN FLUKE MET/CAL[®] PROCEDURES

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INTRO

- The A2LA Measurement Advisory Committee adopted the minimum required contributors that must be included in Electrical & RF Microwave uncertainty budgets which support Calibration and Measurement Capabilities (CMC) on the scope of accreditation. These requirements went into effect for organizations with a renewal date of May 31, 2010 or greater.
- The focus of this paper is to demonstrate one implementation of addressing additional contributors using the Fluke MET/CAL® Platform.

The Problems & Restrictions

- Automated Support for Several UUTs
- Run on Multiple Stations (Different STDs)
- Uncertainties Would Change Over Time
- Calibration Results Must Match Scope of Accreditation (or > Best Measurement)
- Meet A2LA's Specific Requirements
- Limited Time & Resources

A2LA's Newly Adopted Requirements

In their June 2009 newsletter, A2LA specifically outlines a minimum of eight items that must be addressed with two additional items where additional contributors can be included.

ltem#	Name	Requirement	Comments
1-A	Repeatability	Must have	Try getting 10 or more measurements so you have at least 9 DoF
2-A	Reproducibility	If possible	For example, long term data
3-A	Stability/Drift	If possible	See item 6-B
4-A	Others	If possible	
5-B	Reference value from the Accredited, Traceable Certificate	Must have	With this value listed, you have proof traceability
6-B	Absolute Specification for calibration interval	Must have to check if item 5-B is less than item 6-B	Also, if you have long term stability for this parameter for this range, you can set the multiplier/divisor to zero
7-B	Resolutions of standards used	Always list	This is usually small to the rest, but there are exceptions
8-B	Resolution of UUT	Always list	This is usually small to the rest, but there are exceptions
9-B	Environmental effects	Must have, there can be multiple lines for it	This is usually small to the rest, but there are exceptions
10-B	Any other entries that might be helpful for others		

Meeting These Requirements (Using Fluke MET/CAL[®])

- The MET/CAL[®] calibration platform was originally developed as an automated test solution used on the 1720 series controllers
- Built-in uncertainty calculations, accuracy files, and a powerful reporting package simplifies the process of reporting TAR and uncertainty measurement
- MET/CAL[®] out of the box:
 - FSC Codes
 - Can easily be configured
 - (NMEAS=10 & CONF=2.0) plus optional TARGET statements
 - Additional steps will be required

Function Select Codes (FSC)¹

ACC TARGET **VSET & TSET** VSET UUT_RES **VSET NMEAS VSET CONF** VSET COV_FAC VSET S1 VSET S₂ VSET U1-10 **VSET** C1-10 VSET DF1-10 VSET MFILE

Mapping of the Uncertainty Contributors

ltem		MET/CAL Variable
1-A	Repeatability	S1 part of U2 [through repeat measurements, or use U10]
2-A	Reproducibility	U3 reproducibility [in a .ini or measurement code]
3-A	Stability/Drift	U6 Stability drift (from charted values of standards) [in a .ini file or measurement code]
4-A	Others	U4 Other
5-B	Reference Unc	U5 reference value uncertainty [in a .ini file, user ACC file or measurement code]
6-B	Absolute Specification	U1 Absolute spec for calibration interval [in ACC files]
7-B	Resolutions of standards	U7 resolution of Standards [in measurement code]
8-B	Resolution of UUT	S1 part of U2 resolution of UUT
9-B	Environmental effects	U8 U9 Environmental effects [in subprogram what environmental default or enter]
10-	Any other	U10 standard deviation previously determined for runtime nmeas=1 [in measurement code]

In Our Example



- Single Runtime Readings
 - w/Added Contributors from Study (M3003)
- Resolution of UUT
- Published Accuracy of Standards
- Resolution of Standards
- Uncertainties of Calibration of Standards
- Environmental Variations (set to zero)

