

**ESP430CE1A, active energy measurement test conditions and accuracy,  $T_A = 25^\circ\text{C}$  (See Note 1)**

- $f_{\text{ACLK}} = 32,768 \text{ Hz}$  (watch crystal)
- $f_{\text{MCLK}} = 4.194\text{MHz}$  (FLL+)
- $f_{\text{SD16}} = f_{\text{MCLK}}/4 = 1.049\text{MHz}$
- Single point calibration at  $I = 10 \text{ A}$ ,  $\text{PF} = 0.5$  lagging
- Measurements according to IEC1036
- Input conditions (unless otherwise noted):  
 $I_B = 6 \text{ A}$ ,  $I_{\text{MAX}} = n * I_B = 60 \text{ A}$ ,  $n = 10$ ,  $V_N = 230 \text{ V}$ ,  $f_{\text{MAINS}} = 50 \text{ Hz}$

PARAMETER	TEST CONDITIONS	$V_{\text{CC}}$	MIN	TYP	MAX	UNIT
Maximum error	$I = 0.05 * I_B$ , $V = V_N$ , $\text{PF} = 1.0$	3 V				%
	$I = 0.1 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 1.0$					
	$I = 0.1 * I_B$ , $V = V_N$ , $\text{PF} = 0.5$ lagging					
	$I = 0.2 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 0.5$ lagging					
	$I = 0.1 * I_B$ , $V = V_N$ , $\text{PF} = 0.8$ leading					
	$I = 0.2 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 0.8$ leading					
	$I = 0.2 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 0.25$ lagging					
	V1 SD16GAINx = 1 I1 SD16GAINx = 1  See Figure 14: $R1 = 0\Omega$ , $R_B = 12.4\Omega$					

- Input conditions (unless otherwise noted):  
 $I_B = 10 \text{ A}$ ,  $I_{\text{MAX}} = n * I_B = 60 \text{ A}$ ,  $n = 6$ ,  $V_N = 230 \text{ V}$ ,  $f_{\text{MAINS}} = 50 \text{ Hz}$

PARAMETER	TEST CONDITIONS	$V_{\text{CC}}$	MIN	TYP	MAX	UNIT
Maximum error	$I = 0.05 * I_B$ , $V = V_N$ , $\text{PF} = 1.0$	3 V				%
	$I = 0.1 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 1.0$					
	$I = 0.1 * I_B$ , $V = V_N$ , $\text{PF} = 0.5$ lagging					
	$I = 0.2 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 0.5$ lagging					
	$I = 0.1 * I_B$ , $V = V_N$ , $\text{PF} = 0.8$ leading					
	$I = 0.2 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 0.8$ leading					
	$I = 0.2 * I_B$ to $I_{\text{MAX}}$ , $V = V_N$ , $\text{PF} = 0.25$ lagging					
	V1 SD16GAINx = 1 I1 SD16GAINx = 32					

- NOTES: 1. Measurements performed using complete hardware solution. Error shown contain temperature dependencies of all components including the MSP430FE42xA, crystal, and discrete components.
2. I1 SD16GAIN x = 1,4: CT part number = T60404-E4624-X101 (Vacuumschmelze)  
 I1 SD16GAINx = 8: shunt part number = A-H2-R005-F1-K2-0.1 (Isabellenhütte Heusler GmbH KG)  
 I1 SD16GAINx = 32: shunt part number = BVO-M-R0002-5.0 (Isabellenhütte Heusler GmbH KG)

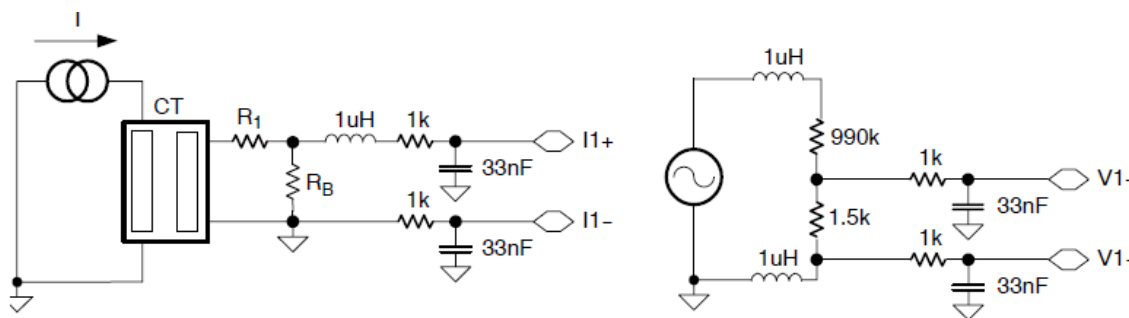


Figure 14. Energy Measurement Test Circuitry (SD16GAINx = 1)

ESP430CE1A (I1 SD16GAINx = 1) typical characteristics (see Note A)

