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APPENDIX G
OF
TEST REPORT T11129A

Test Sample User Instructions (Manual)

Manufacturer:	CHK Wireless Technologies Australia Pty Ltd
Test Sample:	Conductor Mounted Sensor
Model:	LT40-CMS-916
Serial No:	01045016
FCC ID:	P3D LT40-CMS-916
Date:	7 January 2002

LT40
CMS / PAC

Technical
User Manual

These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation.

Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

This device has been designed to operate with an antenna having a maximum gain of 15 dB. Antenna having higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

N3207

WARNING: Any changes or modifications to LT40 devices not expressly approved by CHK Wireless Technologies can void the user's authority to operate the equipment.

"LT40 CMS-PAC User Manual.doc", Revision 61

Printed in Australia.

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1 Overview - Remote Network Monitoring

The LINEtracker LT40 is the latest of CHK Wireless Technologies' fault location products. However it is far more than a mere "yes/no" visual fault indicator. Patented Tracker technology at last ensures location certainty and provides complete network status to pre-empt faults.

The introduction of Date Time Stamp (DTS) fault logging with the LINEtracker IED now provides the Utility with comprehensive data for planning, maintenance, and network performance. Whilst primarily minimizing fault location with visual indication, the LINEtracker pre and post fault data can be used to proactively improve network performance.

- Immediate Fault detection & fault certainty
- Minimize Outages & Patrol Times
- History on feeder activity
- Full Statistical Performance Data reporting
- Identify problem areas - Vegetation & Cracked Insulators
- Minimize Non-Storm Outages
- Protection device duty cycle data
- Just In Time maintenance programs
- GIS and NIS transparent integration
- Extended SCADA view beyond traditional points.

Although local visual inspection and data downloading provide an alternative to the "Half & Reclose" method for locating faults, there are still limitations to its effectiveness. CHK sees the future of Network Performance in Remote Network Monitoring with a Data Management System providing connectivity throughout the Network - hence "*Looking Beyond Fault Indication*".

In essence CHK's approach to fault detection is with Remote Network Monitoring in mind, the LINEtracker is an IED that detects faults as one of its features. The product's flexibility allows for add-on devices to be integrated when required. Utilising fault analysis software and the GLOMES DMS database, a complete solution to Remote Network Monitoring can be provided.

The conductor mounted LT40CMS (Conductor Mounted Sensor) directly measures current and voltage. Any abnormalities (events) sensed are time-stamped and recorded. Each CMS can also be configured to calculate and store time-averaged load current. The event and load information can then be transmitted via local radio to the pole-attached collator (LT40PAC), which analyses the related phases as a system. While local "flashing light" indication is still provided, importantly data can be retrieved and analysed at the pole base by a laptop. Alternatively the data can be transmitted directly to a control room for real time analysis by GLOMES.

DANGER: LT40 IEDs are for use on High Voltage systems!

