

Short Introduction

A major operational risk that can occur with a current transformer (CT) is when the secondary circuit has an open circuit condition whereas the primary circuit is still energized. This could happen during a routine maintenance of the burden or because of damages on leads or contacts. High voltage transients could damage the CT winding which may lead to further destructions.

With the HVR Current Transformer Protection Unit (CTPU) you can protect your CT against these operational risks.

Construction of the HVR "CTPU"

On the right side of the page two can see both available construction drawings of a 3-Phase HVR "CTPU". One with 80mm discs and another one with 150mm discs. Each varistor disc is connected in parallel with a thermostatic switch, which is mounted onto a heat sink plate. The second thermostatic switch is an option and can be used for remote monitoring.

Operation of the HVR "CTPU"

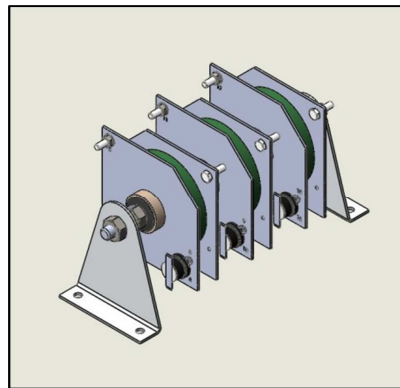
During normal operating conditions, with the burden connected, the rms current through the HVR varistor discs is very low. In case of an open circuit condition the secondary current will pass through the HVR disc. The connected thermostatic switch will now manage the thermal cycling as long as the CT is in open circuit condition. The optional second thermostatic switch could be used for remote monitoring.

Connection of the HVR "CTPU"

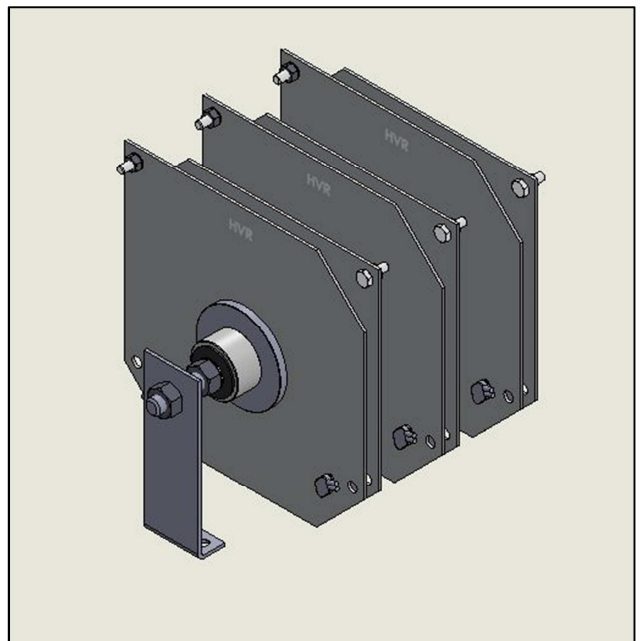
On page 02.14 you can see a drawing of an HVR "CTPU" connected across the secondary winding of the CT parallel with the burden. To prevent a accidentally disconnection of the "CTPU" during maintenance it is recommended to install the "CTPU" as close as possible to the CT.

Construction of the 3-Phase "CTPU 8xx"

HVR-CTPU8xx/3E/T



HVR-CTPU15xx/3E/T



Choosing the Correct HVR CTPU

There are 12 standard 6 different **HVR CTPU8xx** and also 6 different **HVR CTPU15xx** specifications which can be used for a wide range of burdens and operating conditions. These are referenced by either a number. For simplicity the procedure for selecting the correct HVR CTPU has been broken down into the following 5 steps:

Step 1

- Identify the relevant table for the application.
- For metering applications refer to **Table 1.x**.
- For protection applications refer to **Table 2..x**

Step 2

- Select the HVR CTPU specification.
- For metering applications select the HVR CTPU according to the CT Rated Secondary Current and the CT Burden of the system.
- For protection applications select the HVR CTPU according to the CT Rated Secondary Current, the Maximum Fault Current as a Multiple (X-Times) of Rated Current and the CT Burden of the system.

