ULLTRA™ High Performance Transformers

Not all Energy Efficient Transformers are created equal

Ultra Low Loss TRAnsformers, ULLTRA, are designed to deliver more energy savings than any other transformer on the market. The result is a high performing transformer that offers the highest efficiency in the industry under either linear or non-linear loading and maintains these high efficiency levels at not only 35% loading but over a wide load range.

Although other energy efficient transformers on the market may meet new, more demanding standards such as defined by the Department of Energy (DOE) in the Code of Federal Regulations (CFR) 431, these standards only restrict losses under linear loading and at 35% load levels. By designing based on Weighted Average Efficiency, ULLTRA High Performance transformers outperform other energy efficient transformers over the entire operating range but especially at mid to high load levels. They exceed DOE 2016 efficiency levels at their peak performance loading of 50%, assuring the most energy savings under any loading.

Applications

A perfect solution for any application where energy efficiency and lower life cycle costs are critical – K-12 and Higher Education, Government, Healthcare, Commercial, Industrial and LEED buildings.

Applications that expect heavier loads such as Data Centers, Solar and other Alternative Energy projects, will benefit from ULLTRA Series Transformers ability to maximize savings under ANY load and for ANY load profile.

Quicker PAYBACK PERIOD

Mirus offers eVALUATOR™, a proprietary and complimentary payback analysis tool for transformers. By entering some simple data into the program it calculates accurate payback and energy savings and takes into account the effects of harmonics created by non-linear loading.

ULLTRA improves paybacks by allowing for 'Right Sizing'. Right Sizing takes into account that a transformer designed to maintain high efficiencies under heavy and non-linear loading can be significantly smaller than one optimized for light loading. The transformer can be sized to operate at heavier load levels, where it is better utilized, without sacrificing energy efficiency. This not only saves energy and the associated operating costs, but also saves on initial costs. In addition, smaller transformers require less materials, such as steel and copper, providing further environmental benefit.

Paybacks are particularly good in applications where both light and heavy loading can be expected. For example, transformers used for alternative energy sources, such as Solar Power, will be nearly fully loaded during peak daylight hours but very lightly loaded at night.

Real-world Tested. REAL-WORLD PERFORMANCE

Like all of Mirus' products, ULLTRA High Performance Transformers undergo rigorous real-world tests in Mirus' own Harmonics & Energy Lab. Load profiles are matched to real-world conditions. With the largest non-linear load bank in the industry, Mirus can test transformers up to 225 kVA under full non-linear load conditions to ensure the promised energy savings are realized.

U.S. DEPARTMENT OF ENERGY

DOE 2016 Compliant

MIRUS International Inc.

Weighted Average Efficiency

Since transformer loading can vary broadly, it seems misguided to optimize efficiency at only a single load level. By applying a limit at only 35% loading, manufacturers are encouraged to reduce costs by designing transformers that have higher losses at higher loading levels. Defining a load-based weighted average efficiency equation for commercial transformers provides a better, more energy efficient, cost effective solution for the end user. The initial installation cost of a transformer is small when compared to the "total cost of ownership" which includes the energy component.

Mirus offers two ULLTRA transformer models with designs based on weighted average efficiency; ULLTRA-L for light loads and ULLTRA for a wider load range. To achieve optimal energy efficiency, both are designed to exceed DOE 2016 efficiency requirements at 35% loading but also at an average weighted efficiency that is appropriate for the application.

For light loading:

$$\eta_{TranLL} = 0.05\times\eta_{10\%load} + 0.35\times\eta_{25\%load} + 0.52\times\eta_{35\%load} + 0.05\times\eta_{50\%load} + 0.03\times\eta_{65\%load} + 0.0\times\eta_{100\%load}$$

For wider load range:

$$\eta_{TranHL} = 0.01\times\eta_{10\%load} + 0.03\times\eta_{25\%load} + 0.22\times\eta_{35\%load} + 0.5\times\eta_{50\%load} + 0.22\times\eta_{65\%load} + 0.02\times\eta_{100\%load}$$

Where, ηXX%load = transformer efficiency at XX% load

A comparison of efficiencies on a 75 kVA transformer at various load levels highlights the efficiency improvements of the ULLTRA transformer over standard DOE 2016 designs.

