



USER MANUAL LQT40F



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The LQT40F is a programmable multi transducer for power systems. All electrical quantities for AC current and voltage (True RMS) are covered by one single unit. It can measure single phase systems up to 4-wire unbalanced load systems. Serial communication with Profibus or Profinet.

Our free transducer configuration software “ConfigLQT” is used to easily program the LQT40F via its USB-port.

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1 Instructions

1.1 Purpose of this document

This document describes how to use the LQT40F multi transducer. The user manual is intended to be used by:





- installation personnel and commissioning engineers
- service and maintenance personnel
- planners

1.2 Mounting

The transducer can be mounted on a 35 mm DIN rail according EN50022, on a wall or device cabinet for suitable protection. The enclosure shall not be accessible without tools.

1.3 Installation

The installation shall be made by trained personnel and in accordance with applicable regulations. Before the installation, please check that the transducer is the correct type and complies with the installation needs.

	A marked external circuit breaker to turn off the power supply to the transducer must be installed near. The OFF-position shall be clearly marked.
	Attention: Danger to life! Ensure that all leads are free of potential when connection them!
	Voltage measurements inputs must have circuit breakers or fuses rated 5 Amps or less.
	The measuring circuits from the current transformers must be short-circuited before disconnection. No fuses are allowed on the current inputs.

1.4 Operation

The transducer is intended for operation at an altitude not exceeding 2000 m and in an environment that is not considered as wet location.

Operation temperature: -20...22...24...+55°C

Proper function is only guaranteed if the USB is not connected to the transducer and all the instructions in this manual are followed for safety reasons.

1.5 Safety

All inputs and outputs are galvanically isolated from each other.

Protection class:	II, protective insulation, voltage inputs via protective impedance.
Protection:	IP40 (housing), IP20 (terminals)

1.6 Warning!

Connection must comply with current regulations for systems with rated voltage up to 1000 V. Before switching on or off and if the housing is removed, all voltages to the equipment must be switched off and external currents circuit shorted before disconnected.

1.7 Maintenance

The transducer requires no maintenance. Any repairs shall be performed by trained personnel, or the equipment shall be returned to the supplier for repair.

1.8 Symbols



Double insulated device, protection class 2.



Warning for life-threatening or hazardous for properties situations.



Caution, possibility of electric shock



Read the manual before use



The device must be discarded in a professional way

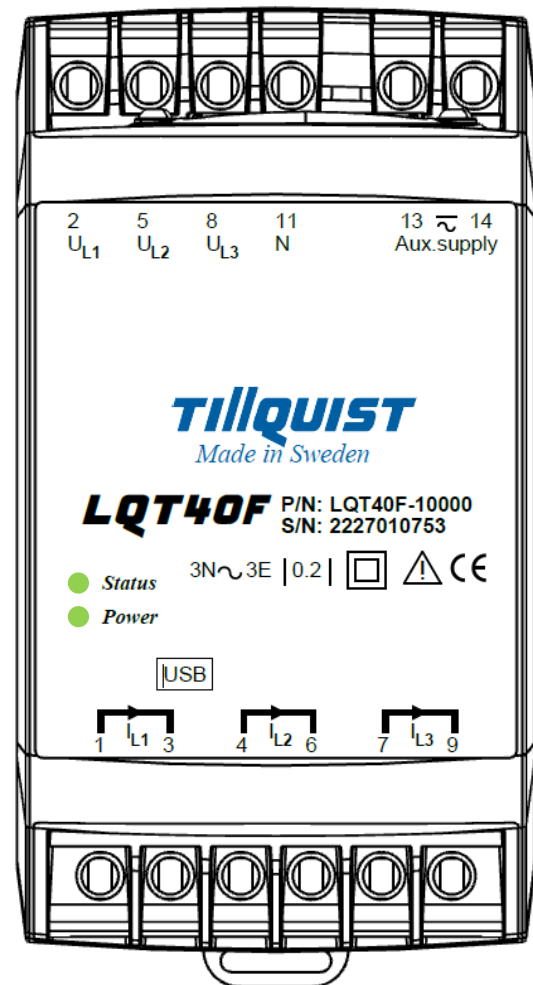


CE conformity mark

2 Connections

2.1 Connection diagram

Voltage input		
U _{L1}		2
U _{L2}		5
U _{L3}		8
N		11
Current input	In	Out
I _{L1}	1	3
I _{L2}	4	6
I _{L3}	7	9
Aux Power Supply		
		13
		14



2.2 Electric connection

The plug-in terminals needs to be removed before accessing the input terminals.