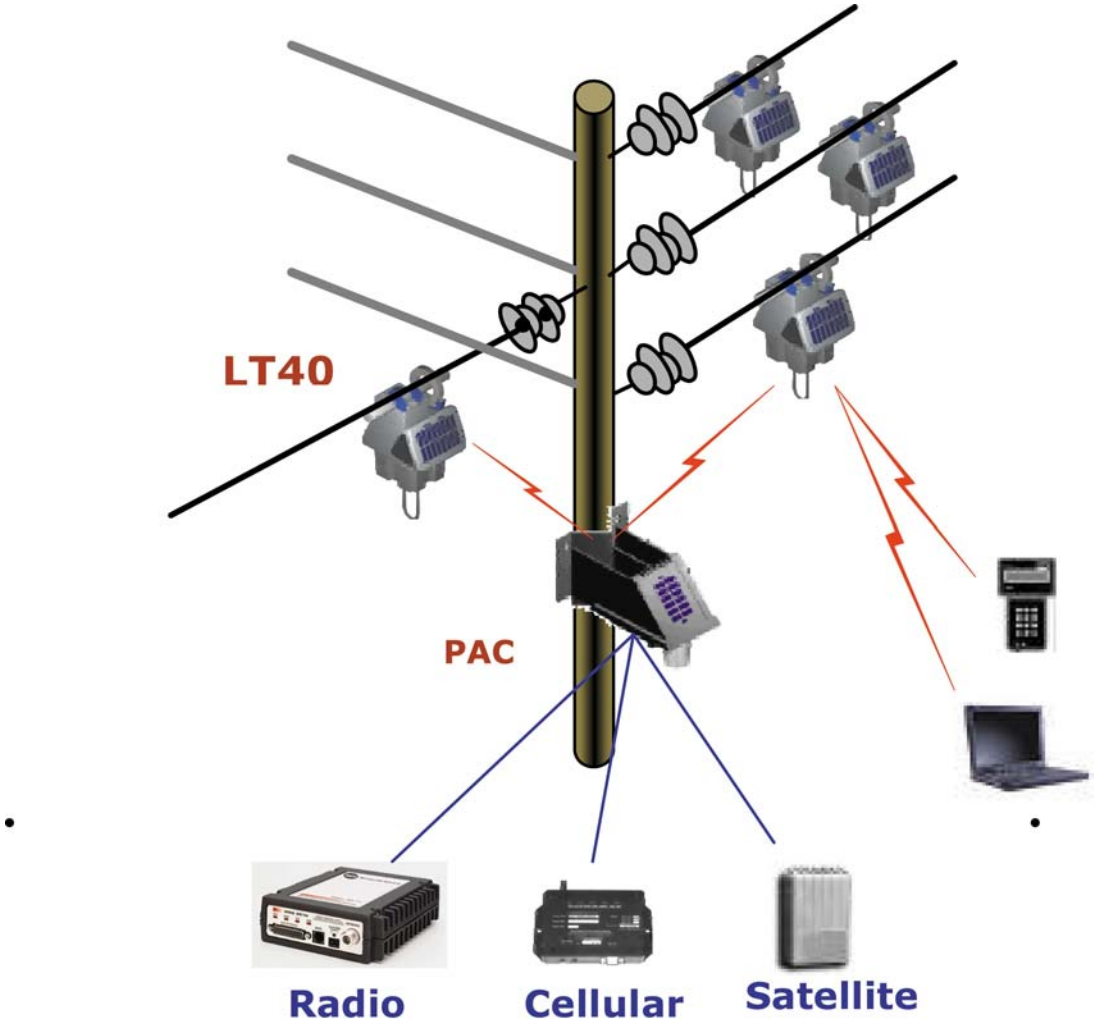
Always ensure that qualified personnel are used to professionally install and maintain LT40 installations. Never install a damaged device

All local safety and OH&S precautions must always followed.

If in doubt, seek assistance!

Figure 1: LT40 CMS

Figure 2: LT40 PAC



1.1 Specifications

Overhead Systems	4 wire with multiple grounds, 3 wire, Single phase, SWER, etc.	
Line Voltage	5kV to 66kV (up to 72.5kV on request)	
Line Frequency	45 to 65 Hz	
Line Current Sensing	10 – 25,000 Amps (Auto digital range adjustment, < 10A by request)	
Trigger Principle	Algorithms based on electrical current ratios, adapt to the line signature and load history. Fault / Inrush discrimination at network energisation.	
Memory Available	Up to 96Kbytes for Event data 128Kbytes SRAM for Waveform Capture. *All event data can be stored as well as transmitted to GLOMES systems.*	
Details Stored Per Event Type	Time stamp, pre / post voltage & current values, 10 cycles of current waveform (includes 3 cycles before fault), 2nd harmonic values.	
Energy Storage	1 x 2V, 8000mAh rechargeable sealed lead acid battery (SLAB)	
Power Source	Solar panel with adjustable mounting angle to allow optimum solar energy capture	
Current Consumption	Normal operation (No RF Transmission) = 5mA.	
Conductor Clamp	3 spring loaded fingers	
Conductor Size	Approx. 5mm (0.2 inches) - 30mm (1.2 inches) diameter.	
Temperature Range	Operating	-20ºC to +50ºC (-4ºF to +122ºF)
	Survival	-40ºC to +85ºC (-40ºF to +185ºF)
	Conductor Normal	-20ºC to +90ºC (-4ºF to +194ºF)
	Conductor	-20ºC to +130ºC (-4ºF to +266ºF)
Weight	CMS - less than 2.0kg (4.4 pounds) on conductor PAC - less than 3.0kg (6.6 pounds)	
Dimensions	CMS - Height 22cm (8.6”), Depth 11cm (4.3”), Width 11cm (4.3”) PAC - Height 25cm (10”) Depth 28cm (11”) Width 16.5cm (6.4”)	
Indicators	CMS: Two high intensity LEDs, Red & Amber PAC: Two high intensity LEDs, Red & Amber, Single Xenon flash tube.	
Communications	Local LT40	RF @ 916.48 MHz FSK. Range approx. 30m.
	GLOMES	GSM, PSTN, Cellular, Satellite, etc. at client discretion

2 LT40 Local RF Communications

WARNING: Any changes or modifications to LT40 devices not expressly approved by CHK Wireless Technologies can void the user's authority to operate the equipment.

