

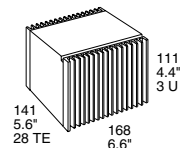
500 Watt AC-DC Converters

T Series

Input to output isolation Single output

- Universal AC input range
- DC output voltage for 24 and 48 V loads
- Battery charging for 24, 36, 48 V batteries with remote temperature control
- Telecom rectifier applications
- Immune to transients and disturbances according to VDE 160 and IEC/EN 61000-4-2,-3,-4,-5,-6
- 4000 V AC input to output electric strength test
- Very high efficiency, typically 93%
- Power factor >0.96, harmonics <IEC/EN 61000-3-2, low RFI
- No inrush current, hot plug-in capability
- High power density, 210 W/dm³, rugged mechanical design
- Very compact 19" cassette (28 TE, 3 U, 160 mm),

Safety according to IEC/EN 60950



Summary

The T series of converters are electrically isolated AC-DC converters with an output power of up to 550 W. For higher power requirements several units may be connected in parallel.

The input of the T units is ideally adapted to the mains: Full power factor correction, no inrush current, low RFI level and high transient and surge immunity are key design features. The T units behave similar to a resistive load.

The L-input provides a universal AC-input range from 85...255 V AC. It is the preferred type for 230 V mains, whereas the U-input range is optimized for 110/120 V mains. The output delivers an electrically isolated Safety Extra Low Voltage (SELV) and is short-circuit and no-load proof. Depending on the type, two output characteristics are available, intended either for rectifier applications or for battery charging purposes.

The latter types can be integrated into systems where the output voltage is backed-up by batteries. The float charge of the battery can be set by a cell voltage selector switch according to the battery type used. Moreover these units feature a temperature sensor input to improve the life expectancy of the battery.

The rectifier types suit for DC-bus applications at constant voltage. As the output voltage is SELV, even electrically non isolated switching regulators such as the Melcher PSR types may be connected to the T output.

The T 1701 types are especially optimized to build distributed power systems together with the Melcher CQ-series DC-DC converters as the signalling capabilities of both families are matched. Distributed power systems have as one advantage less power loss over load lines and fewer regulation problems.

Melcher offers also backplanes for fast and simple set-up of 19" rack systems with T units (see chapter: *Back Planes*).

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Type Survey and Key Data

Table 1: Type Survey (All typical values at 20°C)

Output voltage $U_{o \text{ set}}$ at $U_{i \text{ nom}}$, $1/2 I_{o \text{ nom}}$ [V DC]	Output current $I_{o \text{ nom}}$ [A]	Input voltage range and efficiency				Options
		$U_{i \text{ min}} \dots U_{i \text{ max}}$ 70...140 V AC	η_{min}^1 [%]	$U_{i \text{ min}} \dots U_{i \text{ max}}$ 85...255 V AC	η_{min}^1 [%]	
24.25	16	UT 1201-7 ^{2,4}	91	LT 1201-7 ^{2,6}	91	D B1
25.25...27.25...28.25	14.5	UT 1240-7Z ^{4,3}	91	LT 1240-7Z ^{6,3}	92	
54.5	10	UT 1701-7 ⁵	92	LT 1701-7 ⁶	93	
48	11	–	–	LT 1702-7 ^{2,6}	93	
50.5...54.5...56.5	10	UT 1740-7Z ^{5,3}	92	LT 1740-7Z ^{6,3}	93	
37.9...40.9...42.4	11	–	–	LT 1840-7Z ^{3,6}	91	

¹ Efficiency measured at $U_{i \text{ nom}}$ and $I_{o \text{ nom}}$.

² Instead of output power limitation, output current limitation.

³ Output voltage range controlled by input U_{cr} , remote temperature sensor and cell voltage selector switch.

⁴ Reduced output power for $U_i = 70 \dots 95$ V AC. See *Output Power Limitation*.

⁵ Reduced output power for $U_i = 70 \dots 100$ V AC. See *Output Power Limitation*.

⁶ Reduced output power for $U_i = 85 \dots 155$ V AC. See *Output Power Limitation*.

Type Key

Type Key

Input voltage range U_i

70...140 V, 47...63 Hz U
85...255 V, 47...63 Hz L

Series T

Number of outputs: 1

Output $U_{o \text{ set}}$

24, 27.25 V 2
48, 54.5 V 7
40.9 V 8

Rectifier version 01, 02³

Battery charger version 40⁴

Other voltages 00...99

Ambient temperature range T_A

-25...71 °C -7
Customer specific -0...-6

Auxiliary functions and options

Remote bus voltage monitoring (option) D¹

Cell voltage selector switch Z²

Input fuse externally accessible F

Baseplate (option) B1

LT 1740-7 D Z F B1

¹ See also: *Description of Options* as well as data sheet: *Back Planes for the T Series*.

² Only for T 1240/1740/1840

³ No input for remote temperature sensor

⁴ With input for remote temperature sensor

Example: LT 1740-7Z: AC-DC converter, input voltage range 85...255 V_{rms}, single output 50.5...56.5 V DC, 10 A, operational ambient temperature -25...71 °C, with cell voltage selector switch.

Sensor Type Key

Type Key

Series	S ¹				
Battery nominal voltage					
24 V	24				
36 V	36				
48 V	48				
Cell voltage (at 20°C)					
2.23 V	2.23				
2.27 V	2.27 ²				
Temperature coefficient					
-3.0 mV/K/cell	30				
-3.5 mV/K/cell	35				
-4.0 mV/K/cell	40				
-4.5 mV/K/cell	45				
other temperature coefficients on request					
Cable length (2 m)	02				

S 48 - 2.23 - 30 - 02

¹ Only for LT 1240/1740/1840

² For units without cell voltage selector switch

Functional Description

The T unit is a primary controlled AC-DC converter with a constant switching frequency of 65.5 kHz. The power factor corrected single step conversion of the line input voltage to a low output voltage results in extremely high efficiency.

The input voltage is fed via input fuse, filter and rectifier to the main transformer. The wideband input filter with small input capacitance generates virtually no inrush current. Transient suppressors protect the unit against high voltage peaks and surges. An auxiliary converter generates an internal supply voltage for the primary control logic. The input voltage waveform is sensed by the primary control logic to allow power factor correction.

The main transformer is connected to a rectifier, large output capacitors and an efficient output filter which ensures low output ripple and spikes and provides the necessary hold-up time. The output voltage is fed back to the primary control logic via a signal transformer.

The inhibit signal and the T failure signal are transferred by a second signal transformer (no opto-couplers!).

System Good and Output voltage OK are each indicated by a green LED, inhibit and T System Failure by a red LED.

System Good and Power Down are available as open collector signals at the connector. The threshold level of the Power Down signal can be externally adjusted at the D set input.

Test sockets at the front panel allow the measurement of the output voltage.

The battery charger version provides additional features to control the output voltage. To set it to different battery float charge voltages, a 16-step selector switch (Z) is standard.

A control input for remote output voltage adjustment, by an external temperature sensor is available at the multifunctional inhibit/ U_{cr} control pin. A trim-potentiometer allows fine adjustment of the output voltage.

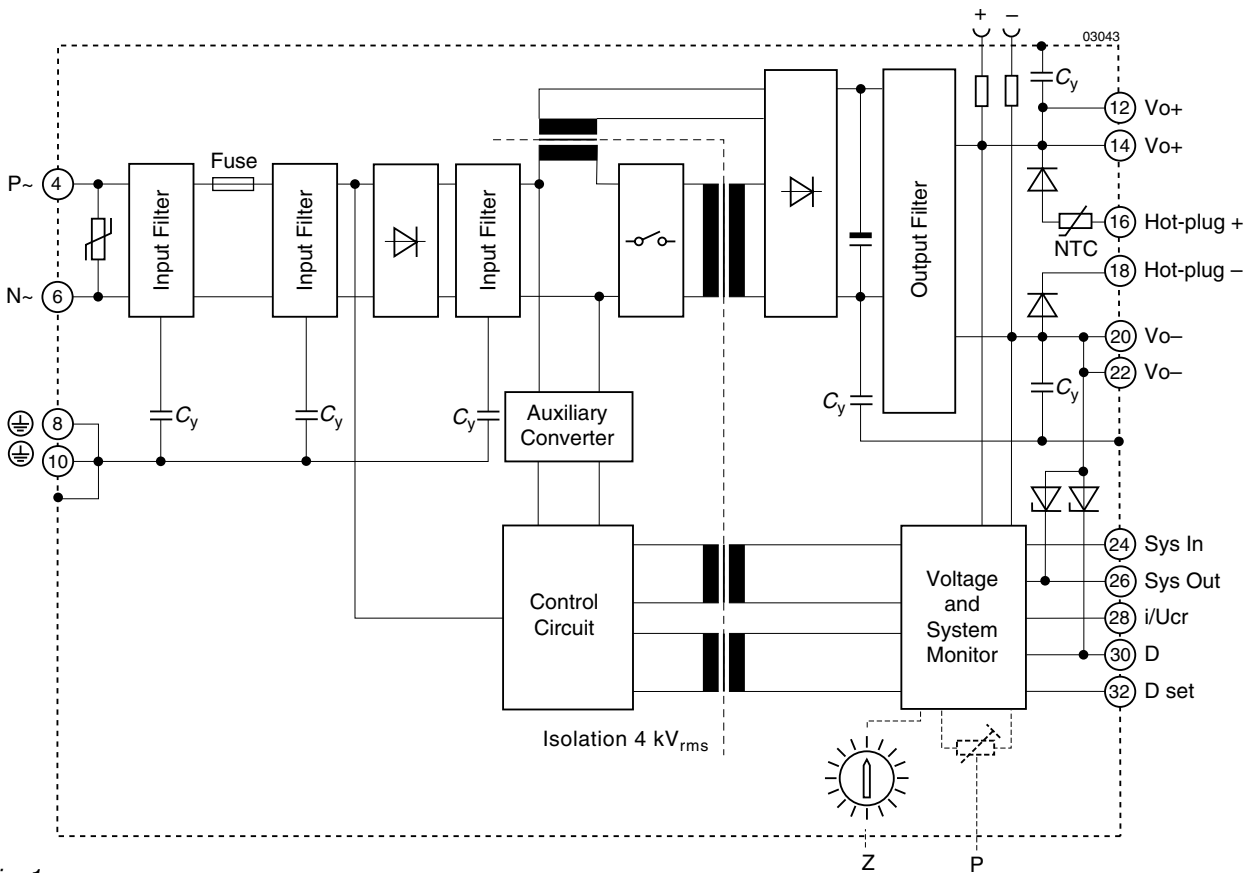


Fig. 1
Block diagram

Electrical Input Data

General conditions:

– $T_A = 20^\circ\text{C}$

Table 2a: Input Data LT types

Input			LT 12xx			LT 17xx			LT 18xx			Unit
Characteristic		Conditions	min	typ	max	min	typ	max	min	typ	max	
U_i	Input voltage range with full output power	AC (47...63 Hz)	155		255	155		255	130		255	V_{rms}
$U_{i \text{ red}}$	Input voltage range with reduced output power ¹		85		155	85		155	85		130	
$U_{i \text{ nom}}$	Nominal input voltage			230			230			230		
$I_{i \text{ nom}}$	Nominal input current	$U_{i \text{ nom}}, P_{o \text{ nom}}$		1.9			2.6			2.2		A_{rms}
$I_{i \text{ L}}$	Input current limit			3			4			4		
$P_{i \text{ 0}}$	No-load input power	$U_{i \text{ min...}U_{i \text{ max}}}, I_o = 0$		6			8			8		W
$P_{i \text{ inh}}$	Input power when inhibited	$U_{i \text{ min...}U_{i \text{ max}}}$, inhibit = low		3			3			3		
PF	Power factor ²	$U_{i \text{ nom}}, I_{o \text{ nom}}$		96			98			98		%
C_i	Input capacitance ³	$U_{i \text{ nom}}$		4			4			4		μF
t_{on}	Switch on delay	$U_{i \text{ nom}}, P_{o \text{ nom}}$		400			400			400		ms
$u_{i \text{ RFI}}$	Input RFI level ⁴	$I_o = I_{o \text{ nom}}$ EN 55014, EN 55011/022			B			B			B	
$U_{i \text{ p}}$	Input overvoltage protection ⁵				264			264			264	V_{rms}
$U_{i \text{ L}}$	Input undervoltage lock-out			75			75			75		V
F	Input fuse 5 × 20 mm			6.3			6.3			6.3		A
f_{tr}	Switching frequency			65.536			65.536			65.536		kHz

Table 2b: Input Data UT types

Input			UT 12xx			UT 17xx			Unit
Characteristic		Conditions	min	typ	max	min	typ	max	
U_i	Input voltage range with full output power	AC (47...63 Hz)	95		140	100		140	V_{rms}
$U_{i \text{ red}}$	Input voltage range with reduced output power ¹		70		95	70		100	
$U_{i \text{ nom}}$	Nominal input voltage			115			115		
$I_{i \text{ nom}}$	Nominal input current	$U_{i \text{ nom}}, P_{o \text{ nom}}$		3.8			5.2		A_{rms}
$I_{i \text{ L}}$	Input current limit			5			6		
$P_{i \text{ 0}}$	No-load input power	$U_{i \text{ min...}U_{i \text{ max}}}, I_o = 0$		6			8		W
$P_{i \text{ inh}}$	Input power when inhibited	$U_{i \text{ min...}U_{i \text{ max}}}$, inhibit = low		3			3		
PF	Power factor ²	$U_{i \text{ nom}}, I_{o \text{ nom}}$		98			98		%
C_i	Input capacitance ³	$U_{i \text{ nom}}$		4			4		μF
t_{on}	Switch on delay	$U_{i \text{ nom}}, P_{o \text{ nom}}$		400			400		ms
$u_{i \text{ RFI}}$	Input RFI level ⁴	$I_o = I_{o \text{ nom}}$ EN 55014, EN 55011/022			B			B	
$U_{i \text{ p}}$	Input overvoltage protection ⁵				165			165	V_{rms}
$U_{i \text{ L}}$	Input undervoltage lock-out			65			65		V
F	Input fuse 5 × 20 mm			10			10		A
f_{tr}	Switching frequency			65.536			65.536		kHz

¹ The output power is reduced because of the input current limitation $P_o \approx U_i [V_{\text{rms}}] \times I_{i \text{ L}} [A_{\text{rms}}] \times \eta$

² Power factor as a function of the input voltage and load as well as harmonic distortion see *Power Factor, Harmonics*.

³ Inrush current stays factor 10 below ETS 300132-1.

⁴ 150 kHz...30 MHz: CISPR 11/22/EN 55011/22 class B, 30...300 MHz: CISPR14/EN 55014

⁵ In case of overvoltage the unit switches off temporarily, resulting in reduced output power and increased RFI.

Input Fuse

An input fuse (5 × 20 mm) fitted in the line (P) path mounted inside the converter protects the module against severe defects. (See also: *Safety and Installation Instructions*.) For applications where the fuse should be accessible: see *Option F*.

Table 3: Fuse Type

Series	Schurter type	Part number
LT	SP F 6.3 A, 250 V	0001.1012
UT	SPT 10 A, 250 V	0001.2514

Inrush Current

The T units operate with 4 µF input capacitance resulting in a low peak current of short duration when the unit is connected to the mains. During switch on the input current can rise up to the input current limit I_{iL} . As a direct result of the low and short inrush current and controlled charging procedure of the output capacitors, the unit can be hot plugged to the mains causing only negligible disturbances. The LT inrush current is a factor 10 smaller than defined in the ETS 300 132-1 standard for Telecom Systems. However the unit should be plugged-in smoothly giving time to the output capacitors to be charged.

Input Under-/Overvoltage Lock-Out

If the specified input voltage range U_i is exceeded, the unit stops operation temporarily resulting in reduced output power and increased RFI. The input is protected by varistors. Continuous overvoltage will destroy the unit.