Inputs L1, L2, L3, N, I1, I2, I3, Aux.supply	
Wire section:	6.0 mm ² / 10 AWG
Clamp opening size:	3.2 × 3.9 mm
Wire stripping:	max 9 mm
Recommended torque:	0.8 - 0.88 Nm / 7.2 - 7.9 in.lbs

2.3 Connection diagrams – System connection

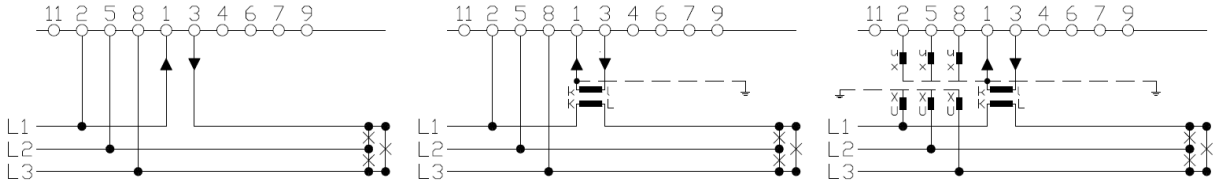
LQT40F system connection is programmable from single phase to 4-wire balanced or unbalanced connection.

Configurable System Connection											
System connection	Application	I1	I2	I3	U1	U2	U3	N	U12	U23	U31
-00	4wire, 3 phase symmetric load	X	-	-	X	-	-	X	-	-	-
-01	1-wire, 1 phase	X	-	-	X	-	-	X	-	-	-
-02	3-wire, 3 phase symmetric load	X	-	-	-	-	-	-	X	-	-
-03	3-wire, 3 phase symmetric load	X	-	-	-	-	-	-	-	X	-
-04	3-wire, 3 phase symmetric load	X	-	-	-	-	-	-	-	-	X
-05	3-wire, 3 phase symmetric load	X	-	-	X	X	X	-	X	X	X
-09	3-wire, 3 phase asymmetric load	X	-	X	X	X	X	-	X	X	X
-11	4-wire, 3 phase asymmetric load	X	X	X	X	X	X	X	X	X	X
-11	4-wire, 3 phase asymmetric load Open Delta	X	X	X	X	X	X	-	X	X	X