WARNING: These products must use custom antenna supplied by CHK Wireless Technologies. *Use of non-standard antenna will void compliance of these products.*

DANGER: Never use damaged antennas. Damaged antennas could potentially cause high voltage corona which could place operators in danger. Antennas are replaceable in case of damage. Please contact CHK Wireless Technologies for suitable replacement antennas.

Each LT40PAC or LT40CMS communicates using local low-power RF communication. This communication system is half duplex 916.48 MHz FSK and allows data to be written to and read from any device without uninstalling or physical contact. In order to reduce battery power consumption of LT40s, the internal RF Transceivers are powered OFF for the majority of time. The receiver typically polls for only 50 ms every second. This polling interval may also be altered under user control for specific applications, but will be reset whenever the unit is reset. Each transmission therefore must include a sufficient preamble stream that exceeds 1 second to ensure that it is present when the LT40 devices periodically polls.

A communication Protocol has been derived to handle Physical, Data Link and Application layers. For more technical information refer to "LT40 RF Data Communication Protocol.Doc"

3 LT40 Installation

DANGER: LT40 IEDs are for use on High Voltage systems!

Always ensure that qualified personnel are used to professionally install and maintain LT40 installations. Never install a damaged device onto HV systems.

All local safety and OH&S precautions must always followed.

If in doubt, seek assistance!

As LT40s are used on high-voltage systems, qualified personnel must always install all LT40 devices. The LT40CMS is clamped onto the HV line normally using a Hotstick ("shotgun stick"), however it may also be installed using other suitable methods such as insulated bucket trucks ("cherry pickers").

Figure 2: LT40 CMS Installation via Hotstick

Figure 3: LT40 PAC Installation

Figure 4: LT40 CMS on Hotstick

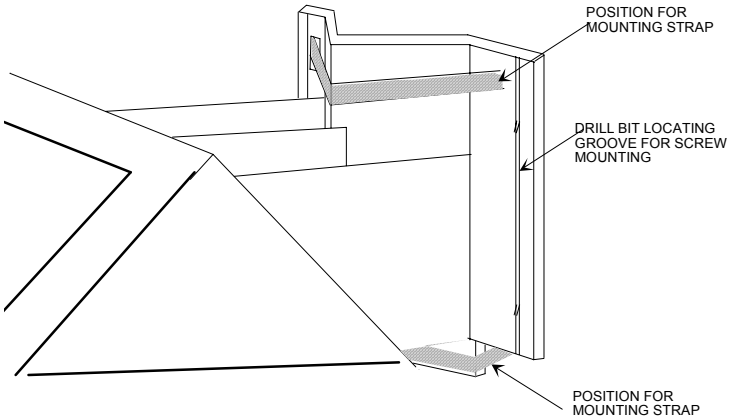


Figure 5: Correct LT40PAC Attachment

LT40PAC units must be attached to poles using two (2) BandIt™ ties as shown. Ensure that both ties are outside the V-shape and are firmly tightened.

A normal installation will include 3 LT40CMS devices with one on each Phase, an LT40PAC and a long-range communications system such as cellular GSM, CDMA, etc (at client discretion). The LT40PAC must be installed on a pole within 30 m of all three LT40CMS devices otherwise local RF communications may not operate.

Figure 6: Example Installation showing LT40CMS, LT40PAC and cellular modem.

There are two important aspects that need to be considered at each installation site.

3.1 RF Communications

It is important to ensure good RF communications. This can be achieved by aligning all antennas in the same plane (i.e. parallel to each other). Antennas should not be pointing at each other (refer figure 1 below). Sometimes due to other factors this can be difficult to achieve. As a rule of thumb,

make sure the angle from parallel does not exceed ±30º. Because the RF Transmitters are low power all LT40 devices must be within 30m of each other.