If the sinusoidal input voltage stays below the input under-voltage lock-out threshold U_i , the unit will be inhibited.

Power Factor, Harmonics

Power factor correction is achieved by controlling the input current waveform synchronously with the input voltage waveform. The power factor control is active in all operating conditions (voltage regulation, output power limitation, current limitation). The power factor control also works with different input voltage waveforms and frequencies. Operation at frequencies above 60 Hz will result in higher leakage currents. For special applications with different frequencies or non-sinusoidal wave forms, please contact Melcher.

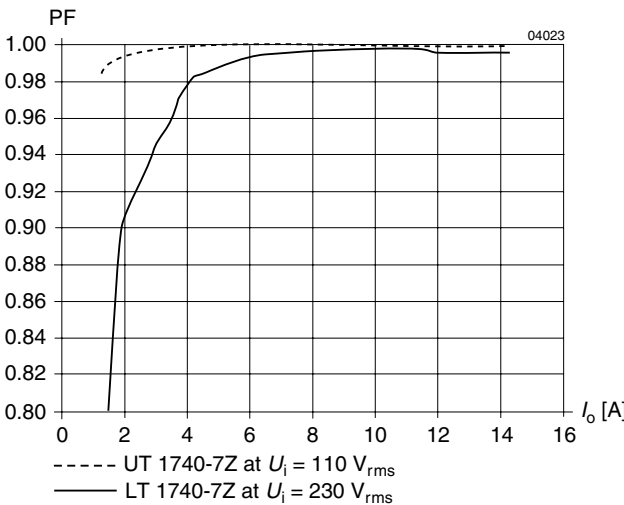


Fig. 2
Power factor

Efficiency

The extremely high efficiency of the T series is achieved by using a single step power factor corrected converter topology together with the most advanced technology in power conversion.

It allows a very compact design in a fully enclosed case without forced cooling.

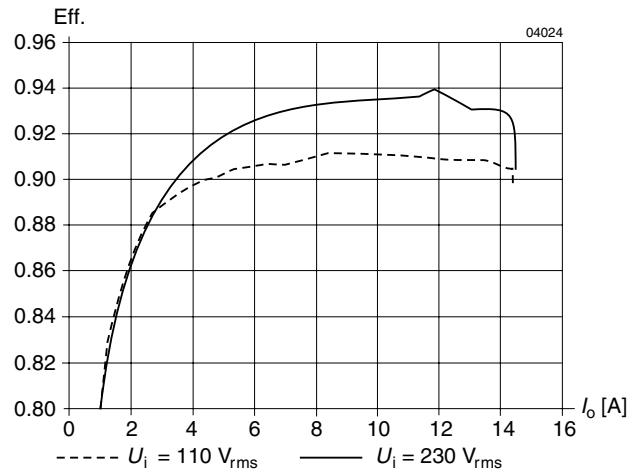


Fig. 3
Efficiency versus load of LT 1701

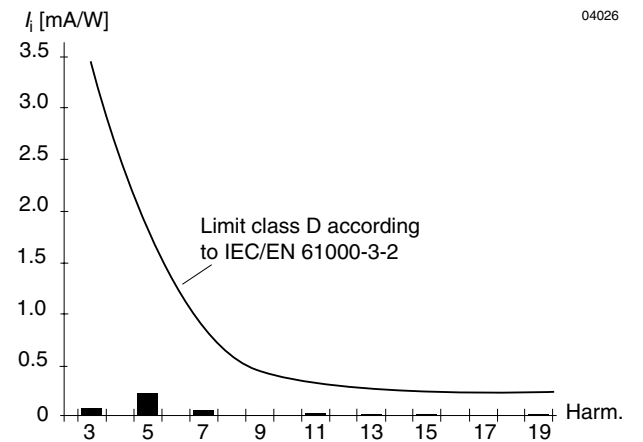


Fig. 4
Harmonic distortion at input LT 1740-7Z, $U_i = U_{inom}$, $I_o = I_{o nom}$

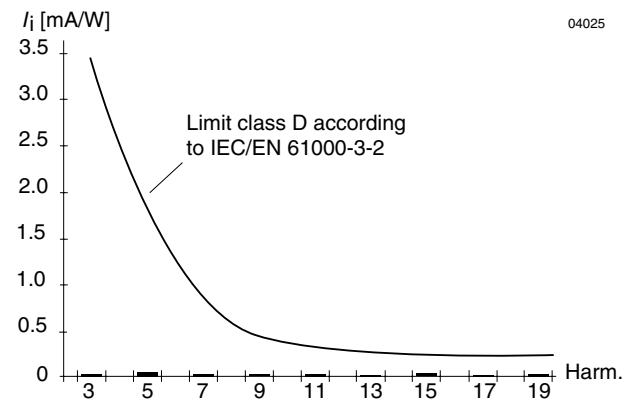


Fig. 5
Harmonic distortion at input UT 1740-7Z, $U_i = U_{inom}$, $I_o = I_{o nom}$

Electrical Output Data of the Rectifier Version

General conditions:

- $T_A = 20^\circ\text{C}$, unless T_C is specified.
- $U_i = U_{i\text{nom}}$, $f = 50\text{ Hz}$

Table 4: Output data

Output		Conditions	LT/UT 1201		LT/UT 1701		LT 1702		Unit
Characteristic			min	typ max	min	typ max	min	typ max	
$U_o\text{ set}$	Output voltage adjustment	$U_{i\text{nom}}$ $I_o = 0.5 \cdot I_{o\text{nom}}$	24.25		54.5		48.0		V
$U_o\text{ set tol}$	U_o setting tolerance		24.0	24.5	54.25	54.75	47.75	48.25	
U_o	Output voltage over input voltage and ¹ load (See fig.: <i>Typical output voltage versus input voltage and output current.</i>)	$U_{i\text{min}} \dots U_{i\text{max}}$ $I_o = 0.01 \cdot I_{o\text{nom}}$ $\dots I_{o\text{nom}}$	23.35	24.95	52.8	55.8	46.3	49.3	
U_{oL}	Output Overvoltage protection by electronic inhibit		32.5		59.3		59.3		
α_{U_o}	Temperature coefficient of output voltage	T_C fixed value	-5		-5		-5		mV/K
$I_{o\text{nom}}$	Nominal output current		16		10		11		A
I_{oL}	Current limit ²	$U_o = 20\text{ V}$	18 ⁴		14.5		14.5		
P_{oL}	Output power limit ²	$U_{i\text{nom}}$	400		550		550		W
u_o	Output voltage noise	Low frequency	$I_{o\text{nom}}$		$I_{o\text{nom}}$		$I_{o\text{nom}}$		V_{pp}
		Switching freq.	IEC/EN 61204 ⁵		40		40		mV _{pp}
		Total	BW = 20 MHz		0.9		1.05		V_{pp}
ΔU_{oI}	Static load regulation ¹ (See fig.: <i>Typical output voltage versus input voltage and output current.</i>)	$I_o = 0.01 \cdot I_{o\text{nom}}$ $\dots I_{o\text{nom}}$	0.6		1.2		1.2		V
ΔU_{oU}	Static line regulation (See: <i>Typical output voltage versus input voltage and output current.</i>)	$U_i = U_{i\text{min}} \dots U_{i\text{max}}$ $I_{o\text{nom}}$	0.3		0.8		0.8		
$u_{o,d}$	Dynamic load regulation ³ (See fig.: <i>Dynamic characteristic under varying load conditions.</i>)	Voltage deviation	$U_{i\text{nom}}$		2.2		2.2		
t_d		Recovery time	$I_{o\text{nom}} \leftrightarrow 1/10 I_{o\text{nom}}$ IEC/EN 61204 ⁶		0.25		0.25		s
C_o	Internal output capacitance		86		41		41		mF

¹ Output voltage decreases with rising output current because of output voltage slope for automatic current sharing capability.

² Due to the large output capacitors the maximum transient value can be much higher.

³ Deviation limited by output overvoltage protection.

⁴ No power limitation, but current limitation.

⁵ See: *Technical Information: Measuring and Testing.*

⁶ See fig.: *Dynamic load regulation.*

Output Characteristics (Rectifier Version)

The T 1701/1702 types can be operated in 3 different modes:

- Output voltage regulation
- Output power limitation
- Output current limitation
- In output voltage regulation mode the T unit can be operated within the full temperature range $-25 \dots 71^\circ\text{C}$.
- In output power or current limitation mode the max. ambient temperature T_A should not exceed 65°C with free air convection cooling.

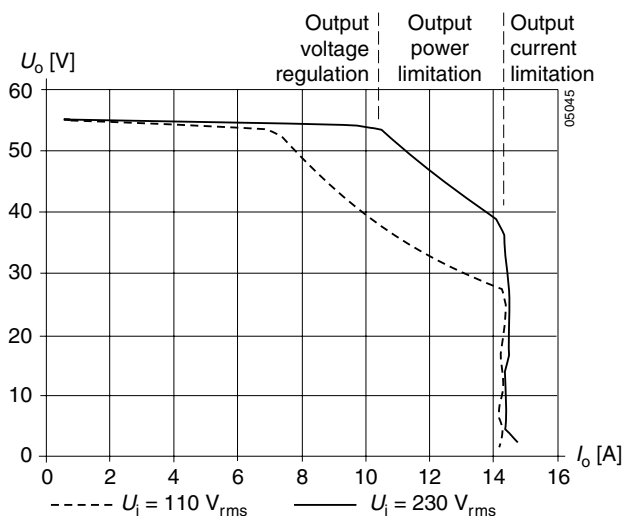


Fig. 6
Output characteristics LT 1701-7

Output voltage regulation (Rectifier Version)

The output voltage of rectifier models is adjusted to a fixed value $U_o \text{ set}$. It relates to the output current and the input voltage which ensures automatic current sharing operation without further precautions when several units are connected in parallel. Rising output current and falling input voltage lead to a decrease of the output voltage, according to the formula:

$$U_o \approx U_o \text{ set tol} + (0.5 - I_o/I_{o \text{ nom}}) \cdot \Delta U_{o \text{ I}} + (U_i - U_{i \text{ nom}})/100 \text{ V} \cdot \Delta U_{o \text{ U}}$$

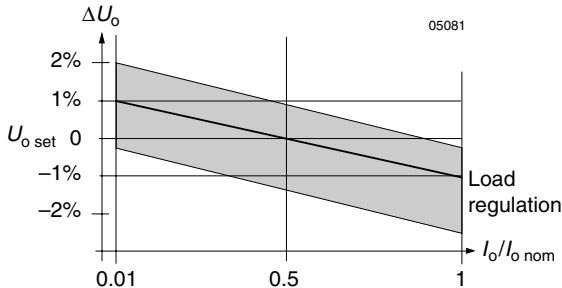


Fig. 7 Typical output voltage versus input voltage and output current of LT 1701

Note: Units with different output voltage regulation characteristics (e.g. less output current dependency) are available upon request.

Output power limitation (Rectifier Version)

Especially for power systems with an output voltage of 48V and more, the rectifier models T 1701/1702 feature an output power limitation mode. The output power is kept constant down to an output voltage of approximately 38 V. This provides improved start-up capabilities of power systems including switched mode power supplies connected to the DC bus (e.g. Melcher CQ units). At maximum load there is no need for a special start-up procedure.

The maximum input current is limited to $I_{i \text{ L}}$. At lower input voltage $U_{i \text{ red}}$ the maximum output power is limited to:

$$P_o \approx \eta \cdot U_{i \text{ red}} \cdot I_{i \text{ L}}$$

(η = efficiency $\approx 90\%$)

The T 1201 types have no output power limitation characteristic.

Output Overvoltage Protection (Rectifier Version)

A slight output voltage overshoot may occur at turn on, inhibit release or during fast load changes. A second, independent control loop interrupts operation above $U_{o \text{ L}}$ indicated by the red LED. The output voltage remains below 60 V (SELV) under all operating conditions.

Note: There is no specific built-in protection against externally applied overvoltages or transient sources like e.g. motors. Never apply voltages >60 V (>35 V) to the output. Otherwise the unit may be damaged.

Output current limitation (Rectifier Version)

The output of the T units is fully protected against continuous short circuit. The maximum constant current is limited to $I_{o \text{ L}}$ (see table: *Electrical output data*). As the LEDs indicating the system status are driven from the output voltage, in short circuit mode all LEDs switch off.

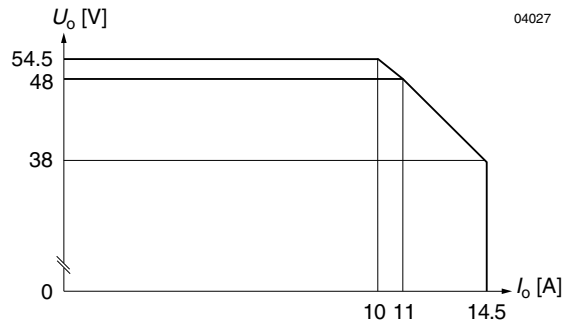


Fig. 8 Typical output voltage versus output current of UT/LT 1701/1702

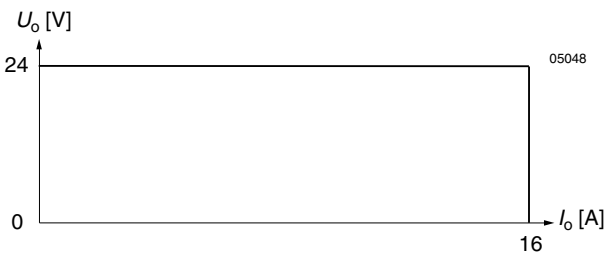


Fig. 9 Typical output voltage versus output current of UT/LT 1201

Hold-up Time (Rectifier Version)

The hold-up time depends upon the output voltage at the time of failure, the minimum acceptable output voltage and the load according to the following formula:

$$t_{\text{hold}} = \frac{U_o^2 - U_{o \text{ min u}}^2}{2 \cdot P_o} \cdot (C_o + C_{\text{ext}})$$

where:

- U_o = Output voltage at the moment of mains failure
- $U_{o \text{ min u}}$ = Minimum acceptable output voltage
- P_o = Average output power during hold up time
- C_o = Internal output capacitance
- C_{ext} = External output capacitance (e.g. on backplane)

Examples of t_{hold} are given in the table below:

Table 5: Hold-up time t_{hold} for T1701

$U_o = 54 \text{ V}$ $P_o \text{ [W]}$	$U_{o \text{ min u}}$				Unit
	46 V	43 V	40 V	38 V	
100	164	219	270	302	ms
200	82	109	135	151	
300	55	73	90	101	
400	41	55	67	75	
500	33	44	54	60	
550	30	40	49	55	

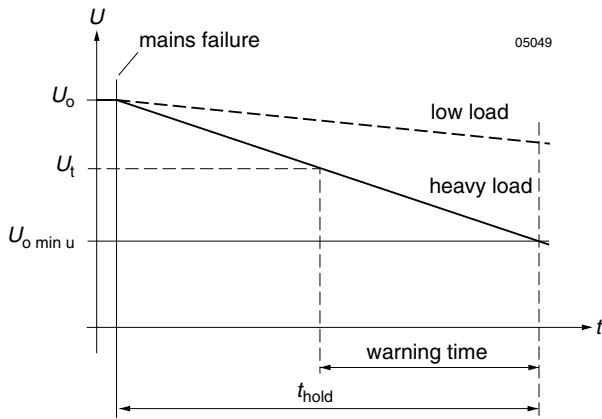


Fig. 10 Hold up and warning time with power down output signal.

The table: *Hold up time* also gives information about the warning time of the power down signal. If for example the threshold level U_t of the power down signal is set to 43 V and the minimum acceptable voltage of the load is 38 V the time between the activation of the power down signal and the switch-off of the load (550 W) will be 15 ms (55 ms - 40 ms).

Pulse Loading (Rectifier Version)

To prevent an overload of the output and filter capacitors the superimposed AC ripple current at the output should be limited as shown below. For high current pulse loads external capacitors are recommended.