Step 3

- Check the leakage current through the HVR CTPU with the burden connected. Using **Table 3.x**, refer to the HVR CTPU derived from steps 1 and 2 above.
- Identify the secondary voltage that appears across the CT under normal operation and cross check that the leakage current will not affect the measurement accuracy.
- In addition, check that this current can flow for an infinite time.
- Next refer to the secondary voltage that appears across the CT under fault conditions and cross check that the higher level of leakage current will still not affect the measurement accuracy.
- In this case the current must be able to flow for a period of time greater than the maximum fault duration. If the values and times are acceptable proceed to **step 4**. If they are outside of the requirements please contact the HVR team.

Step 4

- Check the peak voltage which the CTPU limits the open circuited system to.
- Use **Table 4.x** to check that the chosen HVR CTPU will limit the voltage to a level that will not damage the CT.

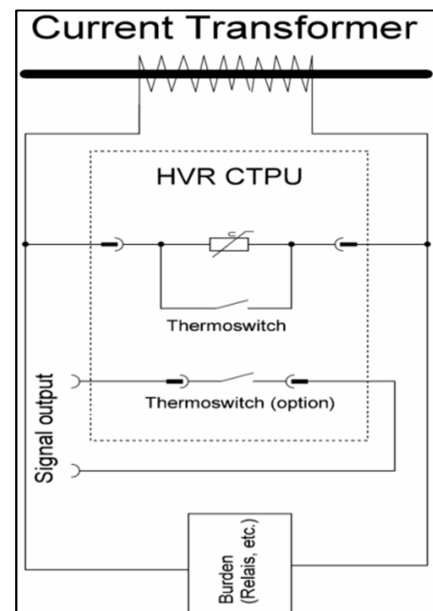
Step 5

- Check if this CTPU is appropriate to bear the failure current for the Failure time. If not, please use a CTPU with a bigger disc diameter.

Step 6

- Confirm if a second thermostatic switch is required.
- Specify whether a second thermostatic switch is required for remote monitoring/ signaling purposes.

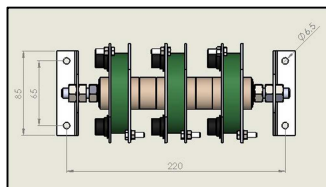
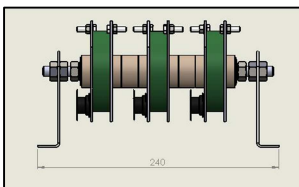
Electrical Connection of the "CTPU"



Specification for Metering CT Applications

Table 1.1 - HVR CTPU 8xx

CT Rated Secondary Current (Arms)	2,5VA	5VA	10VA	15VA	30VA
10	821	821	821	821	821
5	821	821	821	821	821
1	821	821	822	822	822
0,5	821	821	822	822	824

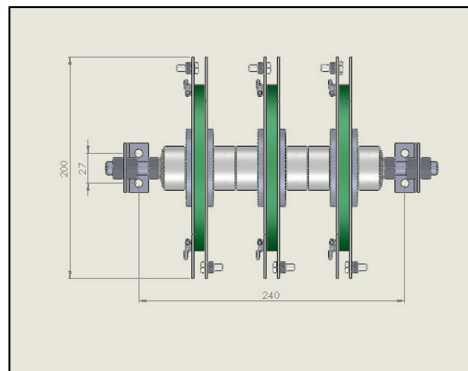
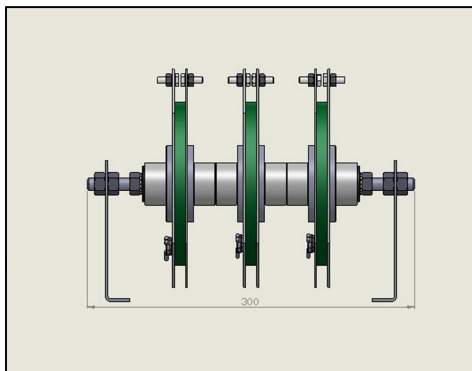


Note: HVR-CTPU8xx/3E/T

Table 1.2 - HVR CTPU 15xx

CT Rated Secondary Current (Arms)	2,5VA	5VA	10VA	15VA	30VA	60VA	120VA	240VA
10	1521	1521	1521	1521	1521	1522	1522	1522
5	1521	1521	1521	1521	1522	1522	1522	1524
1	1521	1521	1522	1522	1522	1523	1525	1526
0,5	1521	1522	1522	1522	1523	1525	1526	

Note: It is assumed that the CT and the HVR CTPU will not be expected to maintain the metering accuracy above twice full load