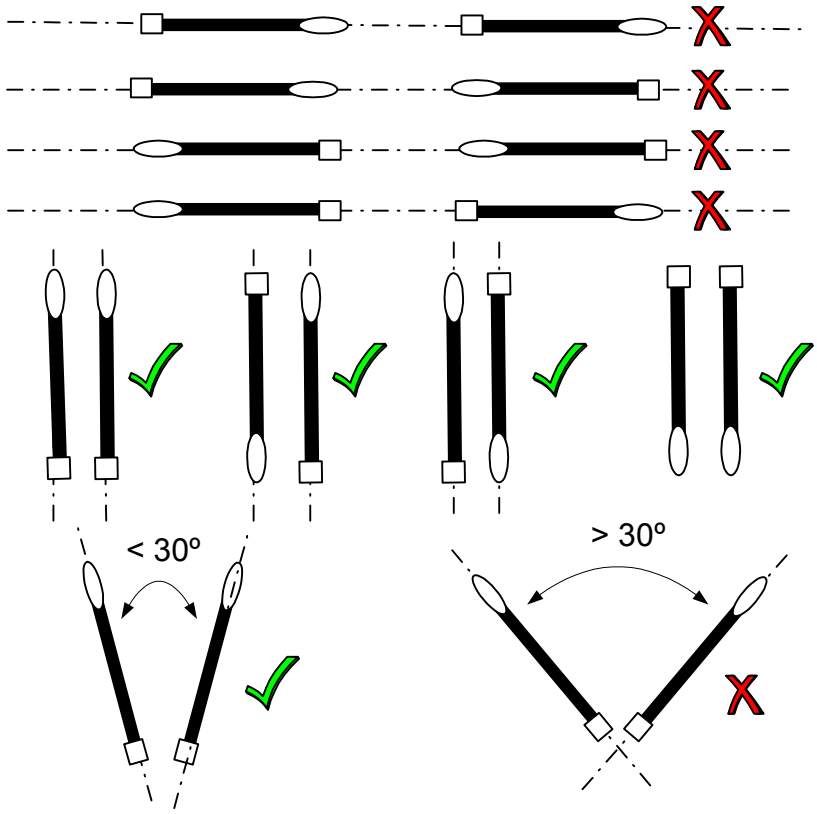


Figure 7: Antenna Orientation

On completion of installation a command must be sent to the LT40PAC to perform an initialisation on the entire system. The LT40PAC will then communicate with all the LT40CMS devices. The operator should watch the RF Carrier indicator on the PC RF communicator. If the operator notices the LT40PAC having difficulty communicating with any one of the LT40CMS devices (this is evident by observing many RF Command retries with no brief Acknowledges) it may be necessary to relocate the specific LT40CMS or LT40PAC a small amount (10 cm). By moving the IED (i.e. antenna) just a small distance, a poor response area or reflected RF can be reduced.

WARNING: These products must use custom antenna supplied by CHK Wireless Technologies. *Use of non-standard antenna will void compliance of these products.*

DANGER: Never use damaged antennas. Damaged antennas could potentially cause high voltage corona which could place operators in danger. Antennas are replaceable in case of damage. Please contact CHK Wireless Technologies for suitable replacement antennas.

RF interference from an external source can prevent the LT40 devices from operating correctly. To test if external RF interference exists, the LT40s can be put into a 'Carrier Detect' mode where by the Red LED will indicate if the LT40 detects any RF above the level where interference can cause problems. The Carrier Detect mode is enabled by setting the RF Polling Interval to 0 seconds, via

the LINESman PC application. If the Red LED is ON for more than 2 seconds in every 10 seconds then interference will cause problems. The operator must either move installation site or locate source of interference and discuss the possibilities of altering its behaviour.

While it should also be noted that the output power of the LT40 RF Transmitter is extremely low, LT40 IEDs may cause interference problems with other RF equipment. The normal "No Line Faults" operation of the LT40 will only have RF transmissions twice per day, typically lasting less than 2 minutes each. These normal transmissions are the "Time Synchronisation" and "Health Check" functions. The time and frequency of these functions are configurable using LINESman but default to occurring together. Other equipment will need to be within approximately 50 m of an LT40 installation to sense the LT40 RF, but relocating an LT40 installation site may be the only solution in some cases.

3.2 Solar Considerations

Each LT40 device contains a solar panel to charge the internal battery. In most cases the solar panel is optimum when facing directly North when in the Southern Hemisphere and South when in the Northern Hemisphere. In deciding the direction of the solar panel, antenna orientation must also be considered. Often Solar efficiency must be compromised in order to ensure good RF communications.