For other pulse loads than stated in the figure below, e.g. $U_i < U_{i\text{ nom}}$, $I_o > I_{o\text{ nom}}$, please contact Melcher.

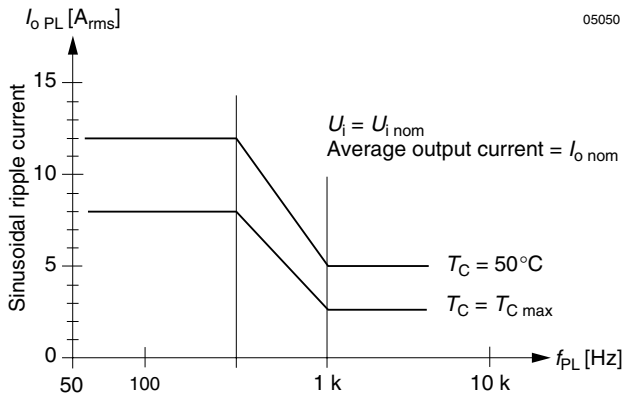


Fig. 11 Maximum allowable AC ripple output current superimposed on the average output current $I_{o\text{ nom}}$ with LT 1701 unit.

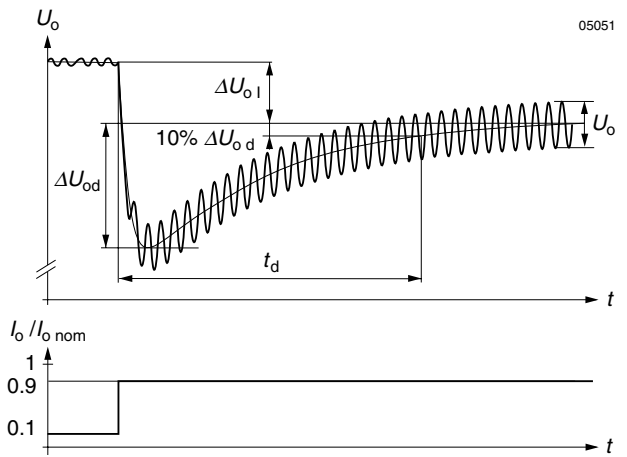


Fig. 12 Dynamic characteristics under varying load conditions (see: *Electrical Output Data*)

Inhibit input (Rectifier Version)

The rectifier versions are equipped with the inhibit function only. (The U_{cr} remote control is used with the battery charger version.)

The unit is enabled by a logic high signal and disabled by a logic low signal. This input is TTL/CMOS compatible, a resistor $<50\ \Omega$ disables the unit, a resistor $>30\ k\Omega$ enables it. The switch-on time t_r of the unit, i.e. the time delay between powering until the full output power is available, is typically 100 ms.

The hold up time at the output after inhibiting depends on the load, the internal capacitance of the unit and additional capacitance on the DC bus.

The inhibit input is protected against DC overvoltage up to 60 V.

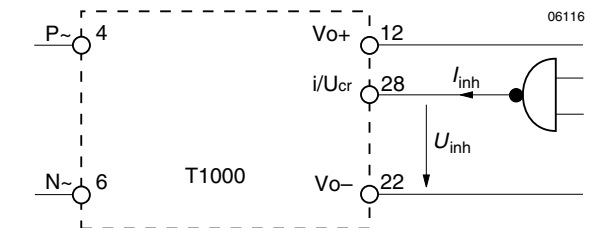


Fig. 13 Inhibit signal connection

Table 6: Characteristics of the inhibit signal

Characteristics		Conditions	min	typ	max	Unit
U_{inh}	Inhibit voltage	$U_o = \text{on}$ $U_{i\text{ min}} \dots U_{i\text{ max}}$ $T_C\text{ min} \dots T_C\text{ max}$	2.5	60		V
R_{inh}	Resistance to $Vo-$	$U_o = \text{on}$	30			k Ω
U_{inh}	Inhibit voltage	$U_o = \text{off}$	-0.7	0.4		V
R_{inh}	Resistance	$U_o = \text{off}$		50		Ω
t_r	Switch-on time until full power avail.	$U_{i\text{ nom}}$		100		ms
P_{inh}	Input power with inhibited unit			3		W

Electrical Output Data of Battery Charger Version

General conditions:

- $T_A = 20^\circ\text{C}$, unless T_C is specified.
- $U_i = U_{i\text{ nom}}$, $f = 50\text{ Hz}$

Table 7: Output data

Output		Conditions	LT/UT 1240		LT/UT 1740		LT 1840		Unit
Characteristic			min	typ max	min	typ max	min	typ max	
$U_{o\text{ set}}$	Output voltage adjustment ¹	$U_{i\text{ nom}}$ $I_o = 0.5 \cdot I_{o\text{ nom}}$	27.25		54.5		40.88		V
$U_{o\text{ set tol}}$	U_o setting tolerance ¹		27.2	27.3	54.45	54.55	40.83	40.93	
$U_{o\text{ range}}$	Output voltage range ²	25.25	28.25	50.5	56.5	37.9	42.4		
U_o	Output voltage over input voltage and load ^{3,1} (See fig.: <i>Typical output voltage versus input voltage and output current.</i>)	LT	$U_{i\text{ min}} \dots U_{i\text{ max}}$	26.8	27.6	53.8	55.0	40.3	41.3
		UT	$I_o = 0.01 \cdot I_{o\text{ nom}}$ $\dots I_{o\text{ nom}}$	26.9	27.65	54.0	55.1		
U_{oL}	Output overvoltage protection by electronic inhibit		32.5		59.3		48.4		
α_{U_o}	Temperature coefficient of output voltage	T_C fixed value	–3		–3		–3		mV/K
$I_{o\text{ nom}}$	Nominal output current		14.5		10		11		A
I_{oL}	Current limit ⁵		20		14.5		16		
P_{oL}	Output power limit ⁵	$U_{i\text{ nom}}$	400		550		450		W
u_o	Output voltage noise	Low frequency	$I_{o\text{ nom}}$		0.71		1.0		0.85
		Switching freq.	IEC/EN 61204 ⁷		40		40		40
		Total	BW = 20 MHz		0.75		1.05		0.9
ΔU_{oI}	Static load regulation ³ (See fig.: <i>Typical output voltage versus input voltage and output current.</i>)	$I_o = 0.01 \cdot I_{o\text{ nom}}$ $\dots I_{o\text{ nom}}$	0.4		0.6		0.6		V
ΔU_{oU}	Static line regulation (See fig.: <i>Typical output voltage versus input voltage and output current.</i>)	$U_i = U_{i\text{ min}} \dots U_{i\text{ max}}$ $I_{o\text{ nom}}$	0.2		0.35		0.25		
$u_{o d}$	Dynamic load regulation ⁶ (See fig.: <i>Dynamic characteristics under varying load conditions without battery back-up.</i>)	Voltage deviation	$U_{i\text{ nom}}$ $I_{o\text{ nom}} \leftrightarrow 10\%$	1.6		2.0		2.5	
t_d		Recovery time	$I_{o\text{ nom}}$ ⁸ IEC/EN 61204	0.2		0.2		0.2	
C_o	Internal output capacitance		86		41		49		mF

¹ Output voltage adjustment with $U_{cr} = 9.5\text{ V}$ (2.27 V/cell).

² Defined by sensor, by remote control and by voltage selector switch.

³ Output voltage decreases with rising output current because of output voltage slope for automatic current sharing capability.

⁵ Due to the large output capacitors the maximum transient output current can be much higher than I_{oL} , P_{oL} , respectively.

⁶ Without battery backup.

⁷ See: *Technical Information: Measuring and testing.*

⁸ See fig.: *Dynamic load regulation. Load current change for specified output. Other outputs loaded with $I_{o\text{ nom}}$.*

Output Characteristics (Battery Charger Version)

The battery charger versions T 1240/T 1740/T 1840 series can be operated in 3 different modes:

- Output voltage regulation
- Output power limitation
- Output current limitation

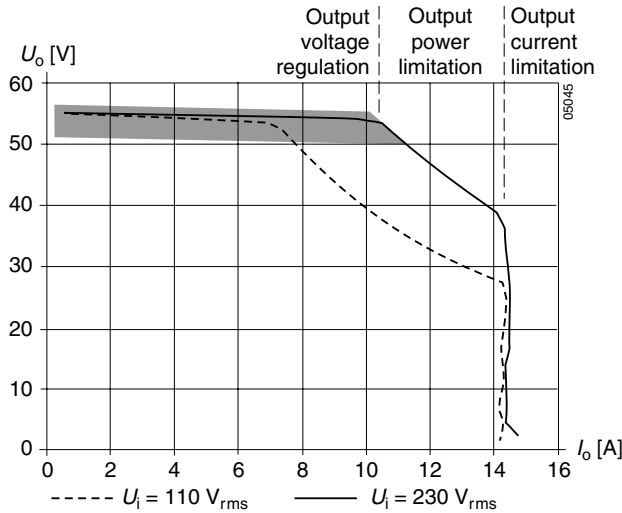


Fig. 14
Output characteristics LT 1740-7

- In output voltage regulation mode the T unit can be operated within the full temperature range -25...71 °C.
- In output power or current limitation mode the max. ambient temperature T_A should not exceed 65°C with free air convection cooling.

Output current limitation (Battery Charger Version)

The output of the T units is fully protected against continuous short circuit. The maximum constant current is limited to I_{oL} (see table: *Electrical output data*). As the LED indicating the system status are driven from the output voltage, in short circuit all LED's will switch off.

Output voltage regulation (Battery Charger Version)

In normal operating mode (unit neither in power limitation nor in current limitation) the output is regulated by a voltage feedback loop. It is adjustet to $U_{o\ set}$ and can be set by the cell voltage selector switch to the appropriate float charge voltage of the battery.

The battery charger version features a control input (pin 28) for remote output voltage adjustment either by a voltage source, a temperature sensor or an external potential divider (see: *Output voltage control via Inhibit/Ucr remote control input*). For fine tuning, the units are fitted with a trim potentiometer accessible from the rear of the connector.

The output voltage relates to the output current and the input voltage which ensures automatic current sharing operation without further precautions when several units are connected in parallel. An increase in output current and a decrease in input voltage decreases the output voltage, according to the formula: $U_o \approx U_{o\ set\ tol} + (0.5 - I_o/I_{o\ nom}) \cdot \Delta U_{o\ I} + (U_i - U_{i\ nom})/100\ V \cdot \Delta U_{o\ U}$

Note: Units with different output voltage regulation e.g. less output current dependency are available upon request.

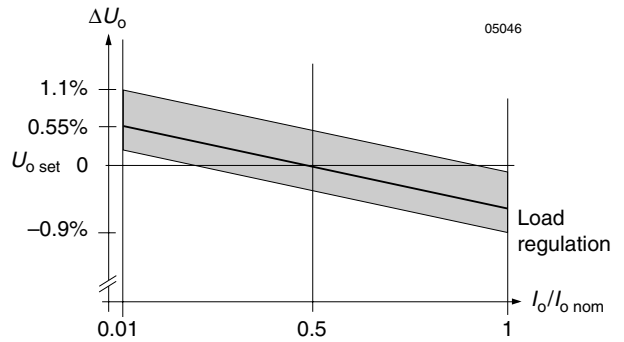


Fig. 15
Typical output voltage versus input voltage and output current of the LT 1740.

Output power limitation (Battery Charger Version)

All battery charger versions feature an output power limitation mode where the output power is kept constant from 2.35 V/cell (for lead acid batteries) to 1.6 V/cell. This provides better starting up capabilities for power systems including switched mode power supplies connected to the DC bus when the battery is charged.

The maximum input current is limited to I_{iL} . At lower input voltage $U_{i\ red}$, the maximum output power is limited to:

$$P_o \approx \eta \cdot U_{i\ red} \cdot I_{iL} \quad (\eta = \text{efficiency} \approx 90\%)$$

Typical output characteristics according to type

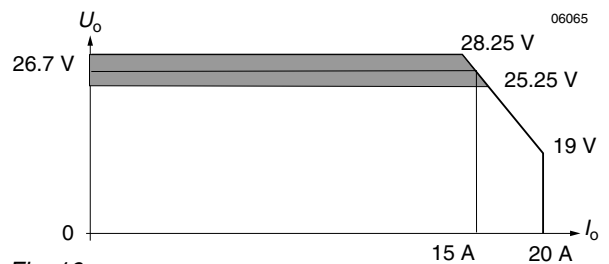


Fig. 16
Typical output voltage versus output current of UT/LT 1240

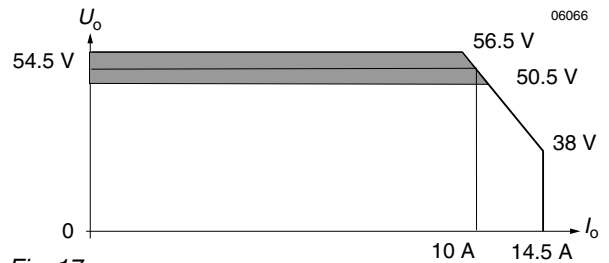


Fig. 17
Typical output voltage versus output current of UT/LT 1740

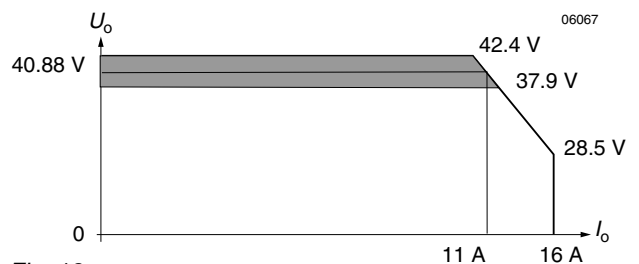


Fig. 18
Typical output voltage versus output current of LT 1840

Output Overvoltage Protection (Battery Charger Version)

A slight output voltage overshoot may occur at turn on, inhibit release or during fast load changes. A second independent control loop interrupts operation above U_{oL} , indicated by the red LED. The output voltage remains below 60 V (SELV) under all operating conditions.

Note: There is no specific built-in protection against externally applied overvoltages or transient sources like e.g. motors. Never apply voltages exceeding U_{oL} to the output. Otherwise the unit may be damaged.

Dynamic output characteristic

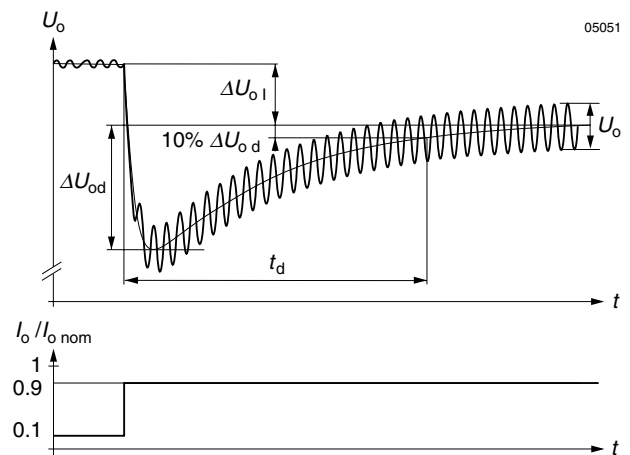


Fig. 19
Dynamic characteristics under varying load conditions (see Electrical output data) without battery back-up.

Control Features of the Battery Charger Version

According to the recommendations of battery manufacturers, the float charge voltage of a lead acid battery should be temperature compensated. Depending upon the battery type and size, charging with different temperature coefficients may be required. An excessive float charge voltage may damage the battery through overcharging.

Most lead acid battery manufacturers recommend cell voltages between 2.23 V and 2.32 V with the nominal cell voltage defined at 20°C and temperature coefficients between -3 and -4 mV/K/cell.

The value of the negative temperature coefficient, is specified by the temperature sensor.

With the cell voltage selector switch Z the required cell voltage can be adjusted at the rear of the unit, making the system flexible to different float charge voltages of battery systems.

