

ULLTRA™ Series Transformers

Ultra Low Loss Transformers



ULLTRA™ Owner's Manual

Warranty

Seller warrants to the Ultimate Purchaser (the purchaser who buys for use, and not for resale) that all products furnished under this order and which are manufactured by Seller will conform to final specifications, drawings, samples and other written descriptions approved in writing by Seller, and will be free from defects in materials and workmanship. These warranties shall remain in effect for a period of twenty five (25) years pro-rated from the date of installation or eighteen (18) months from the date of shipment, whichever occurs first. Parts replaced or repaired in the warrant period shall carry the unexpired portion of the original warranty.

The liability of Seller hereunder is limited to replacing or repairing at Seller's factory or on the job site at Seller's option, any part or parts which have been returned to the Seller and which are defective or do not conform to such specifications, drawings or other written descriptions; provided that such part or parts are returned by the Ultimate Purchaser within ninety (90) days after such defect is discovered. The Seller shall have the sole right to determine if the parts are to be repaired at the job site or whether they are to be returned to the factory for repair or replacement. If during the pro-rated portion of the warranty a replacement unit is warranted, the purchaser shall bear the cost of a replacement unit on a pro-rated basis. The replacement cost shall be 10% of the original purchase price in the second year, increasing yearly to a maximum of 90% of the original purchase price in the 10th year. All items returned to Seller for repair or replacement must be sent freight prepaid to its factory. Purchaser must obtain Seller's Return Materials Authorization (RMA) prior to returning items. The above conditions must be met if warranty is to be valid. Seller will not be liable for any damage done by unauthorized repair work, unauthorized replacement parts, from any misapplication of the item, or for damage due to accident, abuse, or Act of God.

In no event shall the Seller be liable for loss, damage, or expense directly or indirectly arising from the use of the units, or from any other cause, except as expressly stated in this warranty. Seller makes no warranties, express or implied, including any warranty as to merchantability or fitness for a particular purpose or use. Seller is not liable for and Purchaser waives any right of action it has or may have against Seller for any consequential or special damages arising out of any breach of warranty, and for any damages Purchaser may claim for damage to any property or injury or death to any person arising out of its purchase of the use, operation or maintenance of the product. Seller will not be liable for any labor subcontracted or performed by Purchaser for preparation of warranted item for return to Seller's factory or for preparation work for field repair or replacement. Invoicing of Seller for labor either performed or subcontracted by Purchaser will not be considered as a liability by the Seller.

This warranty shall be exclusive of any and all other warranties express or implied and may be modified only by a writing signed by an officer of the Seller. This warranty shall extend to the Ultimate Purchaser but to no one else. Accessories supplied by Seller, but manufactured by others, carry any warranty the manufacturers have made to Seller and which can be passed on to Ultimate Purchaser.

Seller makes no warranty with respect to whether the products sold hereunder infringe any patent, U.S., Canadian or foreign, and Buyer represents that any specially ordered products do not infringe any patent. Buyer agrees to indemnify and hold Seller harmless from any liability by virtue of any patent claims where Buyer has ordered a product conforming to Buyer's specifications, or conforming to Buyer's specific design.

Buyer has not relied and shall not rely on any oral representation regarding the Product sold hereunder and any oral representation shall not bind Seller and shall not be part of any warranty.

There are no warranties which extend beyond the description on the face hereof. In no event shall MIRUS International Inc. be responsible for consequential damages or for any damages except as expressly stated herein.

Service and Factory Repair - Call 1 - 888 - TO - MIRUS (1 - 888 - 866 - 4787)

Direct questions about the operation, repair, or servicing of this equipment to MIRUS International Inc. Customer Support Services. Include the part number, assembly number, and serial number of the unit in any correspondence. Should you require factory service for your equipment, contact MIRUS International Inc. Customer Support Services and obtain a Return Materials Authorization (RMA) prior to shipping your unit. Never ship equipment to MIRUS International Inc. without first obtaining an RMA.

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1.0 Introduction

1.1 General

ULLTRA™ transformers are manufactured to provide optimum performance for a lifetime of uninterrupted service. Careful attention to the following instructions is recommended for safe and reliable operation.

