TCG 01-G & TCG 02-G Firmware Release Notes

Known Issue: For TCG -G series clocks running GNSS receiver firmware version d1.07 or d1.08 and configured to use GLONASS as the only constellation for synchronization, the time reported on the front panel, Configuration Tool and outputs will be ahead of UTC by 3 hours. Note that the pulse and frequency outputs are not affected by this anomaly. It is recommended that TCG products running these firmware versions are not configured with GLONASS as the only constellation. TCG products configured with "GPS + GLONASS" or "GPS" only are not affected by this issue.

Known Issue: When a GNSS reset is performed through the Configuration Tool, the timing outputs may jump by up to 1 second and this time jump may not be reflected by the accuracy indicators in the output signals. This is a temporary condition and the clock returns to normal operation once GNSS synchronization is re-gained.

VERSION F2.30r1 (August 2022)

- **Bug Fix:** TCG 02-G clocks fitted with the OCXO or rubidium oscillator option, that are synchronized and reporting Position Hold, may unexpectedly enter a state where the on-time point of the outputs continuously oscillates back and forth by several milliseconds, while overstating the accuracy. This issue is triggered by an erroneous timing pulse initiated by the GNSS receiver in a faulty state, which then recovers. The TCG 02-G attempts to correct for this erroneous timing pulse, but the characteristics of the trigger causes an oscillatory time jump correction. This could occur indefinitely.

  The handling of erroneous timing pulses has been changed to include additional sanity checking of the incoming timing pulse on the TCG module, where the TCG will only accept a pulse if it is received one second after the previous pulse and will ignore any erroneous pulses.

- **Bug Fix:** Fixed a bug on the TCG 02-G M2 platform, introduced in version 2.30r, that could cause the TCG main board to appear to freeze for a few seconds after a configuration change is applied.
- **Bug Fix:** When a GNSS reset was performed via the Config Tool, the TCG would incorrectly continue to report that it is synchronized for up to 45 seconds before entering holdover. This bug has been fixed. The TCG will now correctly report the Holdover state shortly after the GNSS reset button is clicked.
- **Bug Fix:** Fixed a bug that could cause the TCG to jump to one second behind the correct time on the front panel and non-Ethernet outputs when GNSS is disabled through the Config Tool.

VERSION F2.30r (February 2022)

Firmware version F2.30r and above requires Configuration Tool version 4.6.1.0 or later. This firmware version is not compatible with older Configuration Tool versions.

- **Feature:** A stability validation window has been added for when the device is synchronizing to incoming sync sources. The device will usually take under one minute to synchronize to the source, then it will spend an additional 30 seconds at most validating that the sync source is stable before reporting that it is 'in sync'.
- **Improvement**: Added the ability to force the TCG 02-G to always indicate the G.811 (stratum 1) quality level while in sync. This is indicated in the Synchronization Status Message (SSM)

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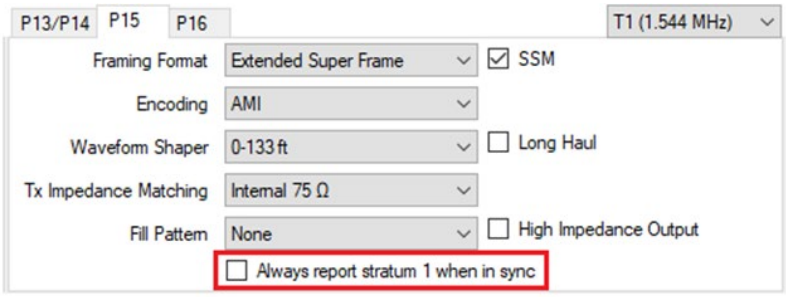
contained in the P15/P16 T1/E1/J1 telecom output from clocks fitted with the M3 expansion option. Tekron Configuration Tool 4.6.1.0 or later is required to configure this option.