Where the selector switch Z is not applicable, a cell voltage adjustment can also be provided via the temperature sensor (see: *Temperature Sensor*).

Although it is not recommended, the output voltage can be set to a fixed value without temperature compensation by an external voltage source or a resistive voltage divider at the remote control input (e.g. if the battery temperature shall be controlled by other systems, see: *Output voltage control via Inhibit/Ucr remote control input*).

What needs to be considered with all battery charger types: The final float charge voltage is only reached with a fully loaded battery. Since new batteries directly supplied from the manufacturer are only charged to 70...80% of their capacity, the battery system should be operated for min. 72 h prior to checking the float charge voltage.

Cell voltage selector switch Z

The standard units T xx40-7Z are equipped with the cell voltage selector switch at the rear side of the unit, which provides an easy way of external adjustment to the recommended float charge voltage for specific battery types. Each switch position allows a step in the output voltage of 10 mV/cell whereby the switch position "0" represents a cell voltage of 2.23 V at 20°C and the switch position "C" gives 2.35 V per cell.

The cell voltage selector switch fits together with the Melcher 2.23 V temperature sensor. The float charge voltage is set by the switch and the temperature coefficient is specified by the sensor type.

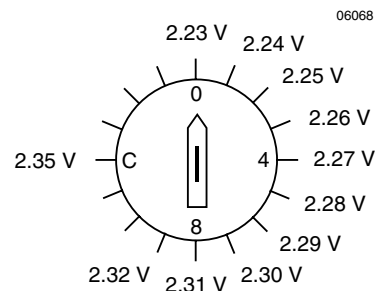


Fig. 20
Cell voltage selector switch

Important: Setting the switch to the correct battery cell voltage is vital for the proper operation of a battery system. Check whether the switch position corresponds to the required battery cell voltage prior to putting a system into operation.

Note: Switching to a different cell voltage while the T unit is in operation may cause a small and short distortion of the output voltage.

Potentiometer for fine tuning

T units are fitted with a one-turn potentiometer for fine tuning of the output voltage to within $\pm 3.7\%$ of U_o . The potentiometer is protected by a plastic cover. To adjust the output voltage for improved current sharing or compensa-

tion for voltage drops over the load lines, each of the T units in a system should be unplugged and adjusted individually to the same output voltage at equal load; otherwise current sharing may adversely be affected.

Output voltage control via Inhibit/Ucr remote control input.

Table 8: Characteristics of the inhibit signal

Characteristics			Conditions	min	typ	max	Unit
U_{inh}	Inhibit voltage	$U_o = on$	$U_{i min} \dots U_{i max}$ $T_C min \dots T_C max$	2.5		60	V
R_{inh}	Resistance to Vo-	$U_o = on$		30 k			Ω
U_{inh}	Inhibit voltage	$U_o = off$		- 0.7		0.4	V
R_{inh}	Resistance to Vo-	$U_o = off$				50	Ω
t_r	Switch on time until full power available		$U_{in om}$		100		ms
P_{inh}	Input power at inhibited unit		$U_{in om}$		3		W

The Inhibit/Ucr remote control input at connector pin 28 provides two functions:

- External adjustment of the output voltage
- Inhibiting of the unit

A voltage < 0.4 V inhibits the output, a voltage > 2.5 V enables it.

By the Ucr remote control input range of 5.5 V $< U_{cr} < 11.5$ V, the output voltage $U_{o set}$ can be adjusted within a range of $+3.6\%$ to -7.9% . This feature is optimized to control the float charge of lead acid batteries.

Outside of the control range, the sensor monitoring circuit generates a system error signal (see also: *System Good*).

In the case of a excessively high control voltage, the output is reduced.

The remote control input is protected against DC overvoltage up to 60 V .

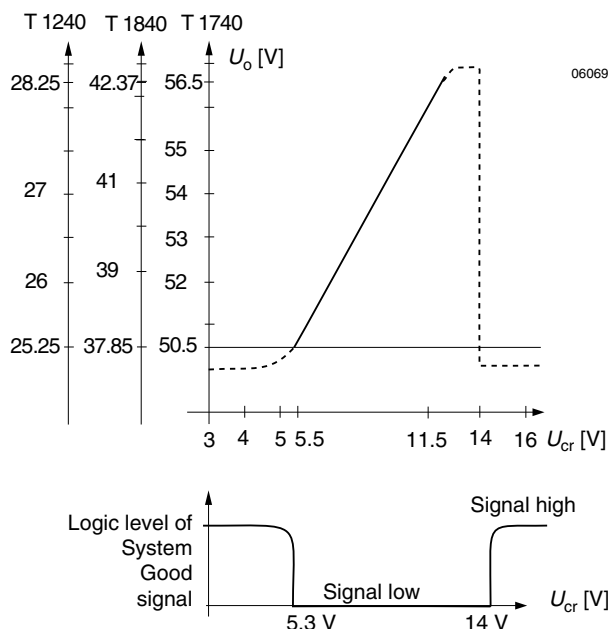


Fig. 21 Output voltage U_o versus control voltage U_{cr} , with corresponding system good signal level

Table 9: Characteristics of the remote control

Characteristics		Conditions	LT/UT 1240 typ	LT 1840 typ	LT/UT 1740 typ	Unit
U_o	Output voltage at: $U_{cr fail} 2.5 \dots 5.5$ V	Voltage selector switch Z set at 2.23 V/cell or without selector switch $U_{i nom}$ $0.5 \cdot I_{o nom}$	25.25	37.85	50.5	V
	$U_{cr control} 5.5 \dots 11.5$ V		$22.5 + U_{cr} \cdot 0.5$	$33.75 + U_{cr} \cdot 0.75$	$45 + U_{cr}$	
	$U_{cr clamp} 11.5 \dots 14$ V		28.25	42.37	56.5	
	$U_{cr fail} 14 \dots 60$ V		25.25	37.85	50.5	
R_{cr}	Input impedance		1	1	1	M Ω
f_{cr}	Frequency limit		1	1	1	Hz

Note: An open inhibit/Ucr remote control input leads to a sensor error signal which is indicated by the Error LED at the front and high impedance of the "System good" signal. The output voltage is reduced to $U_{cr fail}$ condition.

If the voltage selector switch Z is not set at 2.23 V per cell, the $U_{cr fail}$ voltage rises accordingly.

The inhibit input of the T xx40-7Z is not TTL/CMOS compatible and should be triggered by a switch, a relay or an open collector transistor.

Remote control by a resistive potential divider

With a resistive potential divider or a potentiometer connected to the remote control input, a fixed output voltage can be programmed:

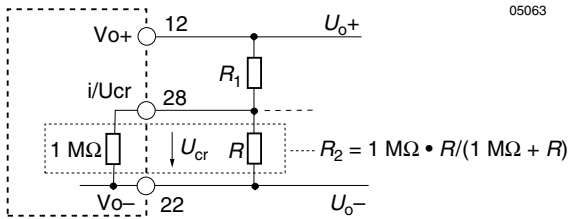


Fig. 22
Voltage setting by a resistive potential divider

$$U_{cr} = U_o - 45 \text{ V} \quad (\text{LT/UT 1740})$$

$$U_{cr} = (U_o - 33.75 \text{ V}) \cdot \frac{4}{3} \quad (\text{LT 1840})$$

$$U_{cr} = 2 \cdot U_o - 45 \text{ V} \quad (\text{LT/UT 1240})$$

$$U_{cr} = \frac{U_o \cdot R_2}{(R_1 + R_2)}$$

R_2 : Value with 1 MΩ internal resistance in parallel with R .
It is mandatory that:

$$\frac{(R_1 \cdot R_2)}{(R_1 + R_2)} > 35 \text{ k}\Omega$$

otherwise the unit might not be able to start.

Remote control by an external voltage source.

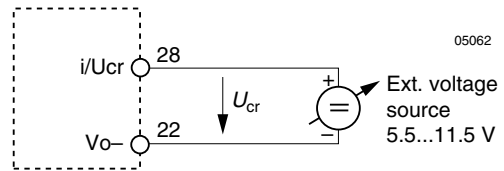


Fig. 23
Voltage setting by an external voltage source

Remote control by a temperature sensor

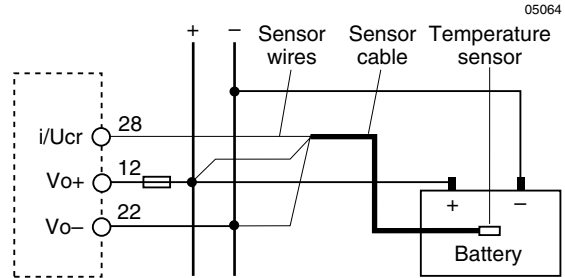


Fig. 24
Voltage setting by a temperature sensor, wiring diagram

The Melcher temperature sensor provides a temperature compensated charging process for lead acid batteries, see also: *Temperature Sensors*.

Temperature Sensors

The active T temperature sensors are of robust construction, mounted into a sealed aluminium tube of 12 mm outer diameter and 50 mm length. The sensors are water proof (IP 66) and high voltage tested with 1.4 kV DC. Connection should be done via the colored 3-wire cable to the T unit output (V_{o+} and V_{o-}) and the remote control input U_{cr} . Wrong connection may damage the sensor.

The temperature sensor should be as close to the battery terminal as possible for most accurate temperature measurements.

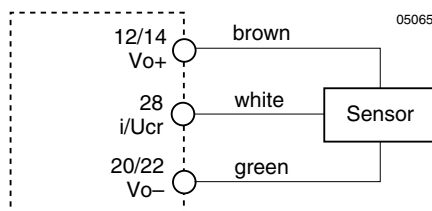


Fig. 25
Wiring diagram sensor

Table 10: Type survey

Sensor types	Battery voltage nominal [V]	Float charge voltage (20°C) [V]	Cell voltage (20°C) [V/cell]	Temp. coefficient [mV/K/cell]	Cable length [m]
S24-2.23-30-02 ¹	24	26.76	2.23	-3.0	2
S24-2.23-35-02 ¹	24	26.76	2.23	-3.5	2
S36-2.23-30-02 ¹	36	40.14	2.23	-3.0	2
S36-2.23-35-02 ¹	36	40.14	2.23	-3.5	2
S48-2.23-30-02 ¹	48	53.52	2.23	-3.0	2
S48-2.23-35-02 ¹	48	53.52	2.23	-3.5	2
S48-2.27-30-02 ²	48	54.48	2.27	-3.0	2
S48-2.27-35-02 ²	48	54.48	2.27	-3.5	2

¹ Standard types for conventional tubular lead acid batteries. The same sensor can be used for battery systems with different cell voltages within the selectable range of Z. Each step on the selector switch changes the cell voltage by 10 mV in the range from 2.23 V up to 2.32 V, at 20°C.

² Standard types for sealed lead acid batteries for LT 1740 without option Z.

Battery specific sensors with cell voltages from 2.23 V up to 2.32 V and temperature coefficients from -2 up to -4.5 mV/K/cell or different cable lengths are available upon request.

Important remarks

Note 1:

By choosing a battery with a large temperature coefficient or with a high cell voltage, the required temperature range may be limited by the output voltage control range of the T unit(s).

Note 2:

The temperature sensor together with the mounting fixture should be mounted as close as possible to the battery. Through their chemical activity batteries may be warmer than the ambient temperature. Battery banks heat up if they are mounted too close together thus blocking free air flow.

Since battery life is halved with every 10 K temperature increase, it is recommended that the batteries be mounted at the bottom of the cabinet or in a separate, cool area.

Note 3:

The sensor supply wire V_{o+} (brown) should be referred to the T unit output pin 12/14. If the sensor common (green) wire is connected to the power bus, resistive voltage drops or voltage drops across decoupling diodes in the V_{o-} supply line will be compensated by the sensor.

Decoupling diodes or fuses in the V_{o-} supply line are not recommended as in case of a short circuit across the output of a T unit, status signalling of the system is affected.

Note 4:

For installation of batteries see also VDE 510 as well as the recommendations of the battery manufacturers.

Table 11: Sensor data

Characteristics		Condition	min	typ	max	Unit
T_{sensor}	Sensor temperature range	$U_{cr} = 5.5...11.5 \text{ V}$	-10		60	°C
U_{cr}	Control voltage range	Absolute ratings	3.9		15	V
$U_{cr \text{ td}}$	Control voltage tolerance	$T_{\text{sensor}} = 20^\circ\text{C}$			±0.1	
		$T_{\text{sensor}} = 0...53^\circ\text{C}$			±0.2	

Functional Features

Available Signals and Status Monitoring

The T series feature an inhibit function as well as several voltage monitoring and indicating functions for easy control and surveillance of a complete custom specific power supply system. All the surveillance functions are driven from the T output potential and also operate in case of a mains failure down to an output voltage of 5 V. The power consumption of the surveillance circuit is typically 10 mA to 20 mA.

Available functions:

- Power Down D pin 30
 - D set pin 32
 - System Good Sys In pin 24
 - Sys Out pin 26
 - Inhibit/Ucr remote control i/Ucr pin 28
- (see Chapters: *Rectifier* respectively: *Battery Charger*)

Optical status monitoring is indicated by 3 LEDs on the front panel:

- System (OK) green
- U_o (OK) green
- Error red

Test sockets at the front panel allow easy measurement of the output voltage.

Power Down

The power down circuitry monitors the output voltage and changes its output signal status from low to high impedance when the output voltage falls below the low threshold level and changes back to low impedance, when the output voltage exceeds the upper threshold level. The rectifier versions have a relatively small hysteresis of 1 V, the battery charger versions have a large hysteresis. The upper threshold level is given the low threshold level is externally adjustable at the D set pin 32. Power Down can for example be used as a save data signal, for low voltage warning, as a low battery signal to avoid deep discharge of the battery during long term mains failure or to prevent connected converters from starting-up at a low bus voltage. For application examples see figures below for power down use.

As it is driven from the output, power down operates independently of the input voltage and load conditions, even if the unit is inhibited.

The standard version monitors the output voltage internally (see fig.: *Standard version; Power down signal monitoring directly the output of the T unit*).

Table 12: Calculation of R_{ext}

Types	$U_t > U_{t\ set}$ (R_{ext} . connected to Vo-))	$U_t < U_{t\ set}$ (R_{ext} . connected to Vo+)
T 12xx	$R_{ext}(U_t) = \frac{463.5}{U_t - 21.0} [k\Omega]$	$R_{ext}(U_t) = \frac{43.2 U_t - 463.5}{21.0 - U_t} [k\Omega]$
T 17xx	$R_{ext}(U_t) = \frac{933}{U_t - 42.5} [k\Omega]$	$R_{ext}(U_t) = \frac{43.2 U_t - 933}{42.5 - U_t} [k\Omega]$
T 18xx	$R_{ext}(U_t) = \frac{461}{U_t - 32.0} [k\Omega]$	$R_{ext}(U_t) = \frac{21.4 U_t - 461}{32.0 - U_t} [k\Omega]$

With option D the output voltage can be sensed externally for example to monitor the system bus decoupled from the power supplies by diodes or fuses.

With option D a resistor of 43.2 k Ω 1% (21.5 k Ω for T 1840) should be fitted externally into the sense line to the bus (see fig.: *With option D; Power down signal monitoring...*).

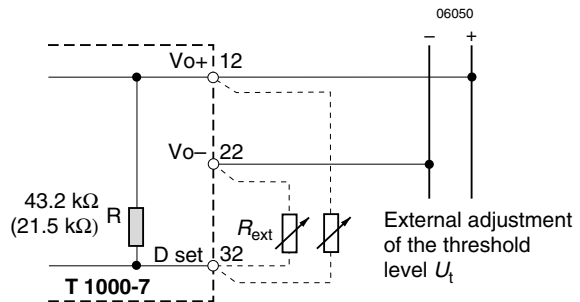


Fig. 26
Standard version; Power down signal monitoring directly the output of the T unit.