Specification for Protection CT Applications

Table 2.1 - HVR CTPU 8xx

CT Rated Secondary Current (Arms)	Max. Fault Current		CT Burden (VA)				
	X-Times	A	2,5VA	5VA	10VA	15VA	30VA
10	5	50	821	821	821	821	821
	10	100	821	821	821	821	822
	15	150	821	821	821	821	822
	20	200	821	821	821	822	822
5	5	25	821	821	821	822	822
	10	50	821	821	821	822	822
	15	75	821	821	821	822	822
	20	100	821	821	822	822	823
1	5	5	821	822	822	822	824
	10	10	821	822	823	824	825
	15	15	822	822	823	824	825
	20	20	822	823	825	825	826
0,5	5	2,5	822	822	823	824	825
	10	5	822	823	825	825	826
	15	7,5	822	823	825	825	826
	20	10	823	825	826	826	

Note: It is assumed that the measurement error is not greater than 1% at indicated multiple of rated Current

Specification for Protection CT Applications

Table 2.2 - HVR CTPU 15xx

CT Rated Secondary Current (Arms)	Max. Fault Current		CT Burden (VA)							
	X-Times	A	2,5VA	5VA	10VA	15VA	30VA	60VA	120VA	240VA
10	5	50	1521	1521	1521	1521	1521	1522	1522	1524
	10	100	1521	1521	1521	1521	1522	1522	1523	1525
	15	150	1521	1521	1521	1521	1522	1522	1523	1525
	20	200	1521	1521	1522	1522	1522	1523	1525	1526
5	5	25	1521	1521	1521	1521	1522	1522	1525	1526
	10	50	1521	1521	1522	1522	1522	1523	1525	1526
	15	75	1521	1521	1522	1522	1522	1523	1525	1526
	20	100	1521	1522	1522	1522	1523	1525	1526	
1	5	5	1521	1522	1522	1522	1523	1525	1526	
	10	10	1522	1522	1523	1523	1525	1526		
	15	15	1522	1522	1523	1523	1525	1526		
	20	20	1522	1523	1524	1525	1526			
0,5	5	2,5	1522	1522	1523	1523	1525			
	10	5	1522	1523	1524	1525	1526			
	15	7,5	1522	1523	1525	1525	1526			
	20	10	1523	1524	1526	1526				

Note: It is assumed that the measurement error is not greater than 1% at indicated multiple of rated Current

Leakage Current through the with the CT Burden Connected

Table 3.1 - HVR CTPU 8xx

	821		822		823		824		825		826	
Voltage (Vacrms)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)
10	1,9	∞	<1	∞	<1	∞	<1	∞	<1	∞	<1	∞
20	32	∞	<1	∞	<1	∞	<1	∞	<1	∞	<1	∞
30	150	∞	2,5	∞	<1	∞	<1	∞	<1	∞	<1	∞
40	540	251	7,8	∞	<1	∞	<1	∞	<1	∞	<1	∞
50	1400	78	18	∞	<1	∞	<1	∞	<1	∞	<1	∞
75	6500	11	72	∞	5,5	∞	1,6	∞	<1	∞	<1	∞
100	16000	3,4	180	∞	15	∞	3,8	∞	<1	∞	<1	∞
150	30000	1,2	1300	74	72	∞	25	∞	<1	∞	<1	∞
200	75000	0,4	4400	16	220	376	73	∞	<1	∞	<1	∞
250	160000	0,1	10000	5,8	580	114	170	392	<1	∞	<1	∞
300	320000	0,06	18000	2,7	1400	39	380	146	1,6	∞	<1	∞
350	700000	0,02	27000	1,5	2500	19	760	63	3,8	∞	<1	∞
400	1300000	0,01	40000	0,9	4200	10	1400	30	8	∞	<1	∞
500			70000	0,4	9500	3,5	2800	12	32	∞	4,6	∞
600			130000	0,2	18000	1,5	6000	4,6	140	215	8	∞
700			210000	0,1	28000	0,8	10000	2,4	390	66	21	∞
800			300000	0,06	38000	0,5	13000	1,6	750	30	43	∞
900			400000	0,04	50000	0,4	20000	0,9	1650	12	70	353
1000					70000	0,2	26000	0,6	2600	6,9	150	148
1100					90000	0,2	36000	0,4	4500	3,6	220	92
1200					115000	0,1	47000	0,3	7000	2,2	500	37
1400					200000	0,06	90000	0,1	15000	0,9	1700	9,3
1600					300000	0,03	130000	0,08	25000	0,5	3000	4,6
1800							200000	0,05	35000	0,3	5000	2,5
2000							250000	0,03	55000	0,2	9000	1,2
2500									120000	0,06	20000	0,4
3000									180000	0,03	35000	0,2
3500									280000	0,02	60000	0,1
4000									400000	0,01	80000	0,07
5000											150000	0,03
7500											310000	0,01