- **Improvement:** The week number base date will now automatically be updated to the current date once per year to prevent rollover. This is only applicable to GNSS receivers with a firmware version of d1.05 or greater.
  GPS uses its own date and time scale, which consists of a week counter and a counter for seconds within the week. The week counter is 10 bits due to hardware limitations of the GPS satellites. It can therefore only count from 0 to 1023, before going back to 0 (sometimes referred to as a "rollover"). The handling of the week number field value is based on a base date stored within the GNSS receiver module of the unit. Correct operation is expected for the 1024 weeks (19.6 years) following that date. This improvement automatically updates the base date to ensure that correct operation continues beyond 1024 weeks following the initial base date.
- **Bug Fix:** Fixed a bug where TCG 02-G and NTS 03-G clocks fitted with the OCXO or Rubidium oscillator option would not apply the configured Minimum SN Value setting, instead continuing to use the default setting. This could cause the clock to synchronize to satellites with a signal to noise ratio below the configured Minimum SN Value setting.
- **Bug Fix:** Fixed a bug where a unit with a TCXO frequency reference fitted could intermittently report in the configuration tool that it was using a Rubidium frequency reference instead of a TCXO reference.
- **Bug Fix:** Fixed a bug where the clock would continue to report in sync with the same accuracy for 60 seconds while a GNSS receiver reset was being performed, despite the GNSS sync source being unavailable during the reset.
- **Bug Fix:** Fixed a bug where on rare occasions, the TCG main board configuration settings could be lost. The firmware now stores a backup copy of the main board configuration to prevent this.

VERSION F2.29r (January 2019)

- **Bug Fix:**
  In TCG 02-G clocks fitted with the OCXO or Rubidium oscillator option, the mask angle may unexpectedly change from the configured mask angle to 60 degrees. The effect of the mask angle change is that it reduces the number of satellites that can be used in time and position calculations, causing loss of sync, and does not recover without external intervention. The issue arose because the internal time reference module was inadvertently reading messaging intended for another subsystem on the bus. One of the timestamp messages that should have been ignored, contained data in the same format as an instruction which configures the GNSS receiver to change the mask angle. The message handling has been changed so that the issue will no longer occur.

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VERSION F2.28r6 (May 2018)

- **Bug Fix:**
  A bug was noticed in the TCG G-Series clock where the Sync Relay Alarm closed when the clock was in the Tuning State (GNSS). The Sync Relay Alarm should close in the Sync State (GNSS). This bug fixes this issue.

VERSION F2.28r5 (February 2018)

- **Improvement:**
  Monitor GNSS receiver activity and perform a GNSS reset if satellite reception is lost following a period of good reception and not subsequently recovered within 120s. The clock synchronization state during this period is not changed and will go to holdover and possibly non holdover as dictated by the clock settings.
- **Improvement:**
  Monitor GNSS receiver activity and wait for 5 seconds before entering holdover or announcing low satellites if the satellites used for timing count drops by more than 3 in one second.
- **Change:**
  Always output the 'Clock Monitor' serial string, regardless of the sync state or suppression settings.

VERSION F2.28r4 (January 2018)

- **Change:**
  The simulated DCF-77 signal has been modified to set the time zone bits Z1 (17) and Z2 (18) to Z1=0, Z2=1 when DCF-77 is configured to carry UTC. Previously when carrying UTC, the simulated DCF-77 signal would use the time zone bits Z1=0, Z2=0. The full behavior of these bits is summarised below.

Simulated DCF-77 Is carrying	Z1	Z2
Local time and unit is **not** in summer-time (CET).	0	1
Local time and unit is in summer time (CEST).	1	0
DCF-77 carrying UTC	0	1

VERSION F2.28r3 (November 2017)

- **Improvement:**
  Added a "maximum inaccuracy check" option, which allows a time inaccuracy threshold to be set, at which the clock will leave holdover and indicate out of sync. This option can be used instead of, or in addition to, the "holdover timeout" option, which causes the clock to indicate out of sync after a specified time in holdover.

  The "maximum inaccuracy check" option is useful for ensuring that the clock does not exceed a specific accuracy level. The clock will automatically take into account factors such as the fitted frequency reference and time in sync to determine how long to remain in holdover.

