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Triangle MicroWorks, Inc.  
IEC 60870-5-104 Slave  
Source Code Library

What's New?

*a description of the changes included in all versions of the library*

Version 3.09.00  
March 15, 2010

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This document describes features or corrections that have been added to the IEC 60870-5-104 Slave Source Code Library.

The symbols to the left of each revision are used to help define the following kinds of revisions:


- 104** Additional IEC 60870-5-104 Features, giving the Library support for more IEC 60870-5-104 objects or functions.
-  Additional Implementation Features, allowing implementers to more efficiently install the Source Code Library.
-  Corrections to problems, with indications for when the problems were introduced.

### **Version 3.09.00 (March 15, 2010)**



-  Modified WinIOTarg to prefer an exact address match when multiple channels are open and disconnectOnNewSyn==true.
-  Added localIpAddress to WinIoTarg to specify the source address to use when Client (or UDP sender) is sending IP messages. This, in conjunction with the Destination IP address and Routing Tables allows control over which Ethernet card is used to establish a connection. (At Windows command prompt, enter "route print" "route add xxx" can be used to add a route to cause a particular NIC to be used.)
-  Enhanced WinIOTarg to support a list of addresses from which TCP/IP connections will be accepted.
-  Added a COT check on File Transfer functions.
-  Added user data pointers to TMWCHNL, TMWSCCTR, and TMWSESN.
-  *Description:* When multiple application contexts are used, closing one deleted the memory pool lock, which could cause problems if another application context was open.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* WinIOTarg could fail to process all available characters, causing timeouts when running at high baud rates.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* When configured to use system time, WinIOTarg System time not setting the dstlnEffect flag correctly.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09

-  *Description:* LinIOTarg did not set dayOfWeek in tmwtarg\_getDateTime function..  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* LinIOTarg could cause high levels of processor utilization when multiple channels were opened.  
*Introduced:* v3.07  
*Resolution:* Fixed in v3.09
-  *Description:* If the cyclic period was too short, not all points would get sent in cyclic messages.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* When a C\_RP command was received, the s14data\_crpnaExecute function or the CrpnaExecuteEvent method was called, even if the command was bad.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* A C\_SC command could be rejected due to elapsed time because of time zone or SU bit settings.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* Added discardIFramesOnDisconnect parameter to disable resending after a reconnection.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09
-  *Description:* New commands could be held off until sending of a multi-ASDU response completed.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.09

### **Version 3.08.00 (September 25, 2009)**

-  *Description:* The rs232Reader thread in WinIOTarg was missing a stop event.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.08

### **Version 3.07.00 (July 17, 2009)**

-  Added LinIOTarg (low-level target for Linux) and new command line-based examples (that can be used with Linux).
-  Integrated WinIOTarg (low-level target for Windows) into the standard release package.



Added IEC 60870-5-104 redundancy examples.



Added FormatMessage Win32 API function to WinIoTarg to provide more descriptive errors instead of just numeric values.



*Description:* A spontaneous event could be sent during a command sequence.

*Introduced:* v3.00

*Resolution:* Fixed in v3.07

### **Version 3.06.00 (April 14, 2009)**



Added TMWCNFG\_MAX\_APPLRCVS to “break out” of loop in tmwappl\_checkForInput() after the specified number of iterations.



Modified timer values in tmwlink\_channelCallback to speed up retries.

### **Version 3.05.00 (December 4, 2008)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.

### **Version 3.04.01 (September 30, 2008)**



Improved comments on compiler options such as TMWCONFIG\_USE\_MANAGED\_SCL.

### **Version 3.04.00 (September 12, 2008)**

**104** Added support for F\_SC\_NB (defined in IEC 60870-5-104 Edition 2).



Added configuration to allow timeouts on responses.



*Description:* The Source Code Library could resend iframes in error if the W value on the receiver was larger than the K value on the sender and if the target layer could not send the iframes as fast as they were generated.