Leakage current which can be continuously dissipated

Leakage current which can be dissipated for the time period indicated

Note: Table 3.1 is based on a max. ambient temp. of 40°C

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Leakage Current through the with the CT Burden Connected

Table 3.2 - HVR CTPU 15xx

	1521		1522		1523		1524		1525		1526	
Voltage (Vacrms)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)	Current (mA)	Load Time (sec.)
10	250	∞	<1	∞	<1	∞	<1	∞	<1	∞	<1	∞
20	600	∞	<1	∞	<1	∞	<1	∞	<1	∞	<1	∞
30	1300	1234	2,8	∞	<1	∞	<1	∞	<1	∞	<1	∞
40	2000	602	9	∞	<1	∞	<1	∞	<1	∞	<1	∞
50	3400	283	18	∞	<1	∞	<1	∞	<1	∞	<1	∞
75	8500	75	85	∞	3,2	∞	<1	∞	<1	∞	<1	∞
100	14000	34	300	∞	10	∞	<1	∞	<1	∞	<1	∞
150	35000	9,2	1400	229	50	∞	8,5	∞	1,3	∞	<1	∞
200	64000	3,8	4500	53	180	∞	26	∞	4,6	∞	<1	∞
250	98000	2,0	12000	16	350	699	110	∞	10	∞	1,2	∞
300	150000	1,1	20000	8,0	950	214	340	599	20	∞	2,1	∞
350	200000	0,69	30000	4,6	1700	103	800	218	38	∞	3,8	∞
400	230000	0,52	45000	2,7	2600	59	1300	118	60	∞	6	∞
500	380000	0,25	85000	1,1	6000	20	3600	34	160	1143	15	∞
600	540000	0,15	150000	0,53	12000	8,5	7500	14	350	435	31	∞
700	760000	0,090	220000	0,31	18000	4,9	13000	6,7	660	198	55	∞
800	950000	0,063	350000	0,17	24000	3,2	18000	4,2	1000	114	80	∞
900	1300000	0,041	450000	0,12	32000	2,1	21000	3,2	1500	68	130	782
1000	1650000	0,029	650000	0,074	50000	1,2	28000	2,2	2100	44	190	481
1100	2350000	0,019	850000	0,051	70000	0,79	35000	1,6	2800	30	280	297
1200	3500000	0,011			120000	0,42	41000	1,2	4000	19	420	181
1400	8000000	0,0043			170000	0,26	140000	0,31	8000	8,2	900	73
1600					260000	0,15	180000	0,21	13000	4,4	1600	36
1800					400000	0,085	250000	0,14	18000	2,8	2600	20
2000					500000	0,061	350000	0,087	25000	1,8	4000	11
2500					1000000	0,024			55000	0,67	7500	4,9
3000											15000	2,0
3500											25000	1,0
4000											38000	0,60
5000											82000	0,22
7500												