Installation, operation and maintenance of transformers should be performed by authorized persons, familiar with electrical apparatus and the potential hazards involved.

	<p>WARNING</p> <p><i>Danger! There is the potential of electric shock whenever working in or around electrical equipment such as transformers. Power must be shut off before any work is conducted on a transformer.</i></p>
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As with any electrical device, transformers must be installed according to the requirements of the national and local electrical codes. Refer to ANSI/IEEE. C57-94 may also be referred to for recommended installation, application, operation and maintenance of ULLTRA™ transformers.

2.0 Installation

2.1 Handling

The ULLTRA™ should be thoroughly protected against the entrance of dust, rain or snow when handled outdoors.

When lifting the ULLTRA™, the lifting cables should be held apart by a spreader to avoid bending the lifting lugs or other parts of the structure. The ULLTRA™ may be skidded or moved on rollers but care must be taken not to damage the base or tip it over. When rollers are used under larger units, skids must be used to distribute the stress over the base.

After the ULLTRA™ is placed in permanent position, shipping braces should be removed and shipping bolts, if present, should be loosened. Where isolation pads have been included, the bolt should be loosened until the spring washer has been relaxed before putting into service. This will reduce noise resulting from the ULLTRA's™ natural vibration.

2.2 Receiving and Inspection

Before accepting the shipment from the freight carrier, inspect the exterior surfaces of shipping container(s), packaging, and equipment for damage that may have occurred during transit. If the shipping containers or equipment show evidence of damage, note the damage on the receiving document (bill of lading) prior to signing for receipt of equipment.

The equipment should be unpacked immediately after receipt, and inspected again for damage to external painted panels and doors and to determine if any internal damage (broken components, disconnected wiring, loose connections, displaced parts, cracked insulators, dirt or foreign material, or evidence of moisture, etc.) has occurred. Verify that the equipment nameplate corresponds with the equipment ordered.

Damage claims should be filed directly with the carrier. Replacements for damaged components can be ordered by calling 1-888-TO MIRUS (1-888-866-4787).

2.3 Storage

If the equipment is to be stored prior to installation, it should be stored in a warm, dry, well-ventilated location that is protected against rain, moisture, splashing water, chemical agents, etc. The equipment should be covered with a tarpaulin or plastic wrapper to protect it against dust, dirt, paint, or other foreign materials. Condensation and moisture absorption must be prevented during storage.

2.4 Location

Location of the ULLTRA™ should be made with consideration given to accessibility, ventilation and atmospheric conditions. Sufficient clearances from walls and other obstructions should be provided to permit unrestricted opening of hinged and removable doors, covers and panels for the purpose of wiring terminations, inspection, maintenance and testing. Also, proper ventilation requires at least 6 in. (155mm) clearance at all ventilation openings. In enclosed rooms, minimum air circulation of 100 ft³/ min per kilowatt of transformer loss should be provided.

Installation locations should be free of contaminants including dust, fertilizer, excessive moisture, corrosive gases, flammable materials or chemical fumes. Filtered air may be considered to reduce maintenance where air born contaminants are a problem.

Enclosures are designed in accordance with NEMA and UL standards and can allow for installation in various environments. ULLTRA™ transformers are equipped standard with NEMA-3R enclosures which are suitable for both indoor and outdoor installations. However, for severe weather conditions (ie. blowing snow, heavy dust or driving rain) additional shielding against the elements may be required or enhanced NEMA-3R or better enclosures should be selected.

Where ULLTRA™ transformers are connected to lines subject to lightning exposure or other voltage surges, careful coordination of BIL levels and protective surge arresters must be made. For derating factors which apply to installation at high altitudes, refer to ANSI C57.12.01-1989.

To prevent accidental contact to live parts through ventilation openings, ventilated transformers should be protected by fences, screens, partitions or walls where practical. Warning signs should be prominently displayed at all entrances.

2.5 Grounding

Consideration must be given to equipment grounding (case and core) and must be made in accordance with all applicable electrical codes. All core and coil assemblies are solidly grounded to the enclosure internally to ensure that all conductive metal parts have the same potential.

The transformer enclosure in turn should also be securely and effectively grounded as a safety precaution.

This grounding should be in accordance with national electrical code standards.