75 kVA Mirus ULL & ULL-L vs typical DOE 2016 Efficiencies

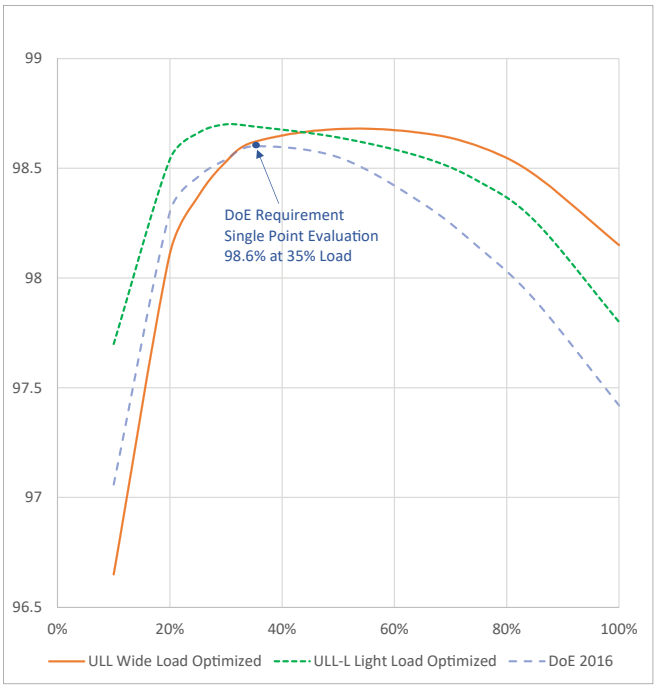
Load Percent	75 kVA		
	DOE 2016	ULL	ULL-L
10%	97.06	96.65	97.7
20%	98.30	98.11	98.54
25%	98.46	98.37	98.66
30%	98.54	98.53	98.7
35%	98.6	98.62	98.69
50%	98.55	98.68	98.64
65%	98.34	98.66	98.55
75%	98.14	98.6	98.44
100%	97.42	98.15	97.8

ULLTRA:

η_{TranHL} = 0.01 x 96.65 + 0.03 x 98.37 + 0.22 x 98.62
+ 0.5 x 98.68 + 0.22 x 98.66 + 0.02 x 98.15
= 98.62%

DOE 2016:

η_{TranHL} = 0.01 x 97.06 + 0.03 x 98.46 + 0.22 x 98.6
+ 0.5 x 98.55 + 0.22 x 98.34 + 0.02 x 97.42
= 98.47%



As can be seen, the weighted efficiency of the DOE 2016 transformer is significantly lower than that of the Mirus ULLTRA. By specifying high efficiency at only one load level (35%), the conventional DOE 2016 transformer often has significantly lower efficiencies at load levels on either side of 35%. By choosing transformers with high weighted average efficiency, the energy savings can be substantial depending upon the transformer's actual loading.

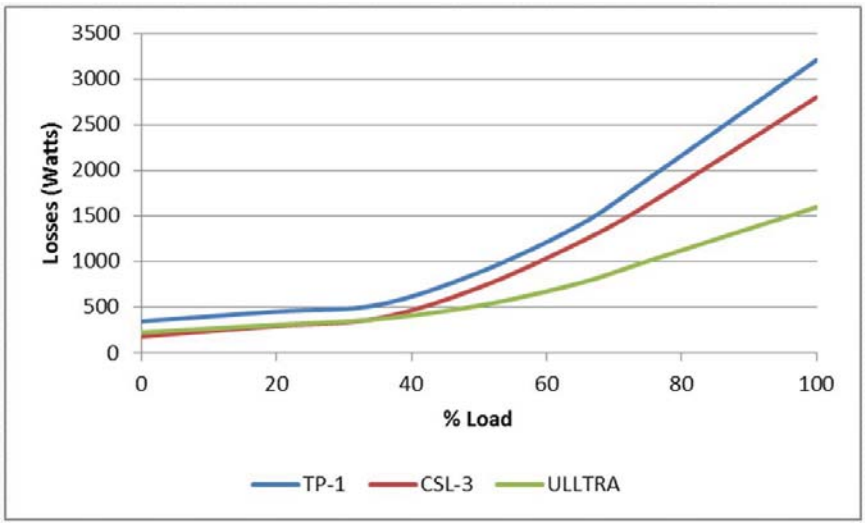
ULLTRA™ – Ultra Low Loss TRAnsformer

- Optimized for any load level making ULLTRA the only transformer ideally suited for both light or heavy loading conditions
- Efficiencies meet DOE 2016 regulations at the mandated 35% loading and even exceed these levels at the transformer's peak design loading of 50%
- Harmonic losses are also reduced to ensure high efficiencies under real world' non-linear loading
- Inrush currents (< 8x rated) and audible noise (3dB lower than standard) are extremely low
- Ideal for Solar Power or other applications where transformer loading varies widely and electricity rates are high