*Introduced:* v3.00

*Resolution:* Fixed in v3.04



*Description:* The “link layer” did not properly handle receiving only the first octet of a message. (This condition is very unlikely to occur, and most likely requires a serial to TCP converter or TCP radio with slow data rates).

*Introduced:* v3.00


*Resolution:* Fixed in v3.04






*Description:* tmwdb\_lockQueue and tmwdb\_unlockQueue were described in the header comments for tmwdb\_storeEntry in tmwdb.h, but they were not defined in tmwdb.c.

*Introduced:* v3.00

*Resolution:* Fixed in v3.04

-  *Description:* Test Frames were sent even after disconnecting.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.04


### **Version 3.03.00 (April 1, 2008)**

-  Added ability to include session indicator in channel statistics.
-  Added additional casting to accommodate compilers that require casting of constants for register shift operations.
-  Modified behavior of Source Code Library to comply with IEC 60870-5-104 Edition 2. This change affects: C\_TS\_TA; handling of delayed commands containing time stamps; maximum APDU length; support for Type IDs <2>, <4>, <6>, <8>, <10>, <12>, <14>, <16>, <17>, <18>, <19>; and updates to the device profile document.




### **Version 3.02.00 (December 7, 2007)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.





### **Version 3.01.01 (August 8, 2007)**

-  Added ability to keep time on a per-session basis. Added pSession to tmwdtime structure; target layer can use this parameter to return a time specific to the session.




### **Version 3.01.00 (May 23, 2007)**

-  Modified online notification algorithm to facilitate notification of sessions that never go online.
-  *Description:* The Source Code Library did not check to see if a command was in progress when it received a new command. If it receives a new command of the same type as a command already it progress, it will now issue a Negative ACT CON to the second command and continue execution of the first command.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.01.00
-  *Description:* The Source Code Library did not properly convert between QCC and counter groups when processing freeze counter command.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.01.00




### **Version 3.00.49 (November 1, 2006)**

-  Renamed TMWCHNL\_STAT\_CALLBACK and TMWSESN\_STAT\_CALLBACK macros to TMWCHNL\_STAT\_CALLBACK\_FUNC and TMWSESN\_STAT\_CALLBACK\_FUNC. This change avoids having a macro and a typedef with the same name.
-  *Description:* The link layer could send, even after the target layer indicated the connection was broken.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.49
-  *Description:* The received frame sequence number processing code was too tolerant of missed frames.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.49
-  *Description:* The Source Code Library did not properly convert between QCC and counter groups when processing a freeze counter command.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.49






### **Version 3.00.46 (April 27, 2006)**

-  Modified release to include WinIoTarg.dll built with Visual Studio 6. This DLL is used when using Visual Studio to build the sample applications.
-  Provided enhancements for Gasunie PIDs introduced in v3.00.45.
-  Updated sample Makefiles to correctly build Source Code Library.



### **Version 3.00.45 (March 17, 2006)**

-  Improved documentation in protocol-specific section of the manual. Provided additional text, reorganized layers, and included all header files that comprise the API.
-  Added support for Gasunie PIDs (mitnc, mittc, csenz, mctna, cctna, msptb, mdptb, mbotb, mmetf, and ctsna). Also optionally modified GI RTU/LU behavior. (Note: this behavior contradicts the specification and should only be used for Gasunie).
-  *Description:* The DEACTIVATE command did not properly cancel the ARM timer.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.45




### **Version 3.00.44 (February 2, 2006)**



-  Added a sample application to provide an example of a multi-threaded, event-driven application.
-  Set receive indication in diagnostic information to indicate the direction of the message.
-  Enhanced statistics to include additional values such as CRC errors, number of invalid start bytes, frame length errors, etc.
-  Added support for maintaining different times on each sector.
-  Split into tmwtarg.h/c into tmwtarg.h/c and tmwtargp.c/c. This change moves all Triangle MicroWorks, Inc. specific code into a separate file. Customers only need to modify tmwtarg.c.