3.0 Operation

For all relatively normal and clean installations, ULLTRA™ transformers will operate satisfactorily under normal conditions of energization and load.

For your reference, fully loaded ULLTRA™ transformers may appear warm to the touch, particularly on the cover of the unit.

Standards permit the temperatures of the cover to be 65°C over ambient. This represents normal loading and should not be of concern.

ULLTRA™ transformers are designed to operate continuously at their full nameplate kVA or kilovolt rating.

ANSI C57.96 provides guidance for loading transformers under different conditions including:

- Ambient temperatures that are varied from the ambient temperatures required for transformer operation.
- Short time overload as it relates to time and temperature and the corresponding loss of life of the transformer.
- Overload that results in a reduction of life expectancy of the transformer.

If the transformer is experiencing increased temperatures, the following load characteristics should be considered immediately:

- Rigorous motor starting loads or other impact type loading for which a specific transformer for that application is required.
- Over-excitation of unit due to excess supply line voltage or current.
- Ambient temperatures above standard.
- Overload beyond ANSI C57.96 guidelines.


If overheating is noted, any attempt to add supplemental fan cooling must be in accordance with factory installation guidelines. Incorrectly

installed fans can misdirect the airflow and cause serious deterioration of the insulation life in a transformer coil.

ULLTRA™ transformers can be shut down and stored for extended periods of time without any deterioration. Care must be exercised to clean and dry units prior to energization, as previously outlined.

4.0 Maintenance

Maintenance would include internal cleaning, tightening of links and bolted connections, servicing and inspection of auxiliary devices.

	<p>WARNING</p> <p><i>Internal maintenance must be performed with a transformer de-energized, isolated and with the terminals grounded.</i></p>
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4.1 Periodic Inspection

Under normal operating conditions and environments, ULLTRA™ transformers do not require maintenance. However, periodic care and inspection is a good practice particularly dependent on the environmental conditions in which the unit is installed.

Peripheral inspection and external dust removal may be carried out while the transformer is in operation. However, access covers must not be opened under energized conditions.

Visual inspection for evidence of loose connections, dirt, moisture, rusting, corrosion, and deterioration of the insulation, varnish or paint.

Observations should be made for signs of overheating and overvoltage creeping. Corrective measures should be taken as necessary.

For early detection of any developing hotspots, an infrared scan can be performed while the ULLTRA™ is operating under its heaviest load condition.

Auxiliary devices should be tested for proper operation.

The ground connection should also be checked to ensure a low impedance connection.

4.2 Cleaning


Excessive accumulations of dirt on the transformer windings or insulators should be removed to permit free circulation of air and to guard against the possibility of insulation breakdown. Particular attention should be given to cleaning the top and bottom ends of the winding assemblies and to cleaning out ventilating ducts. Windings should be lightly cleaned by the use of a vacuum cleaner. If necessary a blower or compressed air may be used but pressure should not exceed 25 psi. Lead supports, tap changers and terminal boards, bushings, and other major insulating surfaces should be brushed or wiped with a dry cloth. The use of liquid cleaners is not recommended due to deteriorating effects on most insulating materials.

Air ducts should be free of any accumulation of dust and debris and any bolted connections of terminals must be in good condition.

Vacuuming or blowing of compressed air from the top down is an accepted practice for removing dust from the ducts of a transformer coil. Low pressure, dry air should be used to avoid further contamination of the windings by foreign material.

4.3 Drying of Core and Coil Assembly

In the event that transformers have been exposed to moisture such as condensation or rain, it is advisable to dry out any unit prior to energization.

	<p>CAUTION</p> <p><i>Constant attention during the drying process is recommended.</i></p>
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When it is necessary to dry an ULLTRA™ transformer before installation or after an extended shutdown under relatively high humidity conditions, internal and/or external heating methods can be used. (See ANSI/IEEE C57.94-1982 for a description of these methods).

Drying may be accomplished by using any hot or warmed air, radiant heat or internal heat that is directed through the windings and not around the sides. Heated air should be allowed to rise up

through the windings for a minimum of twenty four (24) hours after the evidence of condensation is no longer visible. A sufficient quantity of air should be used to assure approximately equal inlet and outlet temperatures.

Air temperature should not exceed 110°C.