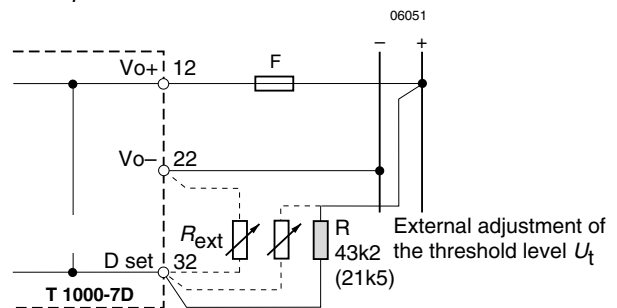


Fig. 27
With Option D; Power down signal monitoring the power bus decoupled by a fuse.

Lower threshold level

With the resistor (R_{ext}) connected to D set input pin 32 and Vo- (or Vo+) the low threshold level can be increased (or decreased) respectively. (See fig. above)

If the D set input is left open the low threshold level of the power down signal is factory set to:

- T 12xx: $U_{t\ set} = 21.0\ V \pm 0.4\ V$
- T 17xx: $U_{t\ set} = 42.5\ V \pm 0.5\ V$
- T 18xx: $U_{t\ set} = 32.0\ V \pm 0.4\ V$

The approximate resistor values for given threshold levels can be calculated from the following formulae; (U_t in V):

The threshold level is adjusted to a DC output voltage. When in operation a sinusoidal low frequency output ripple is superimposed on the DC output voltage. It can be estimated with $U_{ov} = I_o / (2 \cdot \pi \cdot f \cdot C_o)$ where C_o is the internal capacitance of the output of the unit.

Table 13: Resistor values (R_{ext}) for given Power Down threshold value U_t for LT 1740 (typical values)

Characteristics	Conditions	U_t	Unit
U_t Power Down threshold level set by R_{ext}	69 k Ω to V_{o+}	34.4	V
	106 k Ω to V_{o+}	36.4	
	254 k Ω to V_{o+}	39.5	
	left open	42.5	
	309 k Ω to V_{o-}	45.5	
	154 k Ω to V_{o-}	48.5	
	102 k Ω to V_{o-}	51.6	

Upper threshold level

The upper threshold level of the Power down function is given.

The rectifier units T xx01/02 have a relatively small hysteresis of 1 V to prevent oscillation of the signal.

The battery charger units T xx40 have a large hysteresis. The upper level is set at 2.05 V/cell.

To avoid deep discharge of the battery which would decrease the life expectancy, its load should be disconnected from the battery at the low level of the Power down signal. The battery voltage will then recover slowly up to its chemical equilibrium, about 2 V/cell. The load may not be connected again to the battery until the T unit is operating and charging it. Then the output voltage will be higher than 2.05 V/cell

High level of Power down signal

T 1240:	24.6 V	± 0.3 V
T 1740:	49.2 V	± 0.5 V
T 1840:	36.9 V	± 0.4 V

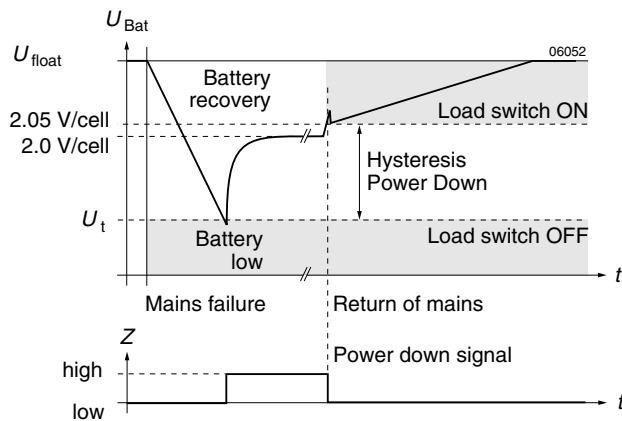


Fig. 28 Hysteresis of power down signal for battery charger types with corresponding level of power down signal

Power down output signal characteristics

The power down output D is an open collector transistor referenced to V_{o-} , protected by a 62 V Zener diode, and is well suited to driving an external relay.

Under normal operating conditions ($U_o > U_t$) the power down output D has low impedance. If the output voltage drops below the power down threshold level, the signal output becomes high impedance.

Table 14: Characteristics of Power Down functions

Characteristics	Conditions	min	typ	max	Unit
I_D Output sink current	$T_C \text{ min...} T_C \text{ max}$			50 ¹	mA
U_{sat} U saturation	$I_D = 50 \text{ mA}$			0.2	V
U_z Zener voltage				62	
P_z Z-diode P_{LOSS}	$T_C = 95 \text{ }^\circ\text{C}$			500	mW

¹ To be limited to 50 mA by the external circuitry.

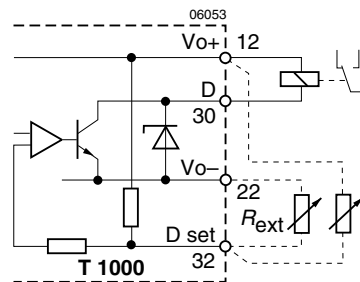


Fig. 29 Power Down – External adjustment of threshold level U_t – Signal electrically isolated by an external relay

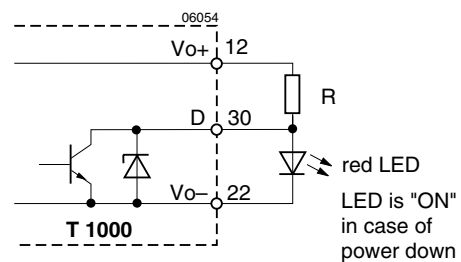


Fig. 30 Remote indication of Power Down by LED

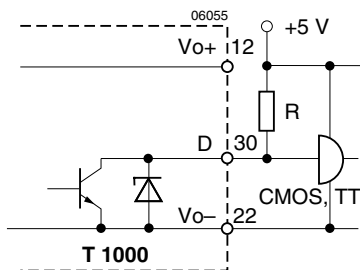


Fig. 31 Remote indication of the output voltage status by CMOS/TTL interface for e.g. Save Data

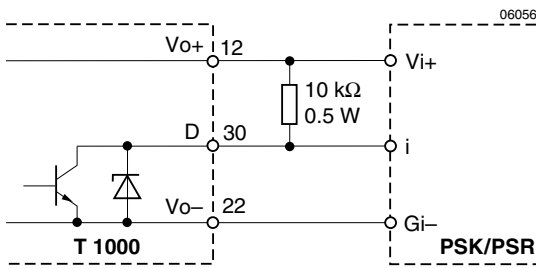


Fig. 32
Power Down used as inhibit to enable a system start-up in case of subsequently connected step-down converters PSK/PSR with low start-up voltage. (For CQ units no pull-up resistor is required.)

System Good

The system good signal provides information about the general function of the T 1000.

It can be used to monitor the status of a single T unit or can be linked with other signals within a power system to drive one single logic signal for the status of the whole system by

Table 15: Characteristics of the system good input and output

Characteristics		Conditions	min	typ	max	Unit
I_{Trig}	Trigger level for logic low input (= System OK)	current driven		100		μ A
U_{Trig}		voltage driven	-0.4		6.2	V
I_{Trig}	Trigger level for logic high input (= System Failure)	current driven		0		A
U_{Trig}		voltage driven	>7.5		60	V
I_{sys}	Output sink current ¹				50	mA
U_{sat}	Saturation voltage	$I_{Sys Out} = 50$ mA			0.2	V
U_z	Zener voltage protection diode			62		
P_z	Power disipation Zener diode	$T_C = 95^\circ$ C			500	mW

¹ To be limited to 50 mA by the external circuitry.

Signal input:

The system good input (Sys In) can be voltage or current driven. To trigger the internal comparator, the voltage at the Sys In pin has to be <6.2 V if voltage driven. If current driven, the sink current to Vo- has to be >100 μ A. An easy way to drive the system good input is achieved by means of an open collector transistor, or a 10 V CMOS interface. (See figures below)

Note: If only the internal status of a T unit is to be monitored, Sys In has to be connected to Vo-.

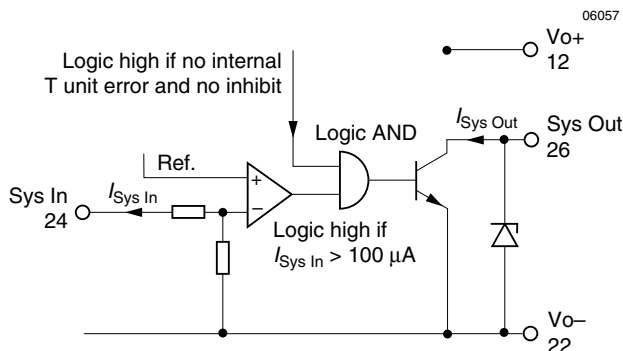


Fig. 33
Equivalent circuit of system good input and output

connecting the output of the system good signal of one unit to the input of the next unit. Low voltage (impedance) of the input and output has the meaning of "System good". The first input of the system has to be connected to Vo-.

The signal "System good" is activated (low impedance) if the following conditions are met:

No external fault

- The Sys input signal is logic low

AND

No faults monitored by the T unit such as:

- Input overvoltage
- Input undervoltage (mains failure)
- Output overvoltage
- Output short circuit
- Internal overtemperature
- Internal circuit fault
- Inhibit/Ucr remote control input error such as (inhibit voltage < 2.5 V (rectifier type); control voltage out of range 5.3 V > U_{cr} > 14 V (battery charger type) or sensor not connected, open remote control input.

Signal output:

The system good signal output (Sys Out) is an open collector transistor referenced to Vo-, protected by a 62 V zener diode. The output is well suited for relay applications.

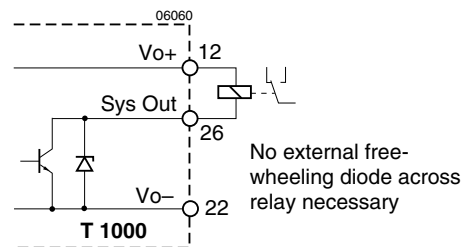


Fig. 34
System status signal electrically isolated by an external relay

Connection in Series of Power Down and System Good (Examples)

To achieve a logic OR function of the system good and power down signal connect the D output to Sys In. The desired function is then obtained from the system good output. The output signal becomes high if the output voltage is lower than the threshold of the power down circuit, inhibit is applied or an internal error has occurred.

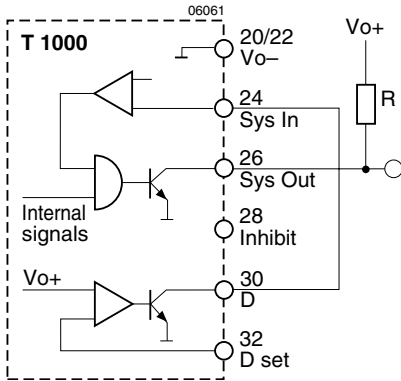


Fig. 35 System Good and Power Down connected in series. Note: Output signal will indicate error at start-up.

Paralleling of Power Down and System Good (Example)

To achieve a logic AND function of the System Good and Power Down connect the D output with the system good output. This combination generates an output signal only in case of severe system errors. Only a T system fault together with a simultaneous Power Down of the output voltage will cause this output signal to become high impedance.

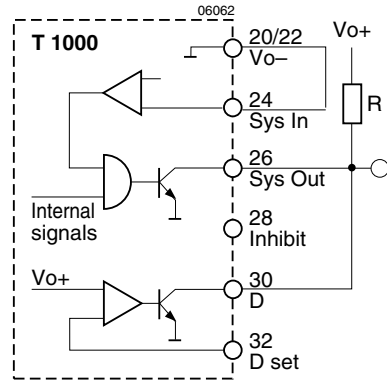


Fig. 37 System Good and Power Down connected in parallel.

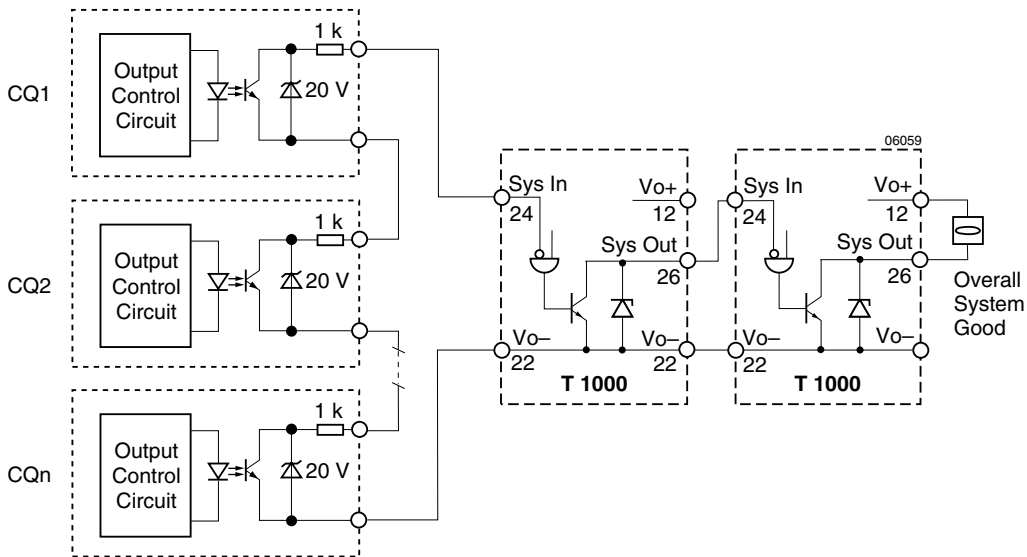


Fig. 36 Wired AND of electrically isolated open collector signals (e.g. the OUT OK signal of CQ units) with the system good signals of T units in series to achieve one signal about the status of the whole system

Display Status of LEDs**LED Sys OK (green)**

corresponds to the system good signal. The LED is ON if no internal or external error is detected.

LED U_o OK (green)

indicates the output voltage status. It corresponds to the power down signal. The LED is ON as long as U_o has exceeded the upper threshold level and has not fallen below the low threshold level U_t .

LED Error (red)

is ON if one or more of the following conditions is detected:

- Input overvoltage
- Input undervoltage (mains failure)
- Output overvoltage
- Output short circuit
- Output voltage below threshold U_t
- Internal overtemperature
- Internal circuit fault
- Inhibit/Ucr remote control input error such as:
 - (inhibit) voltage <2.5 V rectifier type
 - Remote control voltage out of range ($5.3 \text{ V} > U_{cr} > 14 \text{ V}$) battery charger type
 - Sensor not connected, open remote control input

Table 16: System monitoring

Signal status and LED display status depending on the situation of the various system elements

Possible Situation	Open collector output		LED		
	System Good	Power Down	Sys OK	U_o OK	Error
All OK	low	low	on	on	off
No mains and battery OK or no mains and $U_o > U_t$ ²	high	low	off	on	on
Unit inhibited and battery OK or unit inhibited and $U_o > U_t$ ²					
Internal error ²					
System good input logic high ³	high	low	off	on	off
No mains and battery low or no mains and $U_o < U_t$ ²	high	high	off	off	on ¹
Short circuit on LT output, $U_o < 4 \text{ V}$	high	high	off	off	off
Current limit LT output, $U_o > 4 \text{ V}$, $U_o < U_t$ ²	low	high	on	off	on
Battery charger type T xx40: sensor not connected or out of range	high	low	off	on	on

¹ LED is on until the output capacitors are discharged.

² Sys In connected to Vo–.

³ Sys In not connected to Vo– (single T status monitoring) or system status monitoring (see: *System Integration*).

Auxilliary Functions

Connection in Parallel and in Series

The output of the T units may either be connected in series or in parallel.

Connection in parallel: Current sharing between paralleled units is ensured by the output characteristic slope. Several T units may be connected in parallel.

Connection in series: A maximum of 2 T units may be connected in series, however the resulting output voltage of up to 110 V would no longer be SELV. For safety reasons the installation at the output should be protected with supplementary insulation (IEC/EN 60950).