Leakage current which can be continuously dissipated

Leakage current which can be dissipated for the time period indicated

Note: Table 3.2 is based on a max. ambient temp. of 40°C

CURRENT TRANSFORMER PROTECTION UNIT

Table 4.1 - HVR CTPU 8xx

Peak Voltage across the Open Circuit CT with the CTPU Connected

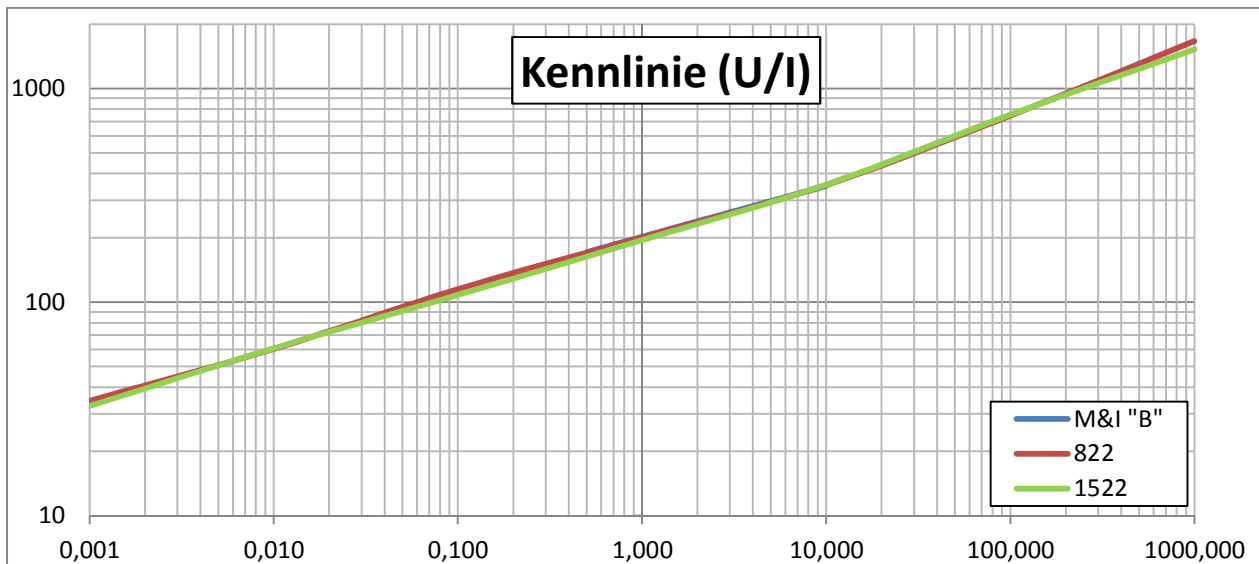
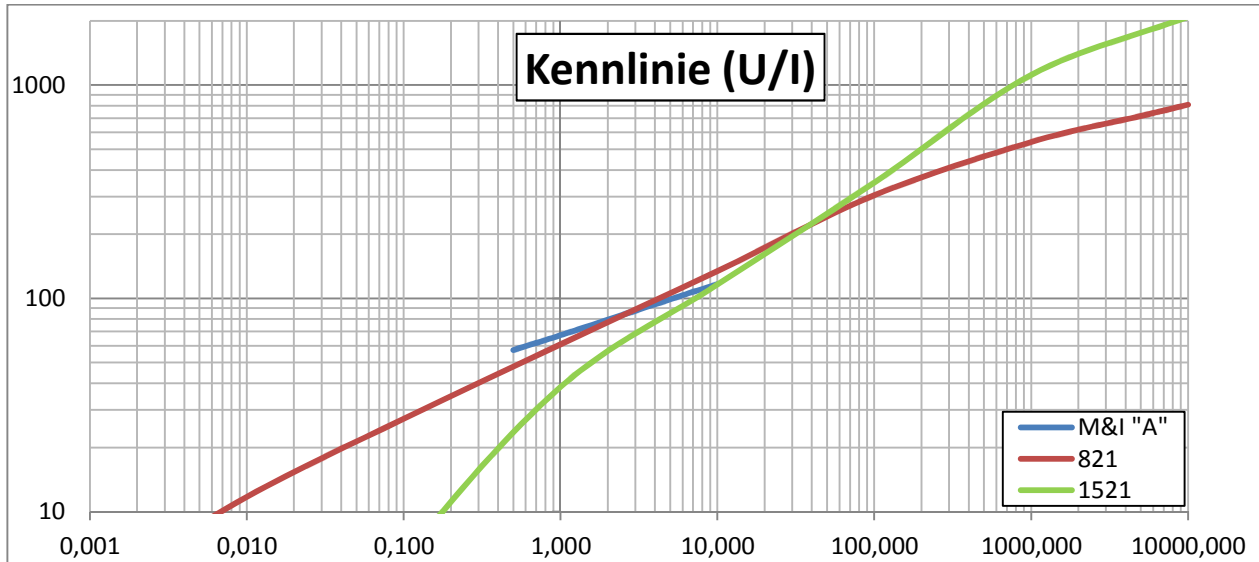
CT-Secondary Load Current (Arms)	821	822	823	824	825	826
	Voltage (Vpeak)					
10	190	499	1008	1403	2489	4525
5	156	424	856	1174	2263	3606
1	86	284	574	758	1598	2758
0,5	66	247	495	636	1457	2546