-05

3-phase
1 element

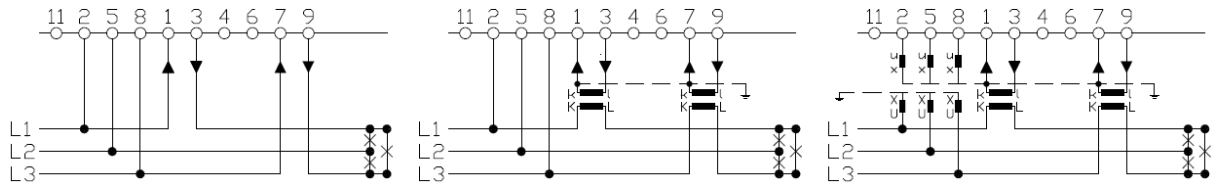
3-wire
3-phase symmetrical load



-09

3-phase
2 elements

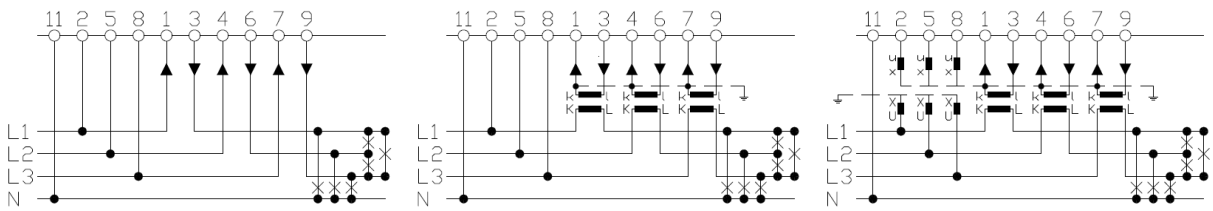
3-wire
3-phase asymmetrical load



-11

3-phase
3 elements

4-wire
3-phase asymmetrical load



3 Measuring

3.1 Measured quantities

Prefix	Quantity	Calculation	System / Phase
I	Input current	$(I1+I2+I3)/3$	System
I1	Phase current L1		L1
I2	Phase current L2		L2
I3	Phase current L3		L3
U	Input voltage	$(U1+U2+U3)/3$	System
U1	L1 Phase voltage		L1
U2	L2 Phase voltage		L2
U3	L3 Phase voltage		L3
P	Active power	$P1+P2+P3$	System
P1	Active power L1		L1
P2	Active power L2		L2
P3	Active power L3		L3
Q	Reactive power	$Q1+Q2+Q3$	System
Q1	Reactive power L1		L1
Q2	Reactive power L2		L2
Q3	Reactive power L3		L3
S	Apparent power	$S1+S2+S3$	System
S1	Apparent power L1		L1
S2	Apparent power L2		L2
S3	Apparent power L3		L3
U12	Main voltage L1-L2		L1 - L2
U23	Main voltage L2-L3		L2 - L3
U31	Main voltage L3-L1		L3 - L1
PF	Active power factor	P/S	System
PF1	Active power factor	$\text{COS}(\varphi1)=P1/S1$	L1
PF2	Active power factor	$\text{COS}(\varphi2)=P2/S2$	L2
PF3	Active power factor	$\text{COS}(\varphi3)=P3/S3$	L3
QF	Reactive power factor	Q/S	System
QF1	Reactive power factor	$\text{SIN}(\varphi1)=Q1/S1$	L1
QF2	Reactive power factor	$\text{SIN}(\varphi2)=Q2/S2$	L2
QF3	Reactive power factor	$\text{SIN}(\varphi3)=Q3/S3$	L3
LF	LF factor	$\text{sign}(Q)*(1- PF)$	System
LF1	LF factor	$\text{sign}(Q1)*(1- PF1)$	L1
LF2	LF factor	$\text{sign}(Q2)*(1- PF2)$	L2
LF3	LF factor	$\text{sign}(Q3)*(1- PF3)$	L3
PA	Phase angel	$PA=(PA1+PA2+PA3)/3$	System
PA1	Phase angel	$\varphi1=\text{ARCCOS}(P1/S1)/\text{PI}*180*\text{sign}(P1)$	L1
PA2	Phase angel	$\varphi2=\text{ARCCOS}(P2/S2)/\text{PI}*180*\text{sign}(P2)$	L2
PA3	Phase angel	$\varphi3=\text{ARCCOS}(P3/S3)/\text{PI}*180*\text{sign}(P3)$	L3
IS	Input current with sign	$(I1+I2+I3)/3$	System
IS1	Phase current with sign	$I1*\text{sign}(P1)$	L1
IS2	Phase current with sign	$I2*\text{sign}(P2)$	L2
IS3	Phase current with sign	$I3*\text{sign}(P3)$	L3
P_I1_U12	Active power, System connection-02		System
P_I1_U23	Active power, System connection -03		System
P_I1_U31	Active power, System connection -04		System
Q_I1_U12	Reactive power, System connection -02		System
Q_I1_U23	Active power, System connection -03		System
Q_I1_U31	Active power, System connection -04		System
F	Frequency		System