4 LT40 Data Storage Protocol

Data within the LT40 devices is stored using a protocol based on DNP3.0. Each record is 16 bytes long and has the following format

ID0	ID1	FLG	M0	M1	M2	M3	T0	T1	T2	T3	T4	C0	C1	na	na

- ID0 is the Device ID Number, ID1 is the Record ID Number
- FLG is DNP Flag representation
- M is Magnitude (up to 32 bit)
- T is Time in seconds (32 bit), C is Time in 20 ms

The table below shows the valid data Records:

Record Name	***Record ID No.***	***Magnitude size (bytes)***	***Time Stamped?***
CONFIG RECORDS			
Device Serial Number	1	4	No
COM Firmware Version	2	2	No
DAQ Firmware Version	3	2	No
IFC Firmware Version	4	2	No
COM Hardware Revision	19	2	No
IFC Hardware Revision	20	2	No
Line Frequency	5	2	No
E-Zero Threshold	21	2	No
B-Zero Threshold	22	2	No
E-Bandwidth Threshold	23	2	No
B-Bandwidth Threshold	24	2	No
DAQ-Options	251	2	No

Record Name	***Record ID No.***	***Magnitude size (bytes)***	***Time Stamped?***
E-Off Fast Filter Ratio	25	2	No
Magnetising Inrush Threshold	58	2	No
Magnetising Inrush Cycle	59	2	No
Current Calibration M Coefficient	65	2	No
Voltage Calibration M Coefficient	66	2	No
Current Calibration B Coefficient	67	2	No
Voltage Calibration B Coefficient	68	2	No
STATUS RECORDS			
Battery Voltage	27	2	Yes
Solar Voltage Minutes	28	2	Yes
Solar Voltage	45	2	Yes
Solar Current	46	2	Yes
PCB Temperature	47	2	Yes
Current Fast Filter Trigger	7	4	Yes
Current Slow Filter	51	4	Yes
Voltage Fast Filter Trigger	26	4	Yes
CMS EVENT RECORDS			
High Current Trigger	6	4	Yes
Current Upper Band Trigger	8	4	Yes
Current Lower Band Trigger	9	4	Yes
Current Peak-to-Peak steady state	10	4	Yes
Current Pre Fault Trigger	69	4	Yes
Voltage On Trigger	11	4	Yes
Voltage Off Trigger	12	4	Yes
Voltage Upper Band Trigger	13	4	Yes
Voltage Lower Band Trigger	14	4	Yes
Voltage Peak-to-Peak steady state	16	4	Yes
Event Triggers	18	2	Yes
Current Magnetising Inrush Ratio	48	2	Yes
Current OFF Trigger	60	4	Yes
External EEPROM Address for High B Waveform	44	2	Yes
LOAD LOG RECORDS			
Current Interval Average	61	4	Yes
PAC COMMUNICATION RECORDS			
DNP Modem Result	29	2	Yes
Child Time Sync Fail	62	2	Yes
Child Health Check Fail	63	2	Yes
Child Data Checksum Mismatch	64	2	Yes
Elapsed Seconds	17	4	Yes

Table 1: LT40 Event Records

5 LT40 CMS (Conductor Mounted Sensor)

5.1 Introduction

The LT40 CMS has been designed to clamp directly onto High Voltage Power lines. Current and Voltage is continuously monitored. Abnormalities in either Voltage or Current are time-stamped and stored. This information is then transferred to a PAC ready for transmission to a utility control room. The CMS may also be configured as a Load Logger, where it calculates and stores time averaged load current data.

5.2 CMS Sensing

The CMS measures Line Current and Voltage. These parameters are digitally converted using a 10 bit A/D converter, with dynamic gain control. The maximum gain is 1024 and the minimum gain is 1. This gives a digital dynamic range of 1024 x 1023 = 1,047,552 bits. The sinusoidal Voltage is sampled at 600 samples per second. The Current is sampled at 1200 samples per second. The Peak-to-Peak for each parameter is calculated over a cycle. These parameters are stored as relative whole number values. A calibration equation is used to convert these bit values to real RMS Amps and Volts.

5.3 CMS Configuration

Configuration is achieved by RF communications using a laptop PC with RF Communicator. A software application, "LINESman" allows set-up of configuration data.

5.3.1 RF Configuration

- Group Number – An identifying number representing a group of CMS's. This allows for multiple groups of CMS's to use a single PAC (i.e. Single CMS group would be set to group 1.)
- Position – An identifying number that represents the Phase number the CMS is attached to (i.e. Phase A, Phase B, Phase C, Neutral, Earth, etc).
- PAC Address – The CMS needs to know the RF address of its PAC (Parent). This enables Event data to be transferred to the PAC.