### **Version 3.00.43 (December 2, 2005)**




-  Provided conditional compiler directives to reduce code size for unsupported data types.
-  *Description:* s4cbota\_processRequest incorrectly use pCSCPoint.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.43

### **Version 3.00.42 (September 9, 2005)**






-  Improved documentation by updating *IEC 60870-5-101 Slave.doc* to improve readability and include all user-modifiable files.
-  Added subversion to SCL filename (e.g., s104v30042.exe). This allows the version number to be determined from the file name. The version number continues to be defined in tmwvrsn.h.
-  *Description:* When using IEC 60870-5-104 Addendum 1 redundancy groups with multiple threads, there was a potential for deadlocking. The SCL now uses one lock around the redundancy group and all channels in this group.  
*Introduced:* v3.00  
*Resolution:* Fixed in v2.00.42


-  *Description:* When configured to keep most recent events, an event buffer overflow could result in a call to s14mem\_free with a null pointer.  
*Introduced:* v3.00.39
-  *Resolution:* Fixed in v3.00.42 *Description:* The Source Code Library could potentially reference a Null pointer in tmwdlist\_removeEntry  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.42

### **Version 3.00.41 (July 20, 2005)**

-  Added examples to show how to add M\_ME\_NA and related commands.
-  *Description:* The Source Code Library could send multiple copies of the same event.  
*Introduced:* v3.00.39  
*Resolution:* Fixed in v3.00.41
-  *Description:* The Source Code Library retained the wrong events when the event buffer overflowed if it was configured to retain the oldest events.  
*Introduced:* v3.00.39  
*Resolution:* Fixed in v3.00.41

### **Version 3.00.40 (June 3, 2005)**

-  Added 101Master sample application executables and required DLLs to allow running this application without having to build it.
-  Improved documentation of memory type configuration.
-  Fixed compiler warning for TMWTYPES\_BOOL type.
-  *Description:* The pseudo-link layer did not wait for a response to “request status” and “link reset” messages before sending confirmed data.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.40
-  *Description:* s104mem\_init() used compiled values instead of runtime values for initialization.  
*Introduced:* v3.00.39  
*Resolution:* Fixed in v3.00.40

 *Description:* If readTimeFormat was set to 24bit or 56bit (which does not make much sense, but is allowed), and if s14data\_msgGetIndexed() returned false, then the Source Code Library would set the VSQ SQ bit for MSPTA and MSPTB responses, which is not allowed.

*Introduced:* v3.00


*Resolution:* Fixed in v3.00.40


 *Description:* TMWMEM\_FREE\_FUNC was doubly defined.


*Introduced:* v3.00.39


*Resolution:* Fixed in v3.00.40


### **Version 3.00.39 (March 29, 2005)**


 Improved memory management within Source Code Library. Added new #define (TMWCNFG\_ALLOC\_ONLY\_AT\_STARTUP) to tmwcnfg.h. Also added new functions that target to set the maximum number of each buffer in each pool at runtime. Both “only at startup” and static allocations use a linked list of free and allocated buffers instead of just an array that was accessed sequentially.


 Added call to channel statistics (TMWCHNL\_STAT\_ACTIVE) to indicate which channel in a redundancy group is active.


 Added ability to save oldest events instead of newest events when an event buffer overflows.

 Added ability to return ACT CON Negative if a Freeze operation fails. If the s14data\_mit Freeze command returns TMWDEFS\_FALSE, the Source Code Library will send an ACT CON Negative.

 Added TMWSCTR\_STAT\_EVENT\_NOTFULL statistic to indicate that the event queue is no longer full. This provides the target the ability to use a pseudo point to indicate event buffer overflow conditions.

 Added description and example of custom ASDU support to User Manual.




 Improved comments in s14data.h to better describe single command parameters.