3.2 Measuring system

3.2.1 Phase-Locked loop - PLL

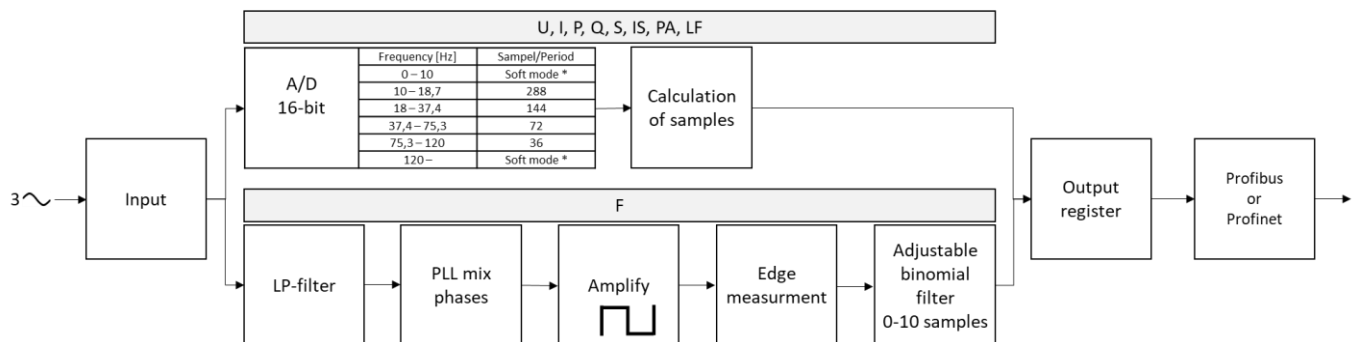
The measuring system use a phase-locked loop (PLL) between 10-120 Hz. All quantities are being measured. The number of samples per period is depending of the frequency.

3.2.2 Soft mode

A fixed sample rate of 1800 samples/second (soft mode) is used when the frequency is lower than 10 Hz or higher than 120 Hz. Measured quantities in soft mode are voltage (U), current (I) and frequency (F).

3.2.3 Block diagram

Schematic block diagram of measure process.



* *Soft mode = 1800 samples / second*

3.2.4 Frequency filter

The frequency measurement is low-pass filtered with a binomial filter. This setting determines the length of the filter in periods of the measured frequency. A shorter length gives a more responsive measurement. A longer length gives a slower, more stable measurement.

Frequency filter is adjustable between 0 – 10.

4 Output – Profibus/Profinet

LQT40F has a Profibus or Profinet output for fast serial communication. Three different set of "Process Data Set Mapping" are available. Each mapping has a unique GSD-file. The files are available from Tillquist homepage.

4.1 Process Data Set Mapping

A: Basic – *Is the same mapping as old LQT60F*

B: Basic + High Resolution F

Parameters							Data Set	
Parameter	Range	Bus value	Type	Byte	Note	A	B	
Bus Inc Num	-	-	0-65535	Unsigned Word	1-2	-	X	X
Data Inc Num	-	-	0-65535	Unsigned Word	3-4	-	X	X
I_RMS	0-12	A	0-65535	Unsigned Word	5-6	(I1+I2+I3)/3	X	X
U_RMS	0-300	V	0-65535	Unsigned Word	7-8	(U1+U2+U3)/3	X	X
P_RMS	±10800	W	±10800000	Signed Double Word	9-12	P=P1+P2+P3	X	X
Q_RMS	±10800	var	±10800000	Signed Double Word	13-16	Q=Q1+Q2+Q3	X	X
F	0-300	Hz	0-65535	Unsigned Word	17-18	-	X	X
F_HIRES	0-300	Hz	0-300000	Unsigned Double Word	19-22	-		X

A: Basic *Bus Increment Number increase with every new message.*
 B: Basic + High Resolution F *Data Increment Number increase with every new measured*

C: Extended

Parameters							Data Set
Parameter	Range	Bus value	Type	Byte	Note	C	
Bus Inc Num	-	-	0-65535	Unsigned Word	1-2	-	X
Data Inc Num	-	-	0-65535	Unsigned Word	3-4	-	X
I_RMS	0-12	A	0-12000	Unsigned Double Word	5-8	(I1+I2+I3)/3	X
U_RMS	0-300	V	0-300000	Unsigned Double Word	9-12	(U1+U2+U3)/3	X
P_RMS	±10800	W	±10800000	Signed Double Word	13-16	P=P1+P2+P3	X
Q_RMS	±10800	var	±10800000	Signed Double Word	17-20	Q=Q1+Q2+Q3	X
F	0-300	Hz	0-300000	Unsigned Double Word	21-24	-	X
I1	0-12	A	0-12000	Unsigned Double Word	25-28	-	X
I2	0-12	A	0-12000	Unsigned Double Word	29-32	-	X
I3	0-12	A	0-12000	Unsigned Double Word	33-36	-	X
U1	0-300	V	0-300000	Unsigned Double Word	37-40	-	X
U2	0-300	V	0-300000	Unsigned Double Word	41-44	-	X
U3	0-300	V	0-300000	Unsigned Double Word	45-48	-	X
U12	0-520	V	0-520000	Unsigned Double Word	49-52	-	X
U23	0-520	V	0-520000	Unsigned Double Word	53-56	-	X
U31	0-520	V	0-520000	Unsigned Double Word	57-60	-	X
P1	±3600	W	±3600000	Signed Double Word	61-64	-	X
P2	±3600	W	±3600000	Signed Double Word	65-68	-	X
P3	±3600	W	±3600000	Signed Double Word	69-72	-	X
Q1	±3600	var	±3600000	Signed Double Word	73-76	-	X
Q2	±3600	var	±3600000	Signed Double Word	77-80	-	X
Q3	±3600	var	±3600000	Signed Double Word	81-84	-	X
LF	±1		±1000	Signed Double Word	85-88	-	X
PA	±180	°	±180000	Signed Double Word	89-92	-	X