5.3.2 Current Measurement Options:

- Zero Threshold - is used to set the noise floor for determination of a zero current level
- Bandwidth Threshold (Current Profiling) – After a Trigger has occurred a +ve and -ve threshold is calculated based on P-P value. When either +ve or –ve threshold is exceeded the Current is time stamped, stored and new Thresholds are derived. The Threshold is typically ±50%, ±25% or ±12.5%. These recorded values provide a profile of the Event Current. The smaller the Bandwidth, the more sensitive the LT40 will be to changes and the larger each fault record will be in terms of bytes stored.
- High Current Ratio - is used to set the High Current trigger level. It is a percentage of the Fast Filter (FF) value.
- High Threshold Span – An alternative Threshold, valid only when High Current Ratio is set to zero. The Threshold Span is a fixed current. The trigger will occur when the Current FF plus the Threshold Span is exceeded (i.e. Threshold Span set to 100Amps and FF is 40 Amps, Trigger will occur when P-P exceeds 140Amps).

5.3.3 Voltage Measurement Options:

- Zero Threshold - is used to set the noise floor for determination of a zero voltage level.
- Off Fast Filter Ratio - is used to set the Voltage OFF trigger level. It is a percentage of the Fast Filter (FF) value. When the P-P is sampled below this threshold the Voltage is deemed to be OFF. The Voltage is time-stamped and stored.
- Bandwidth Threshold (Voltage Profiling) – If enabled a +ve and -ve threshold is calculated based on Voltage P-P value. When either +ve or –ve threshold is exceeded the Voltage is time-stamped, stored and new thresholds are derived. The Threshold is typically ±50%, ±25% or ±12.5%. These recorded values provide a profile of the line Voltage. The smaller the Bandwidth, the more sensitive the LT40 will be to changes and the more memory used for storage.
- Bandwidth Enable - is used to enable detailed triggering on the Voltage. This option works in conjunction with the Voltage Bandwidth Threshold.

5.3.4 Enable Event Logging

This option enables Event Logging in the CMS. If this option is disabled then faults and other trigger conditions will not be recorded in memory and will thus not be available to GLOMES.

5.3.5 Load Logging

- Enable Load Logging - This option enables Load Logging in the CMS.
- Load Logging Interval (mins) - The number of minutes the Current is averaged over and logged into memory.

Refer to “Load Logging” section for more information

5.3.6 LED Indication

- Enable RED LED Flashing – Enables or disabled the RED LED indication for Faults.
- Period (secs) – The Period in secs that the RED LED indicates FAULT status via sequence of Flashes (i.e. Period = 10 second and Transient Fault detected, RED LED will Flash 2 short bursts every 10 Seconds).
- Enable AMBER LED Flashing – Enables or disabled the AMBER LED indication for Line Status.
- Period (secs) – The Period in secs that the AMBER LED indicates Line Status via sequence of Flashes (i.e. Period = 10 second and Volts OFF, AMBER LED will Flash 3 short bursts every 10 Seconds).

Refer Section Device Status LED Indication for more information

5.3.7 Inhibit Trigger Until Time Sync

If enabled all Event Triggers are inhibited until a Time Sync Function has bee performed. It’s important that all CMS’s are synchronised in time before they can obtain valid data. The Time Sync Function can be performed by the PAC or by the user from the LINESman Application.

5.3.8 Inrush Detection

- Enable Inrush Detection – When enabled the CMS will analyse the waveform from each High Current Trigger and determine the level of 2nd Harmonic present.

- Inrush Cycle – The Number of Cycles following a High Current Trigger where the 2nd Harmonic value is calculated.
- Inrush Threshold – The Threshold for deciding if the High Current Event occurred to due Magnetic Inrush. This number relates to the percentage of 2nd Harmonic Vs 1st Harmonic (i.e. Inrush value = 52 has 20% 2nd Harmonic Vs 1st Harmonic @ 50Hz)

5.4 Normal Mode

The majority of time the CMS will simply monitor the status of the Current and Voltage. There will be NO RF communications during this time, unless initiated by an external device (PAC or Laptop PC). During normal operation the CMS will continually sample Voltage and Current. A 5.12 sec averaged value of Voltage and Current is maintained. This averaged value is called the Fast Filter (FF). Thresholds are determined for both Voltage and Current. These Thresholds are based on the FF values (i.e. the High Current Ratio is 200%, the Threshold will be 200% x Current FF value). It is when the measured p-p value exceeds the Threshold that a Trigger Occurs.