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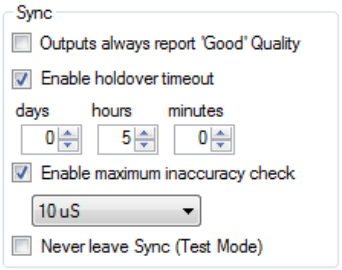
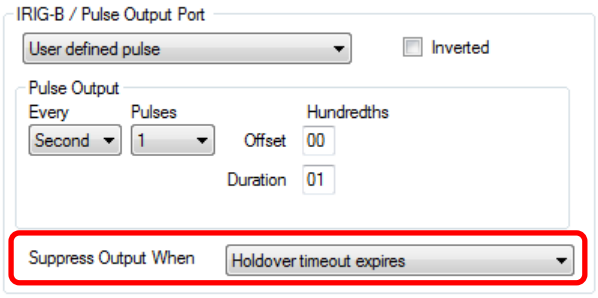
If both “holdover timeout” and “maximum inaccuracy check” are enabled, the clock will leave holdover and indicate out of sync only when **both** the holdover time has expired, and the inaccuracy threshold has been crossed.



- **Improvement:**
  Added the ability to independently suppress individual outputs based on inaccuracy threshold or holdover timeout. When “holdover timeout expires” is selected, that particular output will stop providing a time signal when the clock is out of sync and the specified holdover time has expired.

  When “Inaccuracy threshold is exceeded” is selected, that particular output will stop providing a time signal when the clock is out of sync and the reported inaccuracy has exceeded the specified maximum inaccuracy. When “Never” is selected, that particular output will continue to provide a time signal even when the clock is out of sync.

  This applies to the following ports:
  - Configurable IRIG-B / Pulse output ports (P2, P3, P4 pin 1)
  - P4 serial string output port
  - P5 AM IRIG-B output port
  - P11 configurable IRIG-B / Pulse output port (TCG 02-G M2 expansion)
  - P9 configurable IRIG-B / Pulse output port (TCG 02-G M3 expansion)



- **Change:**
  The persistent holdover availability option is now no longer optional, and is permanently enabled. This is required for correct operation of the clock with the added “maximum inaccuracy check” option.

VERSION F2.28r1 (October 2017)

- **Improvement:**
  Added the ability to apply firmware upgrades to the GNSS receiver module of TCG 02-G clocks fitted with OCXO or Rubidium oscillators. This change allows for future field upgrades to be

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applied to the GNSS receiver module. Clocks not fitted with OCXO or Rubidium oscillators already have this capability.

VERSION F2.28r (May 2017)

- **Feature:** Added support for enabling the persistent holdover availability option. Tekron Configuration Tool 4.2.1.10 or later is required to enable this option.

  Normally, the clock can only enter holdover if it has been in sync for at least 5 minutes. If persistent holdover is enabled, and the clock has initially been in sync for at least 5 minutes, then the clock can still enter holdover if it experiences a sync switching condition. For example, sync is lost, regained for less than 5 minutes, then lost again. Such a condition may exist when GNSS jamming is present, or in the case of a poor antenna installation.

  Please note, when entering holdover after a period of intermittent sync the holdover period timer is reset. This may cause the clock to enter into an extended holdover period, if the sync switching condition continues to be present. By disabling persistent holdover, you can ensure that the time in holdover is not extended by periods of intermittent sync lasting less than 5

  minutes.

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- **Feature:**
  Added Tekron String-H option to P4 serial time string output. Tekron Configuration Tool 4.2.1.10 or later is required to select the String-H option. The format of String-H is as follows:

About	String-H
Timing	The string is transmitted once every second, with the leading edge of the "start" bit of the first character <STX> exactly on the second that the message describes.
Definition	<STX>D:dd.MM.yy;T:w;U:hh.mm.ss;uvxy<ETX>
Placeholder	**Content**
<STX>	Start of Text (HEX 02)
D	ASCII "D"
:	HEX 3A (colon)
dd	Day of month: "01" – "31"
.	HEX 2E (full stop)
MM	Month of year: "01" – "12"
yy	Year: "10" – "99" representing the last two digits of the year
;	HEX 3B (semicolon)
T	ASCII "T"
w	Day of Week "1" to "7", "1" = Monday
U	ASCII "U"
hh	Hour: "00" – "23"
mm	Minute: "00" – "59"
ss	Second: "00" – "59"
u	ASCII "#" (hash) if not synchronised since last reset, or space (HEX 20) if synchronised since last reset
v	ASCII "*" (asterisk) if clock is running on local oscillator, or space (HEX 20) if clock is currently synchronised
x	ASCII "U" if UTC time, or ASCII "S" if DST, or space (HEX 20) if standard time
y	ASCII "!" (exclamation) if DST change pending, or ASCII "A" if leap second pending, or space (HEX 20) otherwise
<ETX>	End of Text (HEX 03)