ULLTRA-H1E™ – Harmonic Mitigating Transformer

In applications where non-linear loading is expected to be severe, the ULLTRA-H1E combines the proven harmonic mitigating properties of Mirus' Harmony™ HMT line with superior energy efficiency, low inrush and low audible noise found in the ULLTRA design.

- Voltage distortion (flat-topping) is minimized by cancelling zero sequence fluxes within the secondary windings and eliminating circulating currents in the primary windings
- Treats triplen harmonics (3rd and 9th) within the transformer and 5th and 7th upstream
- The highest efficiency harmonic mitigating transformer from the company that first introduced HMT's to the market in the early 1990's



75kVA Transformer Comparison under Linear Load

Features

- Highest efficiencies in the industry at any load profile and at all load levels
- Lowest Life Cycle Costs for best paybacks and improved bottom line
- H1E improves reliability by reducing voltage distortion
- Exceeds DOE energy conservation standards for distribution transformers requirements in a wider load range
- Lower losses minimize energy waste and protect the environment by reducing greenhouse gas emissions
- Energy savings are realized even during peak load conditions when environmental impact is greatest
- Contributes to LEED (Leadership in Energy Efficient Design) in Energy & Atmosphere and Innovation & Design categories
- Performance validated through linear and non-linear load testing in Mirus' Harmonics & Energy Lab
- Inrush magnetization currents are the lowest in the industry
- Lower audible noise levels: 3dB to 5dB below NEMA ST-20 requirements

ULLTRA™ Series

General Specifications:

Primary
3-Phase, 3 wire, 60Hz

Secondary
3-Phase, 4-wire, 60Hz

Operating Temp. Rise
ULL: 115°C
ULL-L: 130°C

Insulation Class
220°C

Primary Taps
15kVA (and all 208V): ± 1 x 5%
30kVA - 300kVA: +2 x 2.5%, - 4 x 2.5%
500kVA - 750kVA: ± 2 x 2.5%

K-Factor Rating *(at 150°C rise)*
ULL: K13
ULL-L: K9

Neutral Bus Ampacity
200% of phase current

Energy Efficiency *(†see table)*
Meets and/or exceeds the US Department of Energy DOE 2016 efficiency requirements

Magnetizing Inrush
< 8 times FL RMS

Winding Material
Copper

Insulating Varnish Impregnation
Polyester Resin

Audible Sound Level
3dB to 5dB below NEMA ST-20

Enclosure
Type: Nema-3R, ventilated
Paint: Polyester powder coated
Colour: ANSI 61 Grey

Electrostatic Shield
Single, [double]

Applicable Standards
NRCan, NEMA ST20, NEMA TP2, CSA C9, CAN/CSA-C802.2, DOE 2016

Options:

Over-Temp. Sensors
[170°C], [200°C]

Solid Bottom Plate
Available for 'MT' case only

ULL

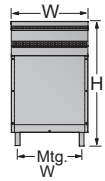
Sizes			Efficiency				Impedance		
kVA	Case	Weight †	Linear		K-13 Non-Linear	No-Load	ULLTRA H1E Zero Sequence		3 Phase
Primary	Style	lbs [kg]	35% Load*	50% Load	50% Load	Losses (W)	Zo	Xo	Short Circuit
15	MT2	250 [115]	97.90%	97.96%	97.0%	75	<0.95%	<0.3%	2.0-3.5%
30	MT2	375 [170]	98.25%	98.35%	97.5%	115	<0.95%	<0.3%	2.0-3.5%
45	MT3	500 [227]	98.40%	98.45%	97.7%	150	<0.95%	<0.3%	2.0-3.5%
75	MT3	850 [386]	98.60%	98.65%	98.0%	225	<0.95%	<0.3%	2.0-3.5%
112.5	MT4	1000 [454]	98.74%	98.82%	98.2%	320	<0.95%	<0.3%	2.5-5.0%
150	MT4	1200 [544]	98.83%	98.85%	98.3%	400	<0.95%	<0.3%	2.5-5.0%
225	LT1	1800 [820]	98.95%	99.00%	98.5%	560	<1.0%	<0.5%	3.0-6.0%
300	LT2	2500 [1135]	99.02%	99.07%	98.6%	710	<1.0%	<0.5%	3.0-6.0%
500	LT3	3175 [1440]	99.14%	99.20%	98.7%	1100	<1.5%	<0.5%	4.5-7.0%
750	LT3	4250 [1928]	99.23%	99.28%	98.8%	1550	<2.0%	<1.0%	5.0-8.0%