The Software Model

Main Procedure

UUT Specific

Controls Execution Organize Results Evaluates Pass/Fail

*Supports Interface

Sub Config

Station Specific

Calls Specific STDS Customer Options AC Current Fluke 87 & Resistor

AC Current Fluke 87

AC Volts 34401A & Julie

Supporting .ini Files

	2.004 2.005	VSET VSET	CONF = 2.00 NMEAS = 1		
2.010 2.011 4.003 2.013 2.014	MATH MATH TARGET MATH CALL	M[1] =10e M[19]=1 -m S[30]="Te HVI PFT-1	3 st Voltage= "& M[1] &" Frequence 003 Sub Config	cy= 60"	
	4.001 4.002	LABEL CALL	Measure.Volts.Ac CLSP-Measure.Voltage.AC.(HV)	(34401A & HVA100)	
		4.011 344 # Calculate 4.012 MAT # Return the 4.013 MAT 4.014 MAT 4.016 MAT # Include St 4.017 IF 4.018 MAT 4.019 VSE # Assuming ti 4.024 MAT 4.025 VSE	01 V the Voltage H L[2]=Abs(MEM*100e3) Measured Value and Uncertainty H L[10]=ACCV2("HP 34401 H L[11]=L[2]*.005; L[32] H S[31]="Value= "&L[32] andard Resolutions L[2]<11e3 H MEM=(0.1e-6*1000)/1.7 T U7 = [MEM] he 34401 and HVA100 Calibrated H MEM=L[32]/4 T U5 = [MEM]	60H A", "Volts AC", MEM, 60)*1 2]=RSS_L(10,11) &" Unc= " & L[32] 732 at 4tol or Better	N 2W
	<pre># Repea 4.003 4.004 4.005 4.006 # Over 1 4.007 4.008</pre>	at Measurement MATH MATH VSET Ride 34401A & MATH VSET	<pre>s (From Measurement Study) MEM2=INT(Fld(S[31],2,"Value=") S[1] = "c:\\metcal\\Station\\E MEM = RIF(S[1],"Repeatability" U10 = [MEM] HV100 Cal Uncertainty MEM = RIF(S[1],"STDCalUnc",MEM U5 = [MEM]</pre>	/10e3)*10e3 EMU\\34401&HVA100.ini" ',MEM2) 42)	
2.015 2.016 2.017 2.018 2.019	MATH VSET ACC MATH MEMC	M[9]=Fld(UUT_RES = 10.000kV MEM=Fld(S kV	S[31],2,"Unc=")/1e3 100 M9U [31],2,"Value=")/1e3 M19U		

This Is Where You Say WOW!

- U1 Published Specs of STD
- U2 UUT Resolutions
- U5 Ref Unc of STD

- U7-Resolution of STD
- U9 Is Set To Zero

- (Must Have) (Always List) (Must Have) (Always List) (Must Have)
- U10 Repeatability From Study (Must Have)

Reviewing the MFILE

Once you have all your uncertainty contributors added to your program, you can verify all the contributors are there.

#=====	=====	
1.002	VSET	NMEAS= 1
1.003	VSET	MFILE=C:\METCAL\PROC\Tester\TESTER.CSV

	A	F	G	Н	I	J	K	L	М
1	Step Number	UUT Indicated	System Actual	Expanded Uncertainty	Standard Uncertainty	Confidence	Coverage	F	System Accuracy
2	1.011	100	103.4	1.135796343	0.567898172	2	2		1
3	2.004	100	103.32	1.135796343	0.567898172	2	2		1
4	3.004	100	102.16	1.135796343	0.567898172	2	2		1
5	4.004	100	102.13	1.135796343	0.567898172	2	2		1
6	5.004	100	101.1	1.135796343	0.567898172	2	2		1
7	6.004	100	101.08	1.135796343	0.567898172	2	2		1
8	7.004	100	100.61	1.135796343	0.567898172	2	2		1
9	8.004	100	100.59	1.135796343	0.567898172	2	2		1
10									
11									
12									

N	0	р	Q	R	S		Т	U	V	W	Х	Y	Ζ	AA	BA	BC	BD
S1	S2	Standard Deviation	RSS	U1	U2		U3	U4	U5	U6	U7	U8	U9	U10	UUT Resolution	Number of Measurements	Value 1
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	103.4
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	103.32
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	102.16
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	102.13
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	101.1
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	101.08
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	100.61
0	0.002886751		0.567898172	0.5	0.002	2886751	0	0	0.25	0	0	0	0	0.1	0.01	1	100.59

Guard Bands and Z540.3 Checks

- MET/CAL[®] contains flexible guard banding commands
- Post calibration analysis of risk compliance is more practical
- Method Six of Z540.3 handbook

Test Description	<u>True Value</u>	<u>T est Result</u> <u>Units</u>	Lower Limit	<u>Upper Limit</u>	Exp Uncert			<u>TAR</u>
.00 units		103.400 _units	96.000	104.000	1.1e+000	_units	>P FA	4.00
00 units		103.320 _units	96.000	104.000	1.1e+000	- ^{units}		4.00
00 units		102.160 _units	97.000	103.000	1.1e+000	_units	PFA>	3.00
00 units		102.130 _units	97.000	103.000	1.1e+000	_units		3.00
00 units		101.100 _units	98.000	102.000	1.1e+000	_units	PFA>	2.00
00 units		101.080 _units	98.000	102.000	1.1e+000	- ^{units}		2.00
00 units		100.610 _units	98.900	101.100	1.1e+000	_units	PFA>	1.10
.00 units		100.590 _units	98.900	101.100	1.1e+000	_units		1.10

Summary

- A2LA's new requirements for uncertainty budgets and the 2% false except requirements in Z540.3 may require labs to make modifications to their existing automated test systems
- This paper should serve as a guide for developers writing MET/CAL[®] procedures and auditors inspecting calibration labs

Questions and Answers



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