Transformers that have been exposed to flood conditions, direct rain or sprinklers, may require special methods to ensure that the equipment is dried appropriately. Contact the factory for proper instructions.

5.0 Technical Data

5.1 General Specifications

Primary

3-phase, 3-wire, 60Hz

Secondary

3-phase, 4-wire, 60Hz

Operating Temperature Rise

115°C (ULLTRA)
130°C (Type L)

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)

13 (Type H & HM)
9 (Type L)

Neutral Bus Ampacity

200% of phase current

Magnetising Inrush

< 10 times FL RMS

Winding Material

Copper

Insulating Varnish Impregnation

Polyester Resin

Energy Efficiency

Sizes	Efficiency	
kVA	Linear	K-13

Primary	35% Load	50% Load	Non-Linear @50% Load	No-Load Losses Watts
15	97.90%	97.96%	97.0%	75
30	98.25%	98.35%	97.5%	115
45	98.39%	98.45%	97.7%	150
75	98.60%	98.65%	98.0%	225
112.5	98.74%	98.82%	98.2%	320
150	98.81%	98.85%	98.3%	400
225	98.95%	99.00%	98.5%	560
300	99.00%	99.07%	98.6%	710
500	99.09%	99.20%	98.7%	1100
750	99.16%	99.28%	98.8%	1550

Linear Load: Meets and/or exceeds the UD Department of Energy Candidate Standard Level 3 (CSL-3) efficiency requirements by ensuring losses are 30% lower than NEMA TP-1.

Non-Linear Load: Exceeds NEMA TP-1 efficiency requirements.

Audible Sound Level

As per NEMA ST-20

15 - 45kVA: 45dB
75 – 150kVA: 50dB
225 – 300kVA: 55dB
500kVA: 60dB
750kVA: 64dB

Enclosure

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

Electrostatic Shield

Single, [optional double]

Impedance

kVA Primary	Impedance		3 Phase Short Circuit
	ULLTRA H1E Zero Sequence Zo	Xo	
15	<0.95%	<0.3%	2.0 - 3.5%
30	<0.95%	<0.3%	2.0 - 3.5%
45	<0.95%	<0.3%	2.0 - 3.5%
75	<0.95%	<0.3%	2.0 - 3.5%
112.5	<0.95%	<0.3%	2.5 – 5.0%
150	<0.95%	<0.3%	2.5 – 5.0%
225	<1.0%	<0.5%	3.0 – 6.0%
300	<1.0%	<0.5%	3.0 – 6.0%
500	<1.5%	<0.5%	4.5 – 7.0%
750	<2.0%	<1.0%	5.0 – 8.0%

5.2 Options

Over-temperature Sensors

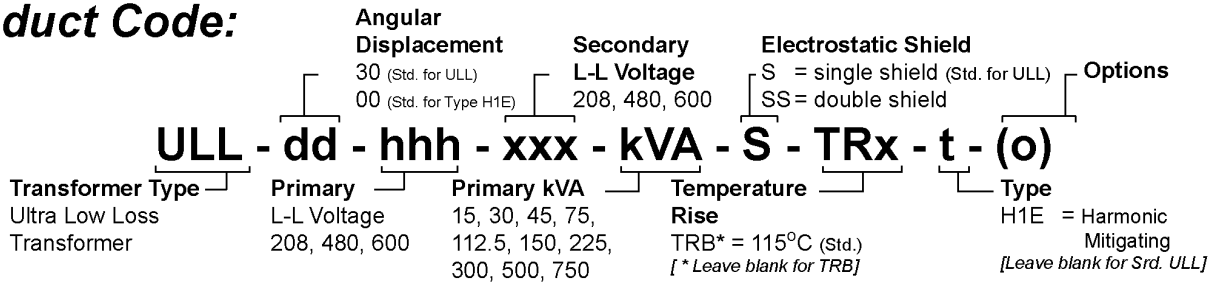
[170°C], [200°C]

Solid Bottom Plate (Case 'MT' only)

[yes], [no]

5.3 Model Number

Product Code:



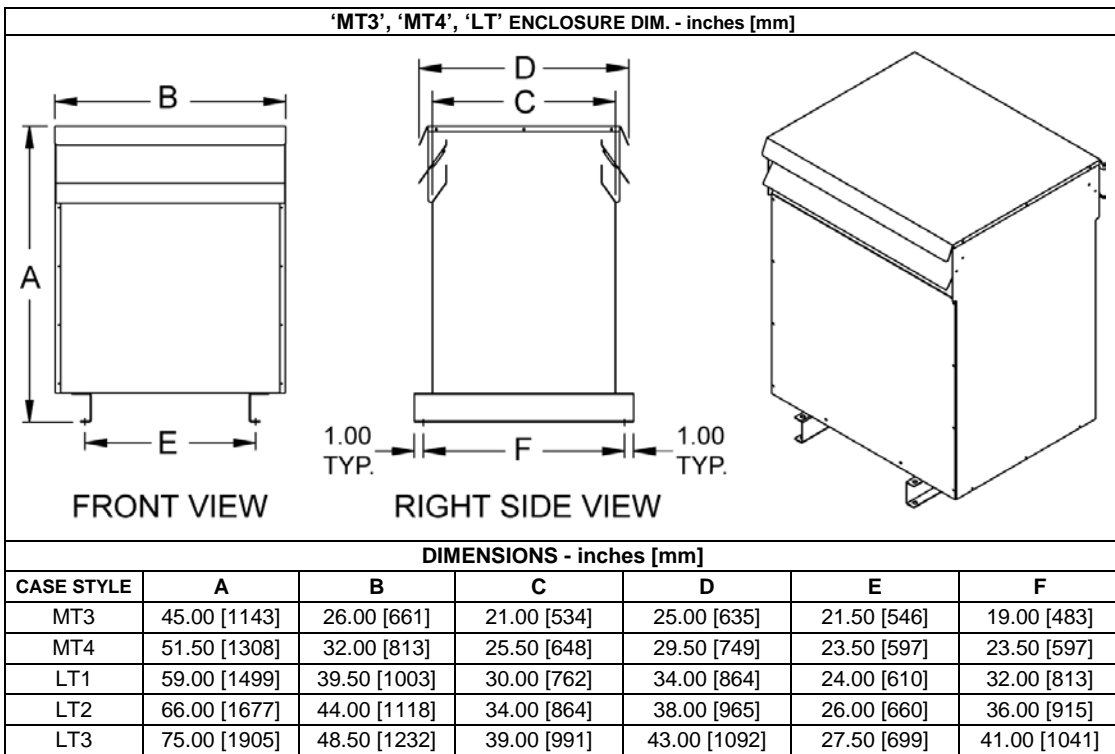
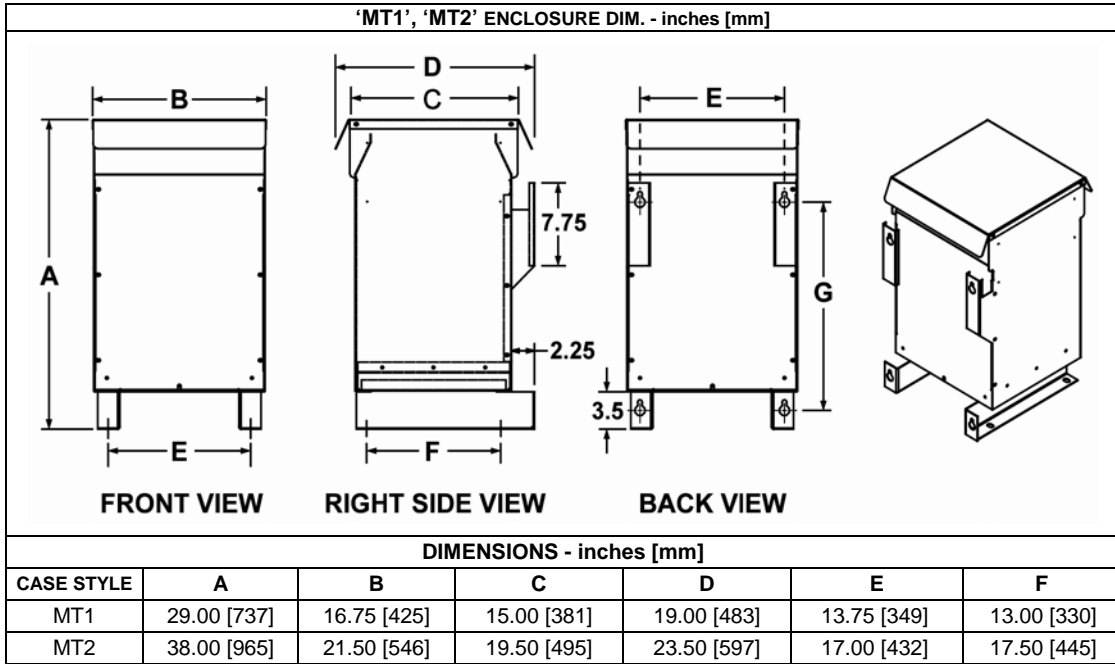
5.4 Terminations (if provided)