Table 4.2 - HVR CTPU 15xx

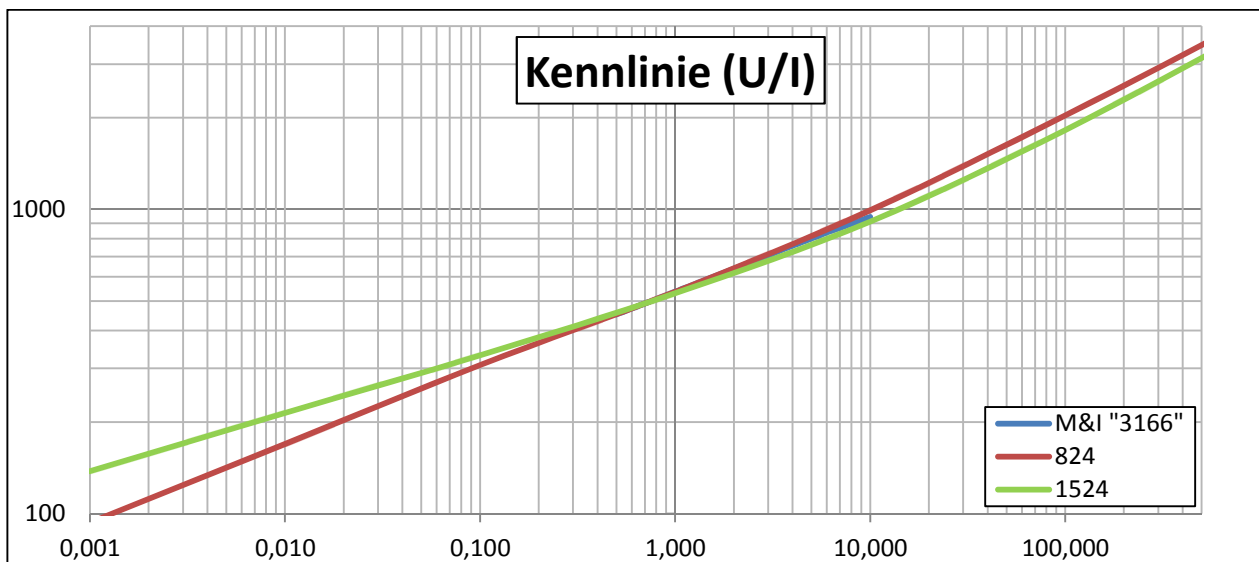
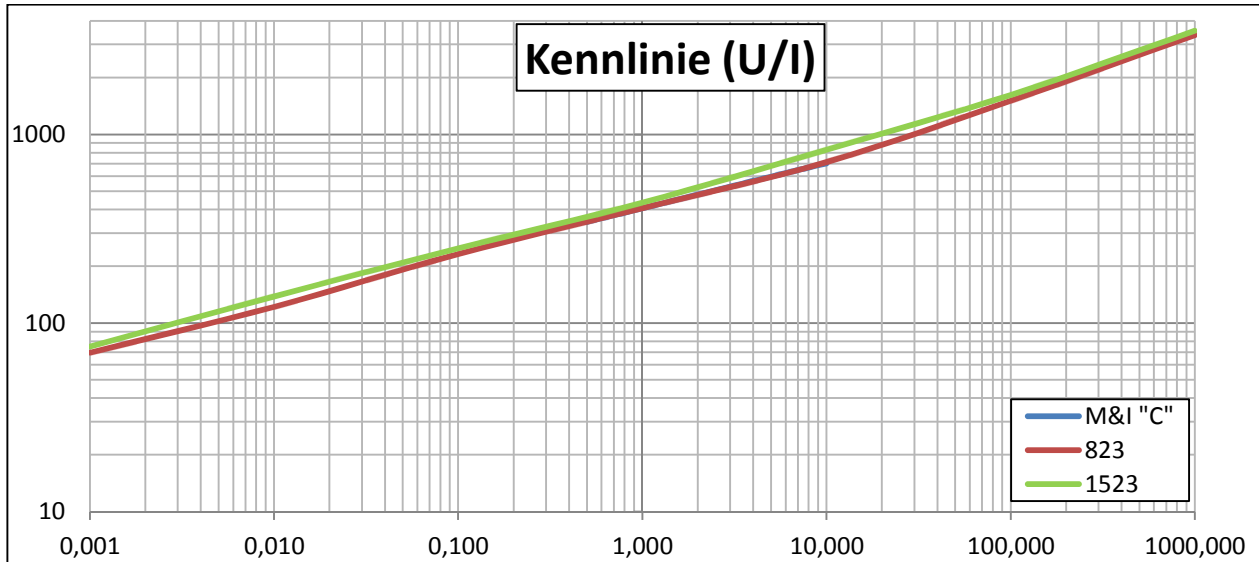
Peak Voltage across the Open Circuit CT with the CTPU Connected