Power Boosting, Redundant Configuration, Hot Plug-in

For redundant configurations the outputs should be decoupled to protect the DC-bus in case of an internal short circuit at the output of any of the paralleled T units.

Decoupling may either be done using series diodes or using appropriate fuses in the output path of each T unit. If the battery voltage is to be monitored, choose T units with option D.

Decoupling diodes provide reverse polarity protection with no reverse current in case of hot plug-in, but have the disadvantage of the forward voltage drop over the diode and higher power loss.

For battery applications decoupling of the T units with fuses is recommended since the voltage drop over the decoupling diodes would decrease the float charge voltage of the battery. In case of an internal short circuit at the output of a charger unit the battery will deliver a very large current causing the respective fuse to blow. The fuse should be mounted in the positive power path of the converter since the monitoring signals of the T units are referenced to the negative path. The fuse type should be suitable for DC application having a current rating of 20 A or more with high breaking capability, e.g. Littelfuse, series 314.

Several T xx40 battery charger units connected in parallel can be controlled by a single voltage source or a single sensor wired to the remote control inputs. If sensors are connected in parallel (redundant configuration), they should be decoupled by 200 kΩ resistors, (see fig.: *Sensors connected in parallel*). An individual sensor for each paralleled T unit is not recommended because current sharing is affected by the sensor tolerance.

The remote control input of the T xx40 units allows hot plug-in to an operating battery system with a single sensor without affecting the float charge voltage.

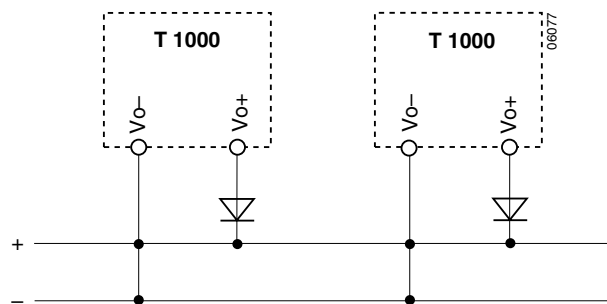


Fig. 39
T unit without battery back-up in redundant configuration

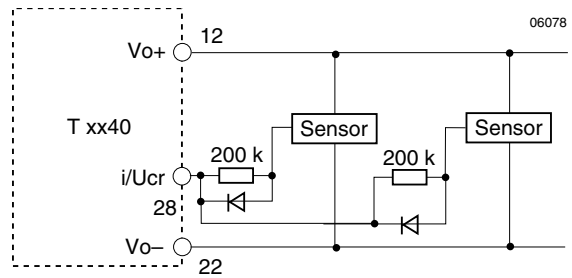


Fig. 38
Sensors connected in parallel.
Sensors in parallel provide redundant voltage adjustment in case of one of the sensors in open circuit or short circuit (add. external components required)

To enable hot plug-in in systems decoupled with fuses the T series is fitted with an NTC resistor limiting the reverse current flowing into the discharged output capacitors (see: *Functional Description*).

For this purpose the pins 16 and 18 have to be connected to Vo+ and Vo- respectively (see fig.: *T xx40 with battery back-up*).

Since pins 16 and 18 are leading pins, the output capacitors are precharged through the internal NTC resistor prior to any other pin making contact. This protects the connector and prevents the DC bus voltage from dropping during hot plug-in. Hot plugging should be done gently. Subsequent hot plug-out/plug-in of a unit with a hot NTC should be avoided as current limiting will be poor. After disconnecting an operating unit it should be cooled down prior to reconnecting to the bus to avoid damage of the fuse or the converter.

Note: The internal NTC limits the reverse charge current flowing into the output capacitors of a T unit when it is plugged into a battery buffered bus. Should however the T unit already be connected when the battery is switched to the bus, the resulting charge current will not be limited. To avoid the fuse to blow or a possible arc across the circuit breaker, the T units should be switched on to the mains prior to connecting the battery. With decoupling diodes, no reverse charge current flows from the power bus into the T output capacitors.

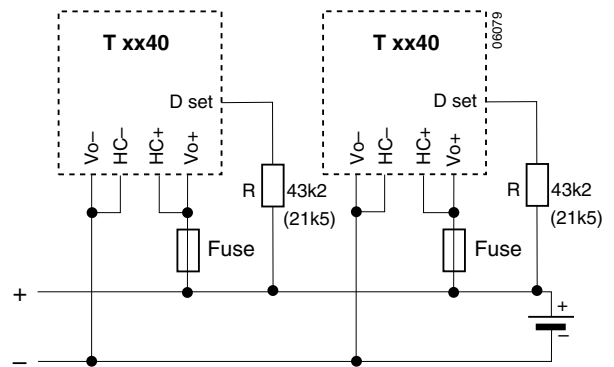


Fig. 40
T xx40 with battery back-up. Power Down signal monitoring the battery voltage.

Battery Size and Ripple Current

Some consideration should be given to the selection of the battery size. According to VDE 0510 part 2, the low frequency ripple current of the floating charge current should not exceed $5 A_{rms}$ per 100 Ah capacity (0.05 C). The power factor corrected single step conversion of the line input voltage to the low DC output voltage generates a ripple voltage at the output of twice the input frequency, causing a ripple current into the connected battery.

For systems where only a small battery back-up time is required, battery charging by one T unit may be sufficient (see also fig. below).

For systems with more than one T unit charging the battery please refer to the chapter: *Back Plane*.

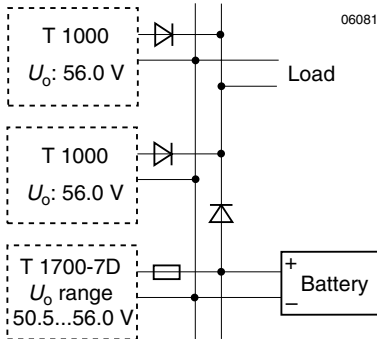


Fig. 41
Alternative configuration for a larger system with a small battery

If the ripple current is too high e.g. in the case of a smaller battery to be connected to the system, a large capacitor with low impedance can be connected in parallel with the battery. Another possibility is to connect an additional impedance to the battery line, e.g. a choke or an NTC-resistor (30 A or 60 A chokes are available on request. Please consult Melcher's application center). Further considerations for the selection of battery size include desired back-up time, required battery life, temperature range and maximum permissible discharge current. Consult the manufacturers of lead-acid batteries for the final selection.

Caution: Lead-acid batteries can generate certain amounts of H₂ and O₂ gas which can form explosive gas mixtures. Sufficient ventilation must be provided in battery cabinets and installation rooms.

Local regulations must be observed. Further information about designing battery systems is contained in VDE 0510, part 2.

Combination of T Units and CQ Units without Battery

In a complete power system consisting of two or more T units in parallel combined with Melcher CQ units it may be desirable to have one common signal indicating the status of the whole system.

The Melcher CQ units provide a galvanically isolated signal Out OK. To obtain a logic AND all CQ Out OK signals should be connected in series (see also fig.: *Wired AND of galvanically isolated open collector signals*). Out OK- of the first CQ unit should be connected to Vo-, Out OK+ of the last CQ unit should be connected to pin Sys In of one of the T units. Sys Out should be connected to Sys In of the next T unit. If one of the units fails (T or CQ) it will be indicated by the overall System Good (see fig. below).

If in a system with 2 redundant T units Power Down is desired as one common signal, independent of a possible failure of one of the two T units, simply interconnect the D pins of the two T units. In this way Power Down only becomes active if both T units fail which would result in the bus voltage falling (see fig. below).

Note: Consider the behaviour of the signalling in a system with decoupling diodes or fuses in the case of a T-failure, with the secondary in short circuit.

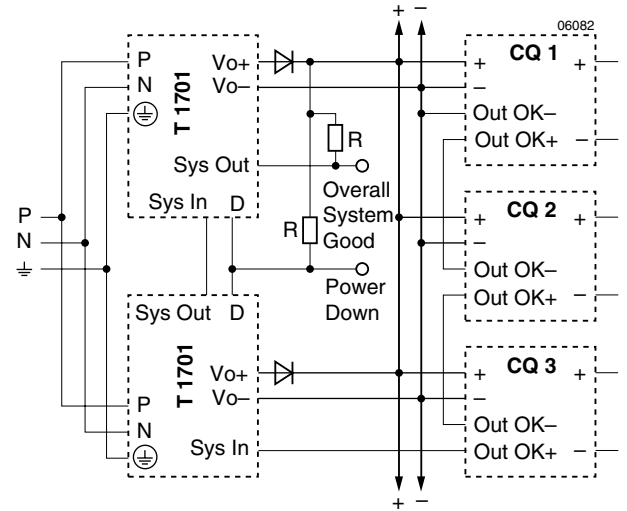


Fig. 42
Monitoring of overall System Good and Power Bus Down in a redundant system

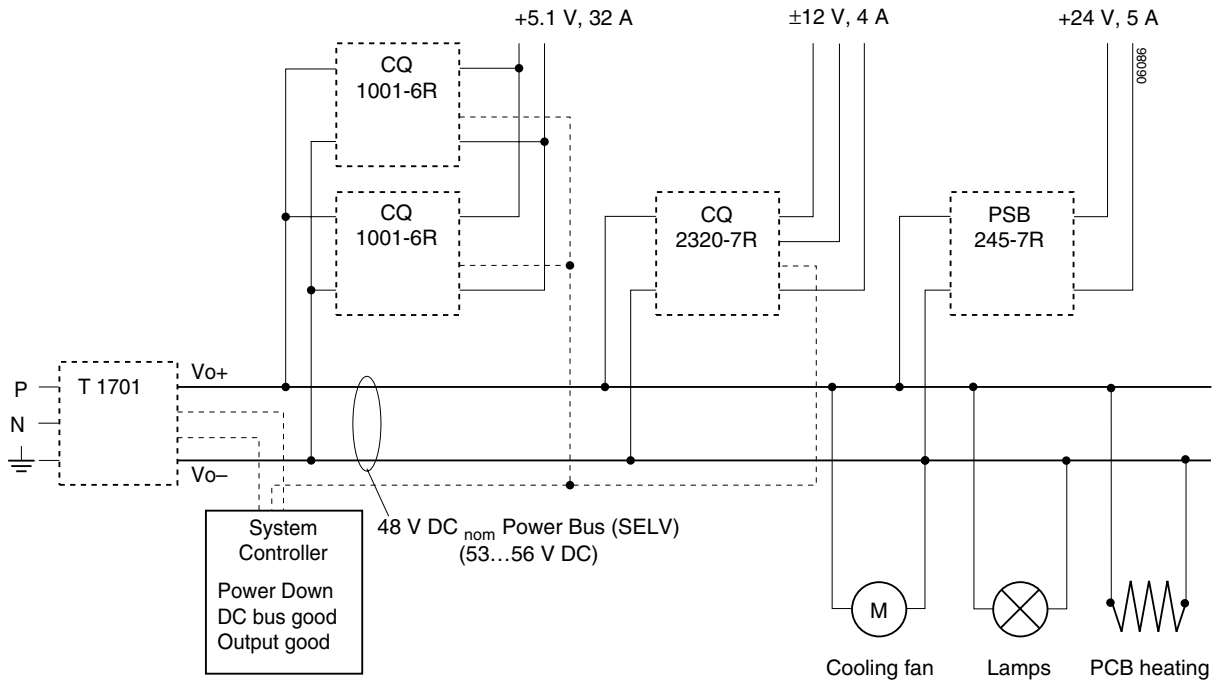


Fig. 46
Front end with various loads (example)

Electromagnetic Compatibility (EMC)

A suppressor diode or a metal oxide VDR (depending upon the type) together with an input fuse and an input filter form an effective protection against high input transient voltages

which typically occur in most installations, but especially in battery driven mobile applications. The T series has been successfully tested to the following specifications:

Electromagnetic Immunity

Table 17: Immunity type tests

Phenomenon	Standard ⁴	Level	Coupling mode ²	Value applied	Waveform	Source imped.	Test procedure	In oper.	Per-form.
Electrostatic discharge (to case)	IEC/EN 61000-4-2	4	contact discharge	8000 V _p	1/50 ns	330 Ω	10 positive and 10 negative discharges	yes	1
			air discharge	15000 V _p					
Electromagnetic field	IEC/EN 61000-4-3	3	antenna	10 V/m	AM 80% 1 kHz	n.a.	26...1000 MHz	yes	1
Electrical fast transient/burst	IEC/EN 61000-4-4	4	capacitive, o/c	2000 V _p	bursts of 5/50 ns 2.5/5 kHz over 15 ms; burst period: 300 ms	50 Ω	1 min positive 1 min negative transient per coupling mode	yes	1
		4	direct, i/c, +i/-i	4000 V _p					
Surge	IEC/EN 61000-4-5	3	i/c	2000 V _p	1.2/50 μs	12 Ω	5 pos. and 5 neg. surges per coupling mode	yes	1
		4	+i/-i			2 Ω			
	VDE 0160	II	+i/-i	2.3 • U _p	0.1/1.3 ms	1700 J max	3 pos. and 3 neg. impulses 6 repetition	yes	3
Conducted disturbances	IEC/EN 61000-4-6	3	i, o, signal wires	10 V _{rms} (140 dBμV)	AM 80% 1 kHz	150 Ω	0.15...80 MHz	yes	1

¹ Normal operation, no deviation from specifications

² i = input, o = output, c = case.

³ Normal operation, short deviation from specs. possible

⁴ Related and previous standards are referenced in: *Technical Information: Standards*

Electromagnetic Emission

The conducted noise emitted at the input of the T units within the frequency range of 10 kHz to 30 MHz is below level B according to CISPR 11/22/EN 55011/22 under all operating conditions.

The radiated noise in the frequency range of 30 MHz to 300 MHz on the input- and the output-side of the T units stays below the limit of CISPR 14/EN 55014 measured

with an MDS-clamp and below level A, according to CISPR 11/22/EN 55011/22 measured with an antenna.

The radiated noise of the T units between 30 MHz and 1 GHz will be reduced if the unit is built into a conductive chromatinized 19" rack, fitted with a Melcher front panel. For units mounted otherwise, e.g. for wall mounting with option B1 (base plate) the radiated noise may be above level A.

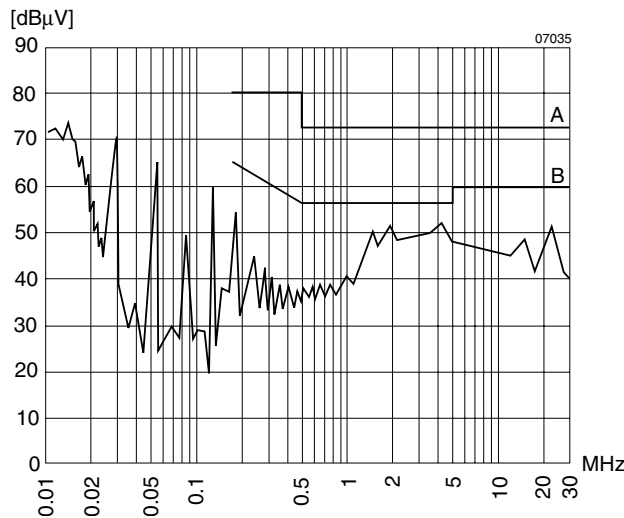


Fig. 47
Typical disturbance voltage (quasi-peak) at the input of a T series AC-DC converter according to CISPR 11/22 and EN 55011/22, measured at U_{i nom} and I_{o nom}.