kVA Primary	Terminal Sizes				
	208V	Primary 480V	600V	120/208V	Secondary Neutral
15	#2-#14	#6-#14	#6-#14	#6-#14	2x#2-#14
30	2/0-#6	#2-#14	#2-#14	2/0-#6	2x2/0-#6
45	250MCM-#6	#2-#14	#2-#14	250MCM-#6	2x250MCM-#6
75	600MCM-#4	2/0-#6	2/0-#6	600MCM-#4	2x600MCM-#4
112.5	2x350MCM-#6	250MCM-#6	2/0-#6	2x350MCM-#6	4x350MCM-#6
150	2x350MCM-#6	350MCM-#6	250MCM-#6	2x350MCM-#6	4x350MCM-#6
225	Copper Pad	Copper Pad	Copper Pad	Copper Pad	Copper Pad
300	Copper Pad	Copper Pad	Copper Pad	Copper Pad	Copper Pad
500	Copper Pad	Copper Pad	Copper Pad	Copper Pad	Copper Pad
750	Copper Pad	Copper Pad	Copper Pad	Copper Pad	Copper Pad

5.5 Enclosures

Sizes		
kVA Primary	Case Style	Weight lb [kg]
15	MT2	250 [115]
30	MT2	375 [170]
45	MT3	500 [227]
75	MT3	850 [386]
112.5	MT4	1000 [454]
150	MT4	1200 [544]
225	LT1	1800 [820]
300	LT2	2500 [1135]
500	LT3	3175 [1440]
750	LT3	4250 [1928]

5.5 Enclosures (continued)



APPENDIX A

AMPACITY RATINGS FOR CONNECTIONS

For a three phase transformer:

$$\text{Line Amperes} = \frac{\text{volt amperes}}{\sqrt{3} \times \text{line Volts}}$$

Ampacity of Insulated Conductor in Raceway

Wire Size AWG No.	60°C (140°F)		75°C (167°F)	
	Conductor Ampacity Copper	Aluminum	Conductor Ampacity Copper	Aluminum
14	15	-	15	-
12	20	15	20	15
10	30	25	30	25
8	40	30	50	40
6	55	40	65	50
4	70	55	85	65
3	80	65	100	75
2	95	75	115	90
1	110	85	130	100
1 /0	125	100	150	120
2/0	145	115	175	135
3/0	165	130	200	155
4/0	195	150	230	180
(250)	215	170	255	205
(300)	240	190	285	230
(350)	260	210	310	250
(400)	280	225	335	270
(500)	320	260	380	310

Full Load Current Table Three Phase Transformer

kVA Rating	Current in Amperes					
	208V	240V	380V	416V	480V	600V
2	5.55	4.81	3.03	2.77	2.40	1.92
3	8.32	7.21	4.55	4.16	3.60	2.88
6	16.6	14.4	9.11	8.32	7.21	5.77
9	24.9	21.6	13.6	12.4	10.8	8.66
15	41.6	36.0	22.7	20.8	18.0	14.4
30	83.2	72.1	45.5	41.6	36.0	28.8
45	124	108	68.3	62.4	54.1	43.3
75	208	180	113	104	90.2	72.1
112.5	312	270	170	156	135	108
150	416	360	227	208	180	144
225	624	541	311	312	270	216
300	832	721	455	416	360	288
450	1249	1082	683	624	541	433
500	1387	1202	759	693	601	481
600	1665	1443	911	832	721	577
750	2081	1804	1139	1040	902	721



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