 *Description:* The IOA would be repeated if all points could not be sent in a single message.



*Introduced:* v3.00

*Resolution:* Fixed in v3.00.39

### **Version 3.00.38 (January 18, 2005)**

-  Modified the API for the channel, session, sector modify functions to initialize a structure with the current settings. Any of these settings may then be modified by the target code.
-  Added ability to display structured IOAs. A new configuration option specified when opening an IEC 60870-5-101 or -104 session indicates that the IOA should be specified as a set of bytes instead of an unsigned long.
-  Add new function `s14data_ccsnaSetTime()`, which by default calls `tmwtarg_setDateTime`. The target implementation can modify this function in order to disable time syncs or to adjust this time before setting it.





### **Version 3.00.37 (December 15, 2004)**

-  Added ability to send events without a time stamp. If the `pTimeStamp` field is Null when calling `s14xxx_addEvent`, the event will be sent using a variation without time.
-  *Description:* `i870lnk4.c` generated two “result comparison always returns 0” warnings if `UCHAR` was defined as 8 bits.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.37

### **Version 3.00.36 (November 2, 2004)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.

### **Version 3.00.35 (September 22, 2004)**

-  Added `#define TMWCNFG_MEMORY_ALIGN_NEEDED` to `tmwcnfg.h` to support processors requiring long word (4 byte) alignment and compilers that create unpacked structures.
-  Added `tmwapp_startTimer` and `tmwapp_cancelTimer` to `tmwtarg.c`.  
NOTE: These functions must be defined in the target in order for the Source Code Library to link.
-  *Description:* Integrated Totals with time tags (`M_IT_TA` and `M_IT_TB`) were never sent in response to a Counter Interrogation (`C_CI_NA`).  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.35
-  *Description:* The Source Code Library did not discard I Format frames on connections that were not active.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.35

### **Version 3.00.34 (July 30, 2004)**



*Description:* The Source Code Library could call tmwtarg\_startTimer with a negative value. For some operating systems, this causes timers to stop running.

*Introduced:* v3.00.32

*Resolution:* Fixed in v3.00.34



*Description:* The algorithm for sorting timers did not work properly if the two times being compared were more than 17 days apart.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.34



*Description:* i870util.h was sometimes included as l870util.h, causing compilation problems with some compilers.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.34



*Description:* The Source Code Library did not wait for Start Act on disconnect/reconnect

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.34

### **Version 3.00.33 (June 17, 2004)**



*Description:* The C\_SE\_TA Setpoint command could reference a Null pointer.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.33

### **Version 3.00.32(June 4, 2004)**



Enhanced support for multiple threads. Added support for one timer queue per channel. Also improved locking/unlocking to prevent threads from being interrupted or deadlocked. This enhancement required two changes to the API:

- Added new #define(TMWCNFG\_MULTIPLE\_TIMER\_QS) to allow support of multiple timer queues (default is TMWDEFS\_FALSE)
- Added new parameter to tmwdb\_storeEntry() to indicate whether the queue should be locked (default is not to lock the queue).

*Any implementation using multiple threads should upgrade to this release*



Added support for IEC 60870-5-104 CICNA QOI reserved or private range values. New functions (s14data\_xxx) were added to determine if the QOI value is supported, and what bit to use in the return from the s14data\_xxxGetMask() functions.



Added support for using RES1 bit in 7 octet binary time to indicate Genuine or Substituted time.



*Description:* Opening a redundant IEC 60870-5-104 channel did not initialize dynamic memory.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.32



*Description:* The `_timerCallback` function in `tmwtimer.c` did not always lock the proper channel.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.32



*Description:* `tmwappl_initApplication()` could not be called more than once.

*Introduced:* v3.00.29

*Resolution:* Fixed in v3.00.32



*Description:* A 31-day timer would expire immediately.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.32

### **Version 3.00.29 (March 31, 2004)**



*Description:* The Source Code Library could send an ACTCON to a CSCNA request before all time tagged events were sent.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.29



*Description:* When configured for Static memory support, the Source Code Library could fail to allocate buffers if they contained non-zero data on startup.