CT-Sekundärstrom (Arms)	1521	1522	1523	1524	1525	1526
	Voltage (Vpeak)					
10	116	355	830	910	2100	3819
5	85	295	690	760	1800	3160
1	38	195	435	530	1100	2000
0,5	24	170	370	450	920	1750

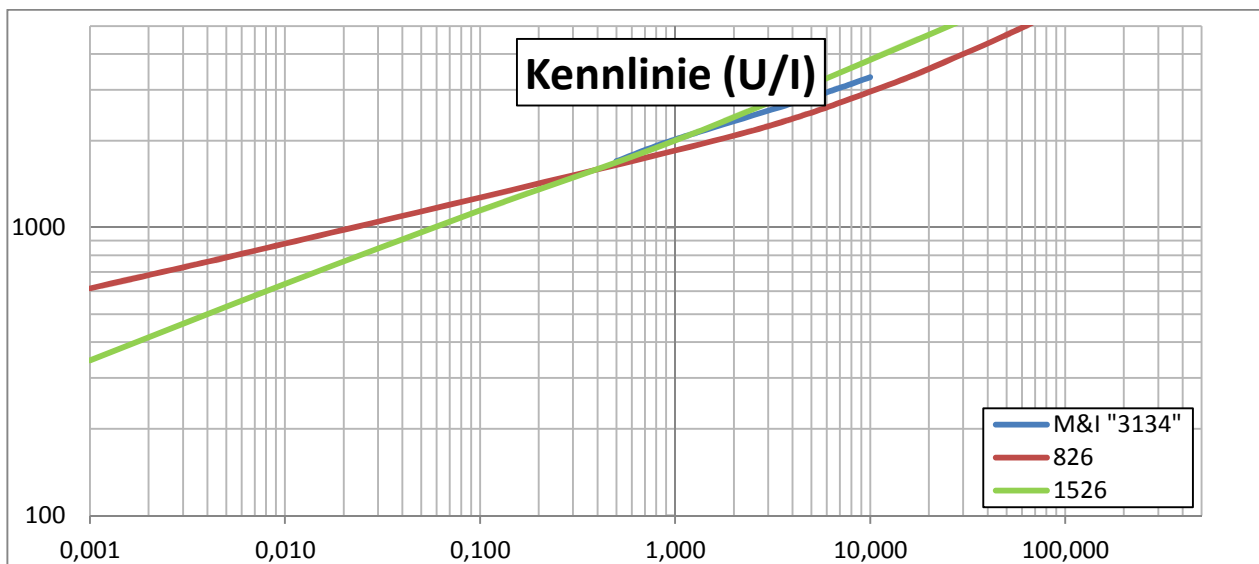
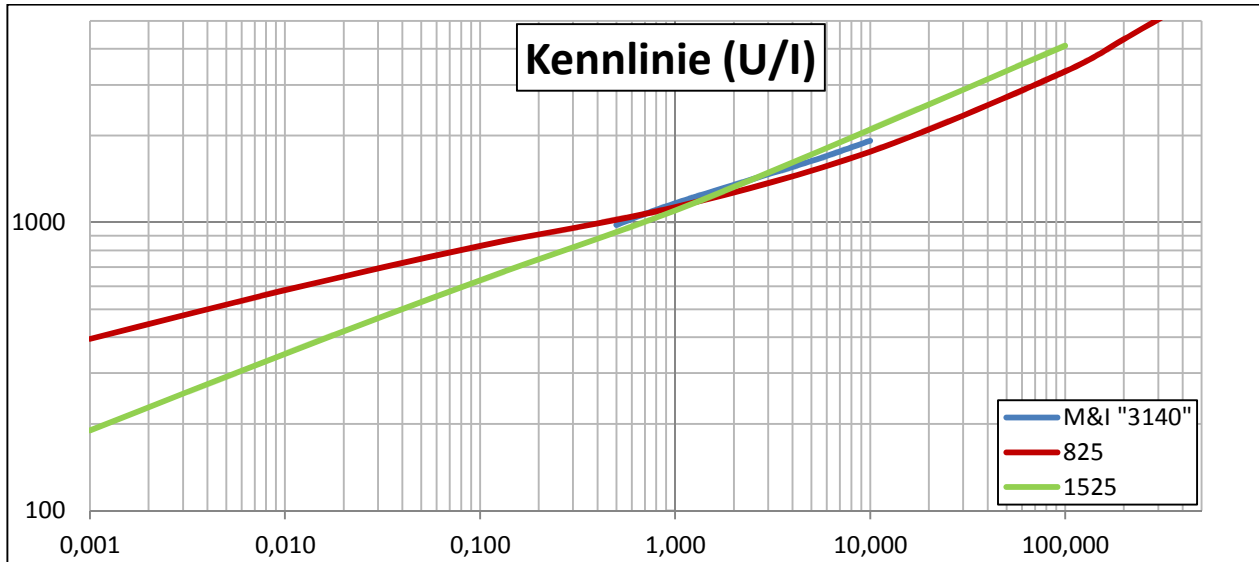
U/I Characteristic of HVR CTPU Varistor Discs compared to M&I CTPU