Each sample for Voltage and Current is stored in a cyclic memory buffer (600 samples/sec). The buffer stores the most recent 3.4 seconds of each parameter. When a High Current Trigger occurs 120 samples (10 cycles @ 50Hz line frequency) are saved for post analysis. 3 cycles pre and 7 cycles post High Current Trigger are saved. This saved waveform is used to determine 2nd Harmonic levels for inrush detection. The event waveform is also downloadable and may be viewed to provide valuable information for the Event.

5.5 Event Mode

Event mode is The CMS enters Event mode when a Trigger occurs. The Trigger can occur due to the following reasons.

- High Current Trigger: Current P-P exceeds High Current Threshold.
- Voltage OFF Trigger: Current Voltage falls below Voltage OFF Threshold for 3 consecutive cycles.
- Voltage ON Trigger: When the OFF Trigger Occurred the Voltage FF is stored (this represents the normal ON voltage of the Line). When the Voltage P-P exceeds 75% of this stored FF the Voltage ON Trigger Occurs.

If a High Current Trigger occurs a 1 minute arming period is commenced. During this period CMS will do Current Profiling (Storing Current values whenever the Bandwidth is exceeded) and continually monitor Voltage. At the end of the 1-minute, the CMS will make decision on the Event type and set LED indication appropriately. If installed with a PAC, the CMS will transmit a command to the PAC indicating that an Event occurred. The PAC within the next minute will retrieve the data relating to this Event.

5.6 Load Logging

The LT40 CMS can be configured to store and time-stamp a time-averaged value for current. The Interval can be set from 1-60 minutes. There is 32 Kbytes available for Load data storage. Each Record consists of 16 Bytes. The Time Sync Function will reset the Load Logging timing variables, thereby enabling a number of CMS devices to be synchronised to each other. The data may be downloaded from the CMS using LINESman PC application. If a PAC is installed with the system, it may be configured to retrieve load Log data from each CMS during the health check. (health checks are normally configured to occur once each day).

6 LT40 PAC (Pole Attached Collator)

6.1 Introduction

The LT40 PAC is used to retrieve and store Event and/or Load data from a number of CMS's, typically 3, one for each phase. The Number of CMS's can be up to 15. Collating the data in a centralised point allows this data to be distributed over a wireless WAN (Wide Area Network). The PAC although not necessary maybe interfaced to a modem in order to communicate with the WAN. The data may also be retrieved via a Laptop running the LINESman application using local RF communication.

6.2 PAC Configuration

6.2.1 RF Configuration

- Group Number – For a PAC the group Number is always 0.
- Position – The Position should always be set to "Pole Attached Collator".
- PAC Address – The PAC Address will be the PACs RF address.

6.2.2 LED Indication

- Enable AMBER LED Flashing – Enables or disabled the AMBER LED indication.
- LED Period (secs) – The PAC will indicate ACTIVE status with 4 short flashes every Period secs.

Refer "LED Indication" section for more information

6.2.3 Health Check Period (Mins)

- The number of minutes between System Health Checks. The PAC will interrogate all CMS's and retrieve current status information. This data is collated and if External Modem configured transmitted to GLOMES.

6.2.4 Time to First Health Check (Mins)

- The number of minutes before the First Health Check is initiated. This allows the operator to ensure the Health Check Modem calls occur during OFF-PEAK times.

6.2.5 Send Load Log Data with Health Check

- If enabled the PAC will retrieve all Load Log data from CMS's since previous successful Load Log Data retrieval. This data is collated and if External Modem configured transmitted to GLOMES.

6.2.6 No. Minutes between Time Sync (Mins)

- The number of minutes between System Time Synchronisation. Each CMS updated with the PACs time and all devices are synchronised in time to approx 0.1mSec.

6.3 PAC- IFC Configuration

The IFC (Interface Controller) is a configurable module that enables communication with an external modem. The modem maybe PSTN, GSM, CDMA, wireless, or any other. The configurable variables allow the operator to adjust most modem communication parameters.

6.3.1 Enable IFC

- This must be checked true if communications with an external modem is desired.

6.3.2 Timing Parameters

- These timing parameters maybe modified to allow for different modem characteristics.

6.3.3 High Baud Rate Enable

- If Enabled the Baud rate to the Modem is 19200. If Disabled the Baud rate to the Modem is 1200.

6.3.4 Do Modem Echo Check?

- If Enabled the IFC will check if each command sent to modem is correctly echoed.

6.3.5 Is Hayes Compatible?

- Ensure this is Enabled if the External modem is a Hayes™ compatible modem.

6.3.6 Modem Dial String

- The telephone number for the GLOMES site. This must not include the Hayes™ "ATD" command string.