*Introduced:* v3.00.23

*Resolution:* Fixed in v3.00.29

### **Version 3.00.28 (March 2, 2004)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.

### **Version 3.00.27 (February 3, 2004)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.




### **Version 3.00.26 (January 15, 2004)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.







### **Version 3.00.25 (December 12, 2003)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.









### **Version 3.00.24 (November 10, 2003)**

-  *Description:* The Source Code Library did not set the set “Unknown IOA” in the COT field for failed commands.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.24
-  *Description:* The Source Code Library did not send a proper response when it received a command for a nonexistent sector.  
*Introduced:* v3.00  
*Resolution:* Fixed in v2.00.24
-  *Description:* The Source Code Library did not echo the command properly if the command failed due to an unknown IOA.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.24



### **Version 3.00.23 (October 31, 2003)**


-  Added locks to tmwmem.c to add support for multiple threads to memory management routines.
-  Provided optimizations when diagnostics are not compiled in.
-  Added ability for target to specify bits in COI field of EOI message.
-  *Description:* The Source Code Library could reference a Null pointer when adding events if the device was out of memory and there were no events on the current event queue.  
*Introduced:* v3.00  
*Resolution:* v3.00.23
-  *Description:* The Source Code Library did not deallocate the txData structure when using a serial link and the confirm was not received.  
*Introduced:* v3.00  
*Resolution:* v3.00.23
-  *Description:* The Source Code Library could fail to send a negative activation termination.  
*Introduced:* v3.00  
*Resolution:* v3.00.23

### **Version 3.00.22 (October 8, 2003)**


-  Added S14data\_dataReady() function to provide ability for target layer to indicate that database accesses are not ready. If s14data\_dataReady returns TMWDEFS\_FALSE, the Source Code Library will return ACTCON to the current command and wait until the database is ready.
-  Removed scanning for Integrated Totals. The application should call s14mit\_addEvent() when the counters are frozen.
-  Changed the interface to s14\_xxxChanged() functions to remove the time stamp, since the Source Code Library sets the time stamp. If the application needs to specify the time stamp, it should call s14xxx\_addEvent() instead of using scanning.
-  Improved detection of sessions going offline. Any application layer error will now take a session offline.
-  Cyclic Data are now sent as part of initialization.
-  *Description:* The Source Code Library could fail to send a response if s14cscna\_checkStatus() did not return TMWDEFS\_CMD\_STAT\_SUCCESS or TMWDEFS\_CMD\_STAT\_FAILED.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.22
-  *Description:* s14fileFDRTA did not properly check the length of the message, which could result in writing past the end of the buffer.  
*Introduced:* V3.00  
*Resolution:* Fixed in v3.00.22
-  *Description:* Some functions called i870chnl\_newTxData without checking to see if it returned Null.  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.22. The SCL now checks for a Null pointer return from all calls to i870chnl\_newTxData.

### **Version 3.00.20 (September 2, 2003)**

-  Added callback function to let target application know when a channel is idle and can be disconnected.
-  An evaluation version of a working sample of a Windows application is now shipped with the Source Code Library. The evaluation expires after running for two hours.

-  *Description:* If TMWCNFG\_SUPPORT\_DOUBLE wasn't supported, compilation issues would occur.  
*Introduced:* v2.00  
*Resolution:* Fixed in v3.00.20

### **Version 3.00.19 (August 8, 2003)**

-  *Description:* The Source Code Library could call tmwtarg\_startTimer even if the timer was already running. This issue only affected event driven implementations (i.e., implementations that did not use the polled timer implementation).  
*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.19

### **Version 3.00.18 (July 22, 2003)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.

### **Version 3.00.17 (July 10, 2003)**



Added Sector statistics callback function and provided event buffer overflow indication.