U/I Characteristic of HVR CTPU Varistor Discs compared to M&I CTPU



U/I Characteristic of HVR CTPU Varistor Discs compared to M&I CTPU



Cross-Reference HVR-CTPU8xx to M&I-CTPU

Table 5.1

HVR-Type		Option 2. Thermostat (NO Normally Open)	M&I Type
CTPU821/1	1-phase Typ	/T	A
CTPU821/2E	2-phase Typ	/T	
CTPU821/3E	3-phase Typ	/T	
CTPU821/4E	4-phase Typ	/T	
CTPU821/5E	5-phase Typ	/T	
CTPU822/1	1-phase Typ	/T	B
CTPU822/2E	2-phase Typ	/T	
CTPU822/3E	3-phase Typ	/T	
CTPU822/4E	4-phase Typ	/T	
CTPU822/5E	5-phase Typ	/T	
CTPU823/1	1-phase Typ	/T	C
CTPU823/2E	2-phase Typ	/T	
CTPU823/3E	3-phase Typ	/T	
CTPU823/4E	4-phase Typ	/T	
CTPU823/5E	5-phase Typ	/T	
CTPU824/1	1-phase Typ	/T	3166
CTPU824/2E	2-phase Typ	/T	
CTPU824/3E	3-phase Typ	/T	
CTPU824/4E	4-phase Typ	/T	
CTPU824/5E	5-phase Typ	/T	
CTPU825/1	1-phase Typ	/T	3140
CTPU825/2E	2-phase Typ	/T	
CTPU825/3E	3-phase Typ	/T	
CTPU825/4E	4-phase Typ	/T	
CTPU825/5E	5-phase Typ	/T	
CTPU826/1	1-phase Typ	/T	3134
CTPU826/2E	2-phase Typ	/T	3217
CTPU826/3E	3-phase Typ	/T	3223
CTPU826/4E	4-phase Typ	/T	
CTPU826/5E	5-phase Typ	/T	

HVR-CTPU15xx

Table 5.2

HVR-Type		Option 2. Thermostat (NO Normally Open)	M&I Type
CTPU1521/1	1-phase Typ	/T	None
CTPU1521/2E	2-phase Typ	/T	None
CTPU1521/3E	3-phase Typ	/T	None
CTPU1521/4E	4-phase Typ	/T	None
CTPU1521/5E	5-phase Typ	/T	None
CTPU1522/1	1-phase Typ	/T	None
CTPU1522/2E	2-phase Typ	/T	None
CTPU1522/3E	3-phase Typ	/T	None
CTPU1522/4E	4-phase Typ	/T	None
CTPU1522/5E	5-phase Typ	/T	None
CTPU1523/1	1-phase Typ	/T	None
CTPU1523/2E	2-phase Typ	/T	None
CTPU1523/3E	3-phase Typ	/T	None
CTPU1523/4E	4-phase Typ	/T	None
CTPU1523/5E	5-phase Typ	/T	None
CTPU1524/1	1-phase Typ	/T	None
CTPU1524/2E	2-phase Typ	/T	None
CTPU1524/3E	3-phase Typ	/T	None
CTPU1524/4E	4-phase Typ	/T	None
CTPU1524/5E	5-phase Typ		None
CTPU1525/1	1-phase Typ	/T	None
CTPU1525/2E	2-phase Typ	/T	None
CTPU1525/3E	3-phase Typ	/T	None
CTPU1525/4E	4-phase Typ	/T	None
CTPU1525/5E	5-phase Typ	/T	None
CTPU1526/1	1-phase Typ	/T	None
CTPU1526/2E	2-phase Typ	/T	None
CTPU1526/3E	3-phase Typ	/T	None
CTPU1526/4E	4-phase Typ	/T	None
CTPU1526/5E	5-phase Typ	/T	None