ULL-L

Sizes			Efficiency				Impedance
kVA	Case	Weight †	Linear		K-9 Non-Linear	No-Load	3 Phase
Primary	Style	lbs [kg]	1/6 of Linear	35% Load*	50% Load	Losses (W)	Short Circuit
15	MT2	470 [213]	97.3%	97.90%	97.0%	50	2.0-3.5%
30	MT2	575 [260]	97.6%	98.25%	97.5%	90	2.0-3.5%
45	MT3	890 [403]	97.9%	98.40%	97.7%	120	2.0-3.5%
75	MT3	975 [442]	98.2%	98.60%	98.0%	170	2.0-3.5%
112.5	MT4	1100 [499]	98.4%	98.74%	98.2%	250	2.5-5.0%
150	MT4	1800 [816]	98.5%	98.83%	98.3%	310	2.5-5.0%
225	LT1	2200 [997]	98.6%	98.95%	98.5%	430	3.0-6.0%
300	LT2	2600 [1179]	98.7%	99.02%	98.6%	530	3.0-6.0%
500	LT3	3175 [1440]	98.8%	99.14%	98.7%	800	4.5-7.0%
750	LT3	4250 [1928]	98.9%	99.23%	98.8%	1100	5.0-8.0%

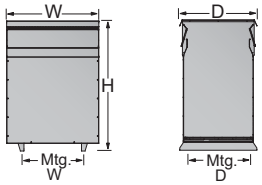
† Approximate Values * DOE 2016, CSL3 specs

'MT' Style Enclosure



Front View *Side View*

'LT' Style Enclosure



Front View *Side View*

Dimensions

Case Style	H (Height) inches [mm]	W (Width) inches [mm]	D (Depth) inches [mm]	Mtg. Center W inches [mm]	Mtg. Center D inches [mm]
MT1	29.00 [737]	16.75 [425]	15.00 [381]	13.75 [349]	13.00 [330]
MT2	38.00 [965]	21.50 [546]	19.50 [495]	17.00 [432]	17.50 [445]
MT3	45.00 [1143]	26.00 [661]	21.00 [534]	21.50 [546]	19.00 [483]
MT4	51.50 [1308]	32.00 [813]	25.50 [648]	23.50 [597]	23.50 [597]
LT1	59.00 [1499]	39.50 [1003]	30.00 [762]	24.00 [610]	32.00 [813]
LT2	66.00 [1677]	44.00 [1118]	34.00 [864]	26.00 [660]	36.00 [915]
LT3	75.00 [1905]	48.50 [1232]	39.00 [991]	27.50 [699]	41.00 [1041]

Product Code:

Transformer Type
Ultra Low Loss Transformer

Secondary L-L Voltage
208, 480, 600

Electrostatic Shield
S = Single shield (Std.)
SS = Double shield

Options

ULL - dd - hhh - xxx - kVA - S - TRB - t - (o)

Angular Displacement
30 (Std. for ULL & Type L)
00 (Std. for Type H1E)

Primary
L-L Voltage
208, 480, 600

Primary kVA
15, 30, 45, 75, 112.5, 150, 225, 300, 500, 750

Temperature Rise
TRB = 115°C (Std.)

Type
H1E = Harmonic Mitigating
L = Optimized for Light Loads
[Leave blank for Std. ULL]

MIRUS International Inc.
31 Sun Pac Blvd., Brampton, ON, Canada L6S 5P6
Tel: 905.494.1120 Fax: 905.494.1140
Toll Free: 1-888 TO MIRUS (888.866.4787)
www.mirusinternational.com

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