Improved implementation of internal data passed to callback functions to return a well defined structure and status codes.



Added TMWTARG\_CONFIG structure to allow specification of parameters that are common to multiple protocols.



*Description:* Closing a sector attempted to deallocate the same memory more than once.

*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.17



*Description:* The Source Code Library could occasionally send responses with a COT of 0.

*Introduced:* v3.00  
*Resolution:* Fixed in v3.00.17

### **Version 3.00.16 (June 19, 2003)**



Added limit checks for sprintf statements. This prevents buffer corruption caused by writing past the end of the current buffer.



Modified Source Code Library to avoid string copies for diagnostics when the diagnostics aren't enabled.



Restructured Source Code Library to allow Master and Slave sessions on a channel simultaneously to support Peer or Dual mode. Removed p10x files.



Added a sector configuration parameter for all command types (CSENA, CSENB, CSENC, CSETA, CSETB, CSETC) to specify whether the optional ACT TERM is sent back to the master upon completion of the Set command.



Added current version number to *tmwvrsn.c/h* in the *utils* directory to simplify determining which version of the Source Code Library is in use.



Improved Protocol Analyzer display to use terminology from standards documents; now display "SQ" instead of "SEQ" for Single/Sequence bit.



Cleaned up compiler warnings and issues identified by *lint*.



*Description:* Broadcast times did not work properly

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.16



*Description:* Broadcast messages for Clock Sync & General Interrogation commands did not work properly

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.16



*Description:* s4cdata\_processRequest used pCSCPoint by mistake

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.16



*Description:* Source Code Library did not send events generated using xxx\_addEvent functions.

*Introduced:* v3.00

*Resolution:* Fixed in v3.00.16.

### **Version 3.00.15 (May 27, 2003)**

No updates to IEC 60870-5-104 Slave Source Code Library in this release.

### **Version 3.00.14 (May 9, 2003)**



Improved memory management. Implemented a new memory management scheme that supports static memory as well as providing limits on the number of each type of structure that can be allocated. It also provides details on how many structures of each type have been allocated and keeps track of the maximum number that was allocated. This provides feedback that can be used in sizing applications and monitoring allocated memory. Cleaned several areas in which memory was not being freed properly.

### **Version 3.00.12 (April 28, 2003):**



Added Incremental Application Layer Response Timeout configuration parameter.



The Incremental Timeout timer is now disabled if the timeout value is set to zero



*Description:* The Source Code Library could reference unallocated memory and cause a crash if Link Layer Confirms were enabled and the Application Layer timeout was configured to be less than ((Link Layer timeout) \* (number of Link Layer retries+1)).

*Introduced:* Version 3.00

*Resolution:* Fixed in version 3.00.12. When the Application Layer times out, it now tells the Transport Layer, which in turn tells the Link Layer.

### **Version 3.00.11 (April 24, 2003):**



If a connection is broken or the remote device restarts, the Source Code Library will attempt to reopen the connection.



Add support for Send /No Reply in monitoring direction.

### **Version 3.00 (April 28, 2003):**




The Triangle MicroWorks, Inc. Source Code architecture was redesigned and reimplemented to follow modern software engineering practices and leverage new techniques in software design. We have also incorporated suggestions from our existing customer base. The main advantages to this redesign include:

- 1) Common source code architecture across all TMW libraries - The use of a common architecture across all libraries significantly reduces time required to port additional protocols to a target device. In addition, using common software across all products results in better code, since common functions are utilized much more frequently than protocol specific functions.
- 2) Source Code Library calling routines are now compatible with a wider variety of event driven techniques, allowing the target application to be achieve higher performance.
- 3) Most configuration parameters are now passed as arguments in Source Code Library function calls instead of macros. This allows for data hiding and protects configuration parameters from accidentally being changed while the Source Code Library is running. In addition, macro calls to target

hardware and the database interface routines were replaced with function calls.