6.4 Time Synchronisation

Each CMS device samples Current and Voltage Asynchronously. That is independently of each other. The Clocks in each device with vary slightly from each other. It is important that the sampled data is synchronised in time so that each CMS's data maybe compared against the other CMS's. In order to achieve this time synchronisation, every configurable period (usually once every day) the PAC will set the CMS's time & synchronise them so that they are all accurate to better than 0.1mSec.

The PAC will add 30 secs to its current time (t+30). Each CMS is then sent the "Set Time" command via RF. This command will load the new time and halt the CMS device; both the Amber & Red LED's on the CMS will light to indicate this. When all CMS's time has been set, the Pac will wait for the t+30 time. When current time equals the t+30 time the "Sync Command" is broadcast to all CMS devices. Each CMS will be re-started with the new time.

Some things to note:

- The PAC time is Never Halted; this ensures daily accuracy is maintained.
- If 30 Seconds expires before the "Set Time" command has been successfully received by all CMS's the PAC will retry in 1 minute using t+60seconds. Again if still fails, a retry occurs with t+120 seconds.
- A DNP Event is added to the PAC data indicating success or failure, If the returned magnitude is 0 the Time Sync procedure was successful, else the RF Address of the device that failed is returned.

6.5 Health Check

Periodically the PAC will perform a Health check function on all its CMS's. The health check comprises of status information like battery voltage, Solar Energy, current Line Voltage, current Line Load, etc. If the "Send Load Log Data with Health Check" configuration variable is enabled

then the PAC will request send the Read Load Log status RF Command. This will provide the start and end address pointers for the load log data to be retrieved. The Load Log data is then retrieved using the Read EXT EEP RF Command. This is done for each CMS. When all data is collated the PAC will initiate (IF IFC is enabled) a modem call to transfer data to GLOMES.

6.6 CMS Event

If an Event should occur on a CMS, 1 minute after the start of the Event, the RF Event command will be sent to the PAC. This command provides the PAC the following information:

- Event Memory Start Address
- Event Memory End Address
- Device ID comprising of Group No. and Position No.
- Line Status.

The PAC will save this information temporarily and wait 30 seconds. This wait period is to provide time for each CMS, which may have also seen an Event, to transmit the Event Command to the PAC. If 30 seconds elapses with no further CMS Event commands, the PAC will begin retrieving the Event data. The PAC will use the Read Ext EEP RF Command with the Start and End Address pointers received from the CMS. The order in which the PAC retrieves the event data is the same as the order in which the Pac received the Event command. When all data is collated the PAC will initiate (IF IFC is enabled) a modem call to transfer data to GLOMES.

7 LT40 PAC IFC (Interface Controller)

The IFC (Interface Controller) is a module that exists within the PAC. This module is responsible for handling Data Protocol and Modem communications. The data collated by the PAC is accessed by the IFC and packed into DNP3.0 frames. These frames are transmitted to GLOMES via the modem link. The IFC and Modem is normally OFF. The PAC will wake up the IFC which inturn wakes up and configures the modem. The IFC sends them Modem dial string to call GLOMES. Once the line is connected to GLOMES the IFC will control the GLOMES protocol. When the data has been successfully transmitted the IFC will shutdown the Modem and the PAC will shut down the IFC. The Data address pointers in the PAC will be reset. If the call was unsuccessful the data pointers are not reset. The PAC will attempt 5 retries. If after 5 attempts the call still fails the PAC will try again 5 times in 2 minutes, then 4 minutes, 8 minutes, 16 minutes, etc until call is successful or another event occurs which resets retry count.

8 LT40 Indications

8.1 Types of Faults

- **Self-Clearing Fault** – High Current was detected but Voltage remained unchanged.
- **Transient Fault** – High Current was detected; Voltage was detected OFF for some period. At end of the1 minute arming period Voltage had returned.
- **Permanent Fault** – High Current was detected; Voltage was detected OFF and was OFF at end of the 1 minute Arming period.

8.2 Device Status LED Indication

The LEDs will indicate using sequences of flashes every period (normally 30 Seconds).

9 Glossary

CMS	Conductor Mounted Sensor
DTS	Date Time Stamp
HV	High Voltage
IED	Intelligent Electronic Device
IFC	Interface Controller
LED	Light Emitting Diode
LV	Low Voltage
ms	Milliseconds
PAC	Pole Attached Collator
PMS	Pole Mounted Sensor
P-P	Peak to Peak
RF	Radio Frequency
RMS	Root Mean Square
SLAB	Sealed Lead Acid Battery