MEASUREMENT ERROR AS % OF READING  
( $T_A = 25^\circ\text{C}$ )

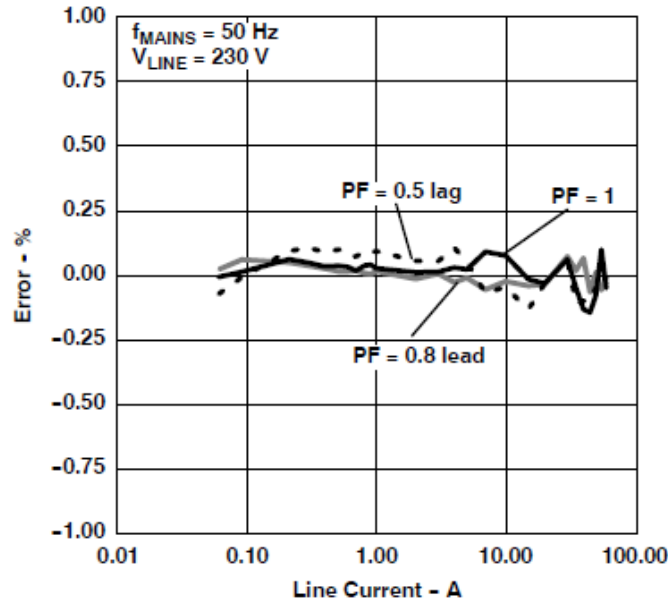


Figure 15

MEASUREMENT ERROR AS % OF READING  
( $T_A = -40^\circ\text{C}$ )

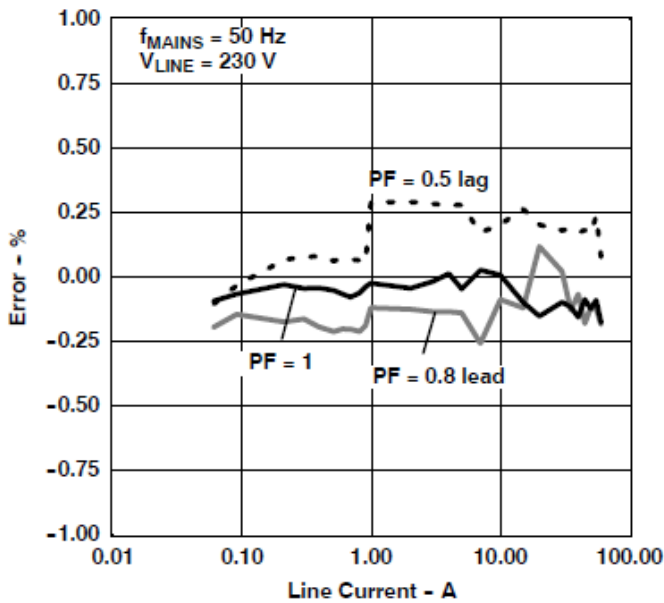


Figure 16

MEASUREMENT ERROR AS % OF READING  
( $T_A = 85^\circ\text{C}$ )

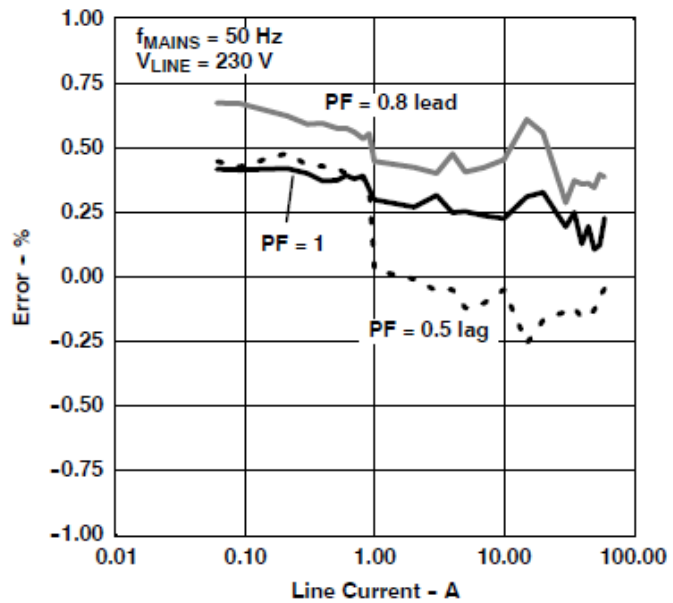


Figure 17

NOTE A. Results corrected for typical phase error of CT used ( $-40^\circ\text{C}$  to  $25^\circ\text{C}$ :  $-0.7^\circ$ ;  $25^\circ\text{C}$  to  $85^\circ\text{C}$ :  $+0.5^\circ$ ).  
See Figure 14 for test circuitry: CT part number = T60404-E4624-X101 (Vacuumschmelze),  $R_1 = 0 \Omega$ ,  $R_B = 12.4 \Omega$ .

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