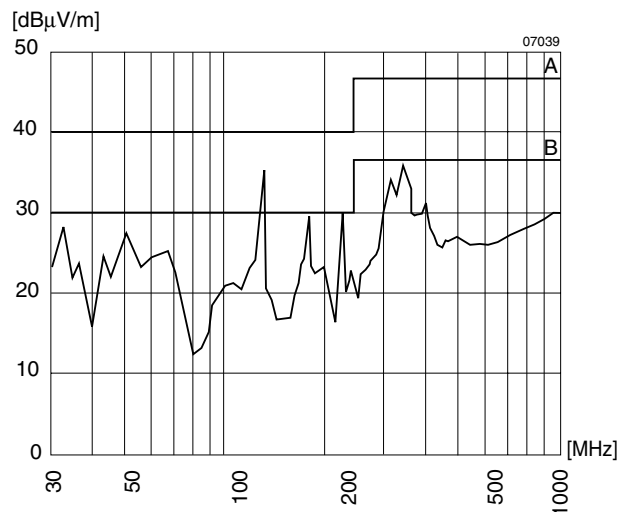


Fig. 48
Typical radiated electromagnetic field strength (quasi peak) of an LT 1740 according to CISPR 11/22/EN 55011/22, normalized to a distance of 10 m, measured on an open area test site at U_{i nom} and I_{o nom}.

Immunity to Environmental Conditions

Table 18: Mechanical stress

Test method		Standard	Test conditions		Status
Ca	Damp heat steady state	IEC/DIN IEC 60068-2-3	Temperature: Relative humidity: Duration:	40 ±2 °C 93 +2/-3 % 56 days	Unit not operating
Ea	Shock (half-sinusoidal)	IEC/EN/DIN EN 60068-2-27	Acceleration amplitude: Bump duration: Number of bumps:	100 g _n = 981 m/s ² 6 ms 18 (3 each direction)	Unit operating
Eb	Bump (half-sinusoidal)	IEC/EN/DIN EN 60068-2-29	Acceleration amplitude: Bump duration: Number of bumps:	40 g _n = 392 m/s ² 6 ms 6000 (1000 each direction)	Unit operating
Fc	Vibration (sinusoidal)	IEC/EN/DIN EN 60068-2-6	Acceleration amplitude: Frequency (1 Oct/min): Test duration:	0.21 mm (10...60 Hz) 3 g _n = 29.4 m/s ² (60...2000 Hz) 10...2000 Hz 7.5 h (2.5 h each axis)	Unit operating
Fda	Random vibration wide band Reproducibility high	IEC 60068-2-35 DIN 40046 part 23	Acceleration spectral density: Frequency band: Acceleration magnitude: Test duration:	0.05 g _{n rms} 20...500 Hz 4.9 g _{n rms} 3 h (1 h each axis)	Unit operating
Kb	Salt mist, cyclic (sodium chloride NaCl solution)	IEC/EN/DIN IEC 60068-2-52	Concentration: Duration: Storage: Storage duration: Number of cycles:	5% (30°C) 2 h per cycle 40°C, 93% rel. humidity 22 h per cycle 3	Unit not operating

Table 19: Temperature specifications

Temperature			-7			Unit
Characteristic	Conditions	min	typ	max		
T _A	Ambient operational temperature range	$I_o = 0 \dots I_o \text{ nom}$	-25		71	°C
		$I_o > I_o \text{ nom}$	-25		65	
	Temperature range for battery charging		limited by U_{cr} range			
T _C	Case operational temperature range at measurement point (see: <i>Mechanical Data</i>)	$I_o = 0 \dots I_o \text{ nom}$	-25		95	
		$I_o > I_o \text{ nom}$	-25		90	
T _S	Storage temperature range (not operating)		-40		100	
T _{Cs}	Shut down case temperature			100		
R _{th CA}	Thermal resistance case to ambient	convection cooling		0.5		K/W
τ _C	Thermal time constant of case			1		h

Table 20: MTBF

Values at specified case temperature	Module types	Ground benign	Ground fixed		Ground mobile	Unit
		40°C	40°C	70°C	50°C	
MTBF ¹	LT 1701-7	198'000	56'000	26'000	20'000	h
Device hours ²		810'000				

¹ Calculated in accordance with MIL-HDBK-217E (calculation according to edition F would show even better results)

² Statistical values, based on an average of 4300 working hours per year and in general field use, over 3 years

Environmental Conditions

Thermal Considerations

Despite the fact that the T series have a very high efficiency the operating losses of the unit will heat the case. The heat sinks are designed to dissipate the power losses at maximum output power over the specified temperature range without forced cooling if the convection cooling provides sufficient air volume, without obstructions for vertical air exchange below and above the units.

Because of the slightly higher power losses in output power and current limitation mode the maximum admissible ambient and case temperature is then lower than in output voltage regulation mode.

The T series have a built-in overtemperature shut down to protect the internal circuitry.

Derating is required for applications with higher operational ambient temperature. Fig.: *Output power vs. ambient temperature* shows the derating of the output power versus operational temperature above the specified ambient temperature of 71°C of an LT 17xx unit. Two different conditions are shown:

a) Unit operating with convection cooling (solid line).

For example if the operational ambient temperature reaches 80°C, the maximum output power should be limited to approx. 290 W. In this case steady operation in output power or current limitation mode is not possible.

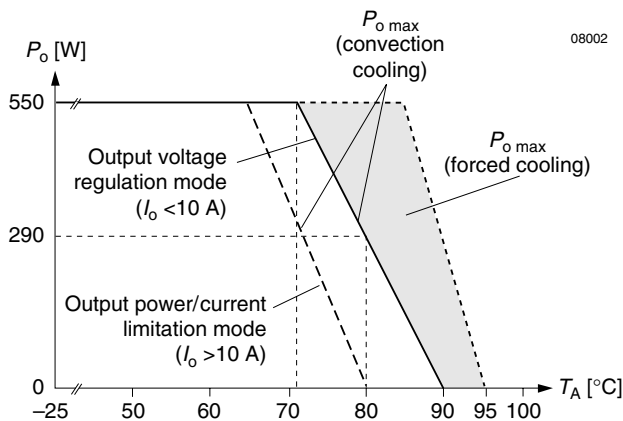


Fig. 49
Output power versus ambient temperature of T 17xx

b) Unit operating with forced cooling (dotted line).

Under these conditions, the case temperature of the T unit is decisive. With sufficient cooling provided (air flow!), the unit still delivers 550 Watts output power in voltage regulation mode even at 85°C ambient temperature, provided that the maximum case temperature of 95°C is not exceeded (Measuring point of case temperature T_C , see: *Mechanical Data*). If the case temperature does not exceed 90°C, steady operation in output power or current limitation mode is still possible. Nevertheless it is not recommended to operate the units continuously close to the maximum case temperature since life time will be reduced.

Since the operating temperature of a power supply is of major importance to reliability the following conditions should be considered:

1. Do not cover heat sinks.
2. Do not obstruct air flow around the heat sinks.
3. Maximize free space around the units.
4. In a system where the power supplies as well as the loads are located in the same enclosure, forced cooling is recommended. The T units should be placed in the lower section of the enclosure.
5. In a closed system heat may build up causing excessive temperatures.
6. Always check the maximum ambient and case temperature after system integration.

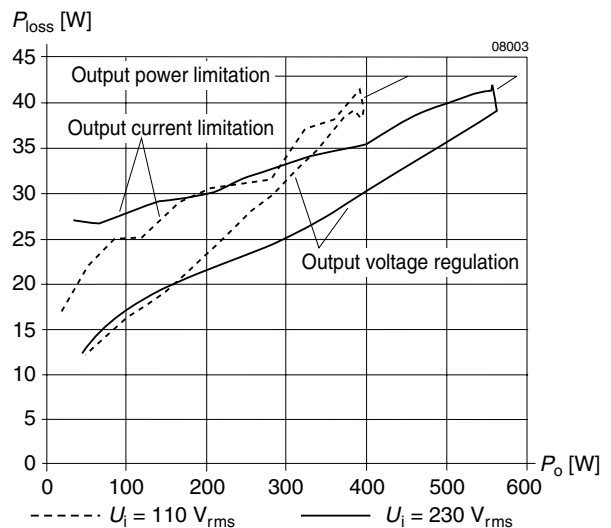


Fig. 50
Internal power losses versus nominal output power of T 17xx

Mechanical Data

Dimensions in mm. Tolerances ± 0.3 mm unless otherwise indicated.



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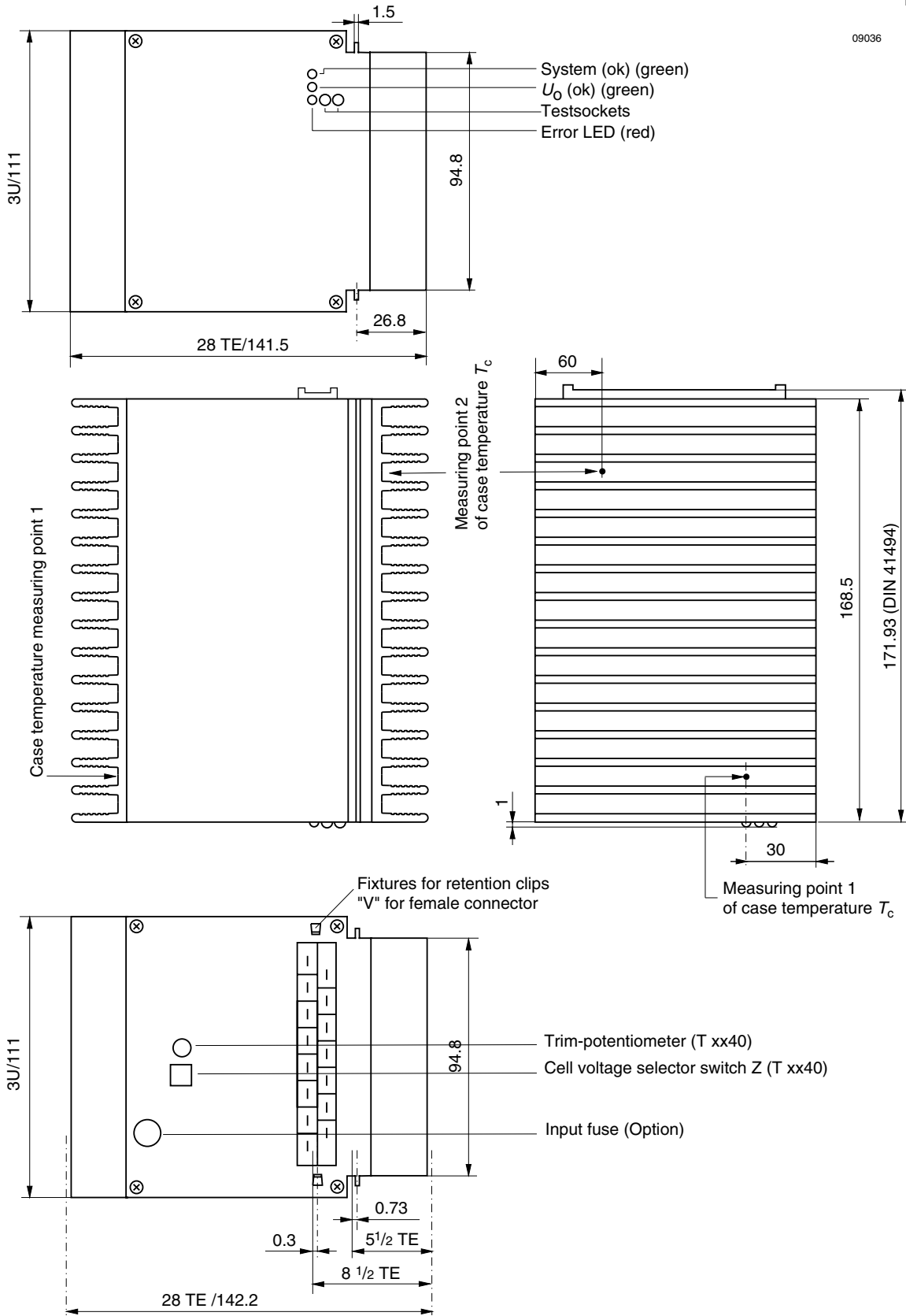


Fig. 51
Case T01, weight 3.0 kg

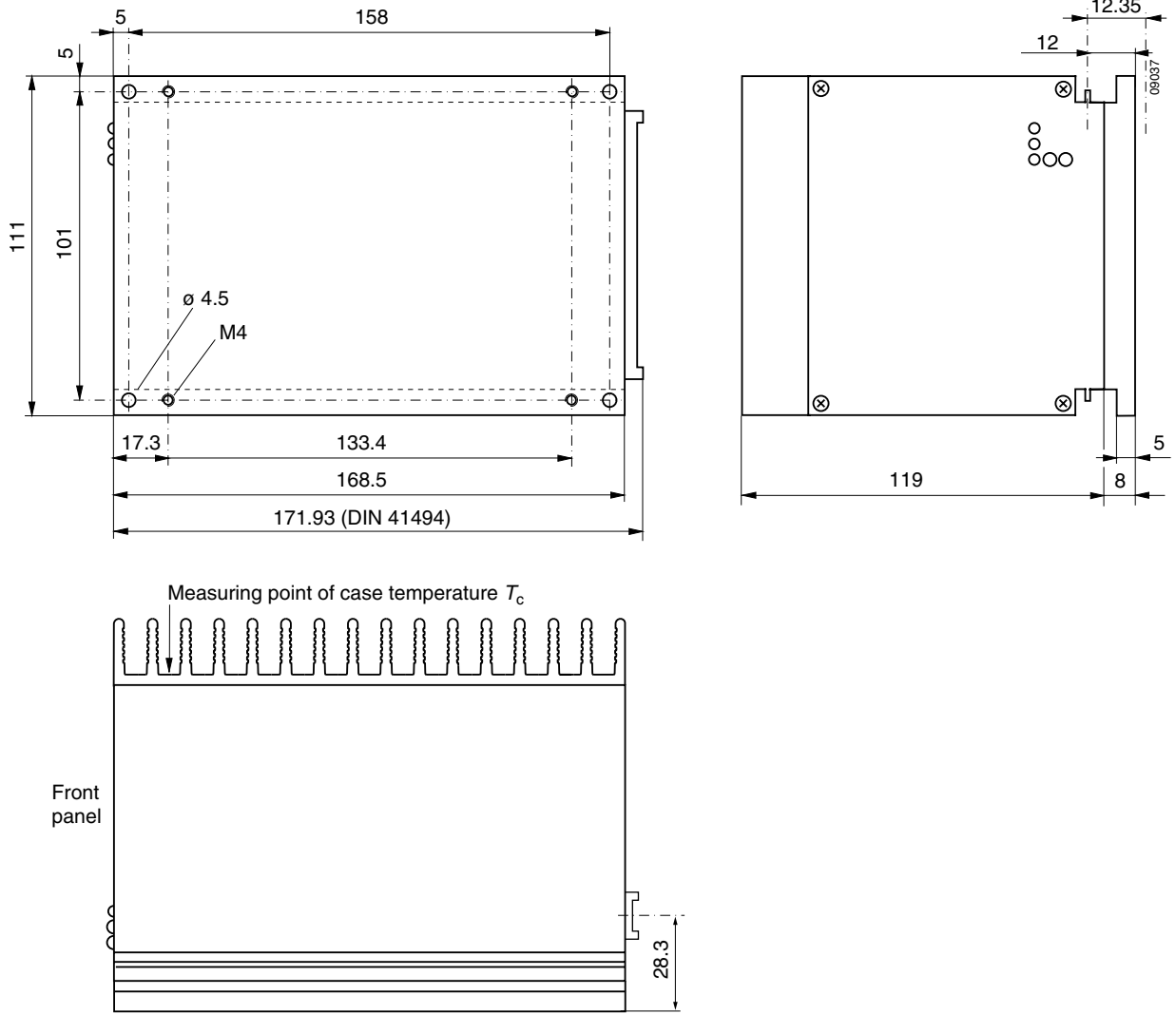


Fig. 52
Case T01 with option B1 (cooling plate)

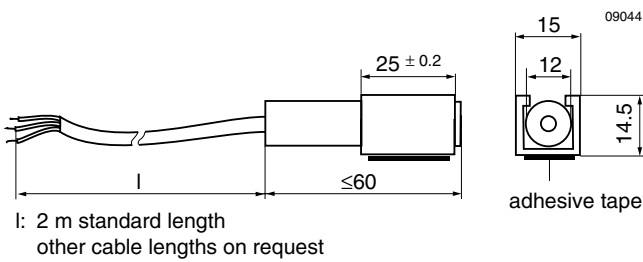


Fig. 53
Temperature sensor with mounting fixture.