- 4) Significant reduction in the time to implement new features - In addition to being more flexible, the use of modern software design practices significantly reduces the time required for Triangle MicroWorks to support new features. As the existing protocols are constantly being improved by the associated Technical Committees and Working Groups, it is essential that the Source Code Libraries are able to remain up to date with the latest standards.

### **Version 2.13 (July 10, 2002):**

 Miscellaneous minor bug fixes.

### **Version 2.12 (March 21, 2002):**

104 Added support for protection equipment events including ASDU types 17(MEPTA), 18(MEPTB), 19(MEPTC), 38(MEPTD), 39(MEPT E), and 40(MEPTF).

### **Version 2.11 (January 24, 2002):**

104 Added support for file transfer in the control and monitor direction.

### **Version 2.06 (September 4, 2001):**

104 Added limited file ID support (Type ID's 122 and 123).

 Fixed compile time errors when `S101TARG_DIAG_FEATURE_MASK()` is set to zero. Introduced in initial release.

### **Version 2.05 (August 31, 2001):**

104 Added new macros: `S104TARG_MEMCOPY()` to specify local memory copy implementation, `S104DATA_SESSION_NOTIFY_ONLINE()` to support target notification of online/offline events. `S104TARG_MALLOC()` and `S104TARG_FREE()` to support dynamic allocation of memory.

104 Added support for Bitstring commands (Type ID 51 and 64) and Bitstring data (Type ID 7, 8 and 33) with and without time tag.











104 Added support for custom ASDU types: 240 – Integrated Totals BCD, 241 – Integrated Totals BDC with Time Tag and 242 – Integrated Totals BDC Command.




Changed `tmwclprm_parseSession()` so that if only 104 libraries are installed, no reference of the `LINK_ADDRESS` configuration parameter is made. Also, if multiple protocols are installed, but the protocol for a communications channel is 104, then the link address is neither displayed or parsed.



Removed unused declaration of `s104dbas_mstnaUseSequence`. The step position information (`MSTNA`) uses `s104dbas_neverUseSequence()`.

-  Added new doubly linked list utilities in `tmwdb1nk.c` and `tmwdb1nk.h`.
-  Added processing of sequence number and time validation for test command with time tag.
-  Variable structure qualifier definitions have been moved from `I870def1.h` to `I870defs.h`. Replaced `I870DEF1_VSQ_SEQUENCE_ADDR_MASK` with `I870DEFS_VSQ_SQ`.
-  Added return status to `i8701nk4_ackSentSequence()`. This status will return false if the channel was closed because of an error, otherwise it returns true for success.
-  Renamed `tmwphys_initChannel()` to `tmwphys_openChannel()` and moved `S104TARG_COMM_OPEN()` macro to inside of `tmwphys_openChannel()`.
-  Added `TMWSTAT_LINK_UNEXPECTED_ACK`, an unexpected acknowledge error code and `TMWSTAT_LINK_REQUEST_CANCELED`, a link level request was cancelled and the session was restarted error code.
-  Changed application callback functions to be accessed through a structure to reduce the number of calling parameters to `I870SCL_BUILD_OUTGOING_FUNC`. Added `beforeTxCallback` and `callbackParam` to application callback capabilities. Defined new `restartSession` callback used to tell the application layer that a link layer session restart occurred.
-  Changed parameters to `I870SCL_PROCESS_INCOMING_FUNC` and `s104app1_processRequest()`.
-  Corrected a problem with `tmwc1prm_parseSector()` that could have resulted in illegal references of memory when multiple Source Code Libraries are installed. Introduced in version 2.02.
-  Fixed sequence number problem when cyclic data is received during initialization by initializing `lastMatchedSequence` to 0. Introduced in version 2.02.

### **Version 2.02 (March 14, 2001):**

-  Initial release of the IEC 60870-5-104 Slave Source Code Library.