C: Extended *Bus Increment Number increase with every new message.*
Data Increment Number increase with every new measured

4.2 Profibus

The address of the Profibus DP is set via the software ConfigLQT.

4.3 Profinet

The Profinet address parameters are set via the free software HMS IPconfig, that is available from Tillquist homepage.

The built-in webserver gives access to:

- Network configuration parameters
- Network status information

5 Commissioning

5.1 Programming of the transducer

"ConfigLQT" is a free configuration software, it is available for download from Tillquist homepage, www.tillquist.com. The software connects to the transducer and make it possible to change the configuration of adjustable parameters and to visualize live readings.

ConfigLQT supports offline configuration of adjustable parameters.

Save and load configuration file.

Functionality of ConfigLQT

ConfigLQT allows the user to:

- See online readings of measured values
- Adjust the functionality of the outputs
- Save parameter settings to a file
- Load parameter settings from a file
- Print settings report
- Upgrade firmware

5.2 LED functionality

LQT40F have two LEDs at front, *Power* and *Status*.

State	Power	Status
Start-up	Flashing - On 1 sec / Off 0.5 sec	Flashing - On 1 sec / Off 0.5 sec
Normal operation	On	Flashing - On 200 ms / Off 200 ms
Error	Flashing - On 100 ms / Off 100 ms	Off

6 Technical Data

	Technical Data	Details	
Input	Voltage range (Un)	100 – 400 V (L-L) main voltage (nominal)	
	Measuring range	1 – 520 V TRMS (L-L) 50/60 Hz or 16⅔ Hz 1-300 (L-N) 50/60 Hz or 16⅔ Hz	
	Frequency	50/60 Hz (10...40...70...120 Hz) 16⅔ Hz (10...15...18...120 Hz)	
	Overload voltage	1.5 x Un – continuously, 2 x Un – 10 s	
	Consumption	U x 1 mA / phase	
	Current (In)	1 – 5 A	
	Measuring range	5 mA – 10 A TRMS	
	Overload current	2 x In continuously, 10 x In 15 s, 40 x In 1 s	
	Consumption	<0.05 VA / phase	
	Auxiliary power supply	24 – 230 VDC / 90 – 230 V AC ±10 %	
	Burden	max 7.1 W / 15 VA	
	Output	Serial communication	Profibus or Profinet
		Profibus	DP-V0 and DP-V1 according to IEC61158 type 3
		Profinet	PROFINET RT Class 1 and 3 PROFINET IRT Ethernet switch
Communication			
General Data	Accuracy	0.2 (Ref. temp. 23 °C)	
	Galvanic isolation	Supply, in- and output are galvanically isolated	
	Connection terminals / Torque	Input and Auxiliary power supply: 6 mm ² / 0.8 Nm Output: 2.5 mm ² / 0.5 Nm	
	Humidity	95 % non-condensing	
	USB	USB Micro-B, port for configuration	
	Temperature	-10...+55 °C (operation) -40...+70 °C (storage) Temperature coefficient < 0.1 % / 10 °C	
	Test voltage	4 kV AC / 1 min	
	Inputs	overvoltage cat. III	
	Pollution degree	2	
	Dimension (W x H x D)	70 x 132 x 101 mm	
	Weight	330 gr	
	Protection	IP40 (housing), IP20 (terminals)	
	Standards	SS-EN 60688 Transducers SS-EN 61010-1 Safety EN 61000-6-2 / -6-4 / -6-5	

*Depending on the version