Safety and Installation Instructions

Connector Pin Allocation

The connector pin allocation table defines the electrical potentials and the physical pin positions on the H15 connector. Pin no. 8 and pin no. 10, the protective earth pins present on all T series AC-DC converters are leading, ensuring that they make contact with the female connector first.

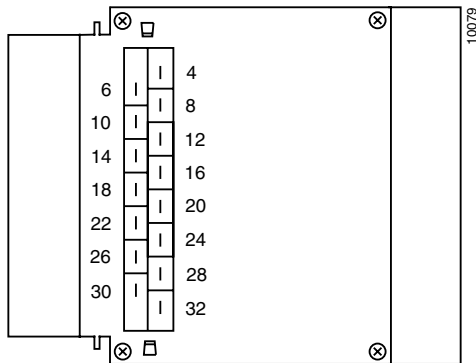


Fig. 54
View of module's male H15 connector

Installation Instruction

The T series AC-DC converters are components, intended exclusively for inclusion within other equipment by an industrial assembly operation or by professional installers. Installation must strictly follow the national safety regulations in compliance with the enclosure, mounting, creepage, clearance, casualty, markings and segregation requirements of the end-use application. See also: *Technical Information: Installation and Application*.

Connection to the system shall be made via the female connector H15 (see: *Accessories*) according to: *Connector pin allocation*. Other installation methods may not meet the safety requirements.

Check for hazardous voltages before altering any connections.

The AC-DC converters are provided with pins 8 and 10 (\oplus), which are reliably connected to the case. For safety reasons it is essential to connect at least one of these pins to the protective earth of the supply system.

The P~ input (pin no. 4) is internally fused. This fuse is designed to protect the unit in case of overcurrent and may not be able to satisfy all customer requirements. External fuses in the wiring to one or both input pins (no. 4 and/or no. 6) may therefore be necessary to ensure compliance with local requirements. A second fuse in the wiring to the neutral terminal N~ is needed if:

- Local requirements demand an individual fuse in each source line
- Neutral to earth impedance is high or undefined
- Phase and neutral of the mains are not defined or cannot be assigned to the corresponding terminals (L to phase and N to neutral).

Table 21: H15 Connector pin allocation

Pin	Electrical determination	Designation
4	Phase	P~
6	Neutral	N~
8	Protective earth ¹	\oplus
10	Protective earth ¹	\oplus
12	Output voltage positive	Vo+
14	Output voltage positive	Vo+
16	Hot plug-in contact ^{1 3} positive	HC+
18	Hot plug-in contact ^{1 3} negative	HC-
20	Output voltage negative	Vo-
22	Output voltage negative	Vo-
24	System good signal input	Sys In
26	System good signal output	Sys Out
28	Inhibit input ² or Remote control input	i/U _{cr}
30	Power down signal	D
32	Power down signal threshold of U _o	D set

¹ Leading pin (pre-connecting).

² Unit operates with open inhibit.

³ External connections see: *Auxiliary Functions: Power Boosting, Redundant Configuration, Hot Plug-in*.

Important: Do not open the modules, or guarantee will be invalidated.

Caution: Prior to handling, the AC-DC converter must be disconnected from mains and from other sources (e.g. batteries). Check for hazardous voltages and hazardous energy before and after altering any connections. Hazardous energy levels may be present at the output terminals for 3 minutes even after the mains input voltage has been disconnected from the unit. This is indicated by the red error LED. It is the responsibility of the installer to prevent an unwanted short-circuit of the AC-DC converter and of the batteries. To prevent an unwanted short-circuit across the output of a disconnected unit, pins 16 and 18 are leading. In case of a short-circuit across the output of a T-unit, all LEDs will be off, though the mains may be present.

Due to high output current value, the T series AC-DC converters provide for each the positive and the negative output path two internally parallel connected contacts (pins 12/14 and pins 20/22 respectively). It is recommended to connect the load to both female connector pins of each path in order to keep the voltage drop and power loss across the connector pins to an absolute minimum.

If a T series AC-DC converter is used for battery charging, check whether the position of the cell voltage selector switch corresponds to the required battery cell voltage prior to putting a system into operation.

Caution: Lead-acid batteries can generate H₂ and O₂ gas which can form explosive mixtures. Sufficient ventilation must be provided in battery cabinets and installation rooms.

Further information about designing battery systems is contained in VDE 0510, part 2.

If a T unit is to be parallel connected with another T unit, it is recommended to connect the two hot plug-in pins of each female connector, HC+ (pin 16) and HC- (pin 18) to their respective output pins Vo+ and Vo- to provide the hot plug-in capabilities.

In case of remote temperature control, the temperature sensor should be connected according to its wiring diagram. Wrong connection may damage the sensor.

Make sure that there is sufficient air flow available for convection cooling. This should be verified by measuring the case temperature when the unit is installed and operated in the end-use application. The maximum specified case temperature $T_{C\ max}$ must not be exceeded. See also: *Thermal Considerations*.

If the end-product is to be UL certified, the temperature test may be repeated as part of the end-product investigation.

Ensure that a unit failure (e.g. by an internal short-circuit) does not result in a hazardous condition. See also: *Safety of operator accessible output circuit*.

Cleaning Agents

In order to avoid possible damage, any penetration of cleaning fluids is to be prevented, since the power supplies are not hermetically sealed.

Audible Noise

Under certain operating conditions, a T series AC-DC converter may generate a slight audible noise due to magnetostriction in the transformer. This noise does neither affect

the function of the unit nor is it detrimental to its performance over time.

Standards and approvals

All T series AC-DC converters correspond to class I equipment. They are UL recognized according to UL 1950, UL recognized for Canada to CAN/CSA C22.2 No. 950-95 and LGA approved to IEC/EN 60950 standards and have been evaluated in accordance with these standards for:

- Building in
- Basic insulation between input and case, based on 250 V AC
- Double or reinforced insulation between input and output, based on 250 V AC
- Operational insulation between output and case
- The use in a pollution degree 2 environment
- Connecting the input to a primary circuit with a maximum transient rating of 2500 V (overvoltage class III based on a 110 V primary circuit, overvoltage class II based on a 230 V primary circuit).

The AC-DC converters are subject to manufacturing surveillance in accordance with the above mentioned UL, CSA, EN and with ISO 9001 standards.

Isolation

The electric strength test is performed as factory test in accordance with IEC/EN 60950 and UL 1950 and should not be repeated in the field. Melcher will not honour any guarantee claims resulting from electric strength field tests.

Important: Testing by applying AC voltages will result in high and dangerous leakage currents flowing through the Y-capacitors (see fig.: *Block diagram*).

Table 22: Isolation

Characteristic		LT/UT AC-DC converter			Sensor	Unit
		Input to case	Input to output	Output to case	Output to case	
Electric strength test voltage	Required according to IEC/EN 60950	1.5	3.0 ¹	0.5	0.5	kV _{rms}
		2.1	4.2 ¹	0.7	0.7	kV DC
	Actual factory test 1 s	2.8	5.6 ¹	1.4	1.4	
	AC test voltage equivalent to actual factory test	2.0	4.0 ¹	1.0	1.0	kV _{rms}
Insulation resistance at 500 V DC		>300	>300	>300	>100	MΩ

¹ In accordance with IEC/EN 60950 only subassemblies are tested in factory with this voltage.

Leakage Currents in AC-DC operation

Leakage currents flow due to internal leakage capacitance and RFI suppression Y-capacitors. The current values are proportional to the mains voltage and nearly proportional to the mains frequency. They are specified at maximum operating input voltage where phase, neutral and protective earth are correctly connected as required for class I equipment.

Under test conditions, the leakage current flows through a measuring instrument (MI) as described in fig.: *Measuring instrument for earth leakage current tests*, which takes into account impedance and sensitivity of a person touching unearthed accessible parts. The current value is calculated by dividing the measured voltage by 500 Ω. If inputs and/or outputs of T units are connected in parallel, their individual leakage currents are added.

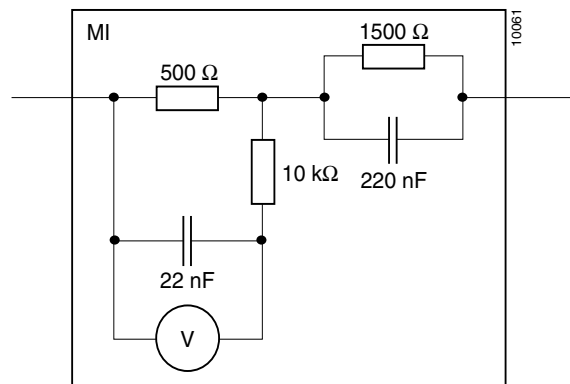


Fig. 55 Measuring instrument (MI) for earth leakage current tests according to IEC/EN 60950, Annex D.

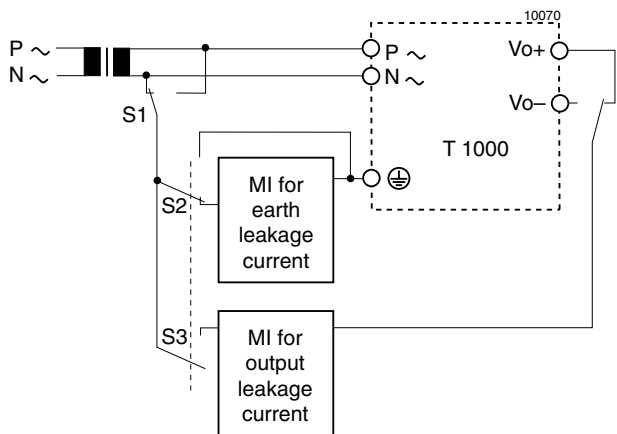


Fig. 56
Test set-up for leakage current tests on class I equipment in single phase configuration. S1 is used to simulate the interchanging of phase and neutral, S2/3 select either the earth or output leakage current measurements, S4 selects either the positive or negative output leakage current measurements.

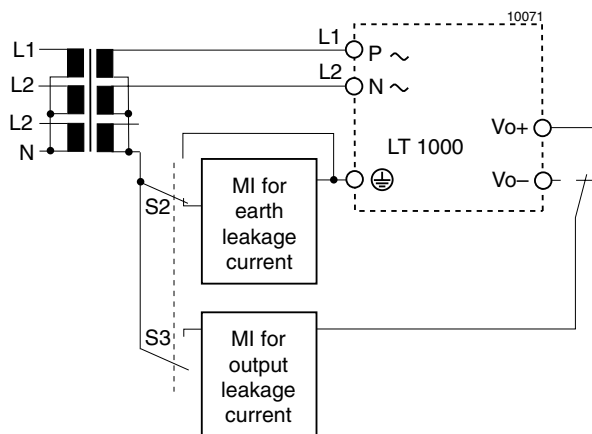


Fig. 57
Test set-up for leakage current tests on class I equipment in 208 V phase to phase configuration. S2/3 select either the earth or output leakage current measurements, S4 selects either the positive or negative output leakage current measurements.

Table 23: Leakage currents

Characteristic		T 1000	Unit
Earth leakage current	Permissible according to IEC/EN 60950	3.5	mA
	Specified value at 255 V, 50 Hz (LT)	1.8 ¹	
	Specified value at 127 V, 60 Hz (LT or UT)	1.1 ¹	
Output leakage current	Permissible according to IEC/EN 60950	0.25	
	Specified value at 255 V, 50 Hz (LT)	<0.1	
	Specified value at 127 V, 60 Hz (LT or UT)	<0.1	

¹ In phase to phase configuration, leakage current is lower.

Safety of operator accessible output circuit

If the output circuit of an AC-DC converter is operator accessible, it shall be an SELV circuit according to IEC/EN 60950 related safety standards

The following table shows a possible installation configuration, compliance with which causes the output circuit of the AC-DC converter to be an SELV circuit according to IEC/EN 60950 up to a configured output voltage (sum of nominal voltages if in series or +/- configuration) of 56.5 V.

Table 24: Safety concept leading to an SELV circuit

Conditions	AC-DC converter	Installation	Result
Supply voltage	Grade of isolation between input and output, provided by the AC-DC converter	Measures to achieve the resulting safety status of the output circuit	Safety status of the AC-DC converter output circuit
Mains ≤250 V AC	Double or reinforced	Installation according to the applicable standards	SELV circuit

However, it is the sole responsibility of the installer to assure the compliance with the relevant and applicable safety regulations. More information is given in: *Technical Information: Safety.*

Protection Degree

IP 30 if female connector is fitted to the unit.

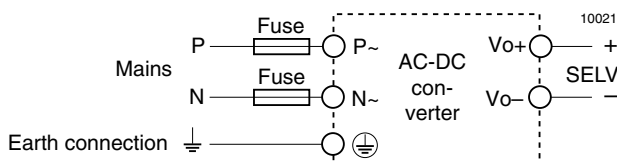


Fig. 58
Schematic safety concept
Use input fuses and earthing of the AC-DC converter as per: *Installation Instructions.*

Description of Options

D Remote Bus Voltage Monitoring

This option is designed for systems using Melcher back-planes or is intended for use in applications where a fuse or a decoupling diode is fitted into the positive supply line to the system bus. The status of the system bus/battery voltage can be monitored rather than the output status of a single T unit. To maintain the adjustment capabilities and resistor values for setting the different threshold values a 43.2 k Ω (21.5 k Ω) resistor should be fitted into the sense line to the bus. If the D set pin is left open the T unit signals permanently Low Bus Voltage.

(See also: *Power Down* as well as data sheet: *Back Planes for the T Series*)

F Externally Accessible Fuse

The standard T units have internally a 5 × 20 mm fuse which is externally not accessible. Some applications require an externally accessible fuse. Option F provides a fuse mounted on the back plate near the converter. The full self-protecting functions of the module do normally not lead to broken fuses, except as a result of overvoltage at the input or if a power component inside fails (switching transistor, freewheeling diode, etc.). In such cases the defective unit has to be returned to Melcher for repair.

B1 Cooling Plate

If a cooling surface is available the T 1000 units can be provided with a mounting plate (option B1) instead of the standard heat sink fitted to the right hand side of the unit. Since approximately 50% of the losses have to be dissipated through the heat sink on the left hand side sufficient free air flow has still to be provided.

Accessories

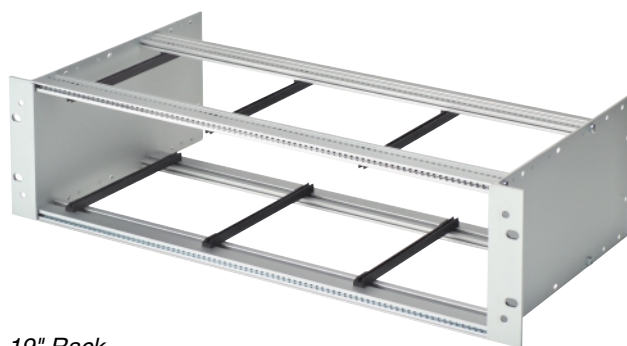
A variety of electrical and mechanical accessories are available, including:

- Front panels for 19" rack mounting, Schroff system
- Mating H15 connectors with screw, solder, fast-on or pressfit terminals
- Connector retention facilities
- Code key system for connector coding
- 19" racks for system integration
- Back planes for system integration
- Temperature sensors for battery charging

For more detailed information refer to: *Accessory Products*.



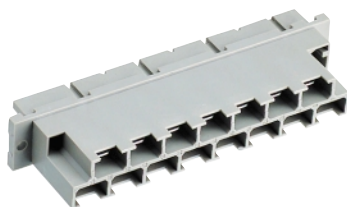
Back planes for system integration



19" Rack



Front panels



*H15 female connector
Code system*