- **Change:**
  Updated the default new clock UTC-TAI offset to be 37 seconds as per the leap second added on January 1st 2017.
- **Bug Fix:**
  During the recent (December 2016) leap second event, it was observed that the GNSS/GPS receiver module continued to report the previous UTC-TAI offset for many hours following the actual changeover. Prior to F2.28r, the firmware would ignore the UTC offset advice from the GNSS/GPS module for six and a quarter hours following the leap second event. This was found to be insufficient, and has been increased to 36 hours.
- **Bug Fix:**

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Fixed a bug that, if the 'Suppressed when out of sync' option is selected, caused the first pulse of the first IRIG-B frame to occur 2 milliseconds early when sync is achieved.

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VERSION F2.27r1 (Limited Release)

- **Bug Fix:**
  Since F2.27r, units fitted with a Rubidium or OCXO frequency reference failed to maintain the holdover state, reverting to the out of sync state within 1 second of losing all time sources.

VERSION F2.27r (10 August 2016)

- **New feature:**
  TCG 02-G Clocks fitted with OCXO or Rubidium frequency reference options now support synchronisation to external IRIG-B, PTP, and NTP sources as a slave.
- **Improvement:**
  Holdover times up to 970 days are now supported, an increase from the previous limit of 3.5 days. Tekron Configuration Tool 4.1.1.1 or later is required to configure holdover times up to this limit.
- **Bug Fix:**
  The Synchronization Status Message (SSM) contained in the P15/P16 T1/E1/J1 telecom output from clocks fitted with the M3 expansion option now correctly indicates synchronization quality. The synchronization quality is indicated in accordance with ITU-T G.704.

  The indicated quality degrades at an oscillator-dependent rate while in holdover. 'Do Not Use' is indicated at the end of the configured holdover period.

  Previously, the SSM bit order was reversed, resulting in incorrect indication of quality.

VERSION F2.27b5 (Limited Release)

- **Bug Fix:**
  Clocks fitted with two Ethernet modules now support test mode. Only affects version F2.26.
- **Bug Fix:**
  Fixed firmware upgrades in clocks fitted with two Ethernet modules and running firmware F2.26.

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VERSION F2.26r (Limited Release)

- **New feature:**
  Added support for OCXO and Rubidium frequency reference options.
- **Improvement:**
  Improved accuracy of quality reporting during sync and smoother degradation of quality during holdover. This enables IEDs to make accurate decisions on change of time quality.
- **Improvement:**
  Holdover times up to 3.5 days are now supported, an increase from the previous limit of 42 minutes.

VERSION F2.25r4 (16 March 2016)

- **Bug Fix:**
  When the GNSS satellite constellation is restricted to GLONASS only, and the unit has not been previously synchronised to GPS, the UTC time may be offset by the current leap second difference between GPS and UTC time. This fix detects and corrects the offset.

VERSION F2.25r3 Limited Release (4 December 2015)

- **Bug Fix:**
  Fixed a bug introduced in F2.25r2 that could cause disruption to the communications between internal clock modules in TCG 02-G clocks fitted with the M3 expansion option.

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VERSION F2.25r2 (29 July 2015)

- **New feature:**
  Added new display page which will display the current IP address on the front panel LCD. To change the front panel display, press the button on the front of the unit between the SYN and ALM LED's. Pressing the front panel button will cycle through available display pages. This feature can be used to check the IP address of the clock.

- **New feature:**
  The serial string output on P4 can now be configured to provide a 9-bit serial output instead of the original 8-bit serial output. The configuration tool 4.1.0.5 or later is required to select the new serial string options. The new configuration options are as follows.

Configuration Option	No. Data Bits	Parity	No. Stop Bits
8-O-1 (New)	8	Odd	1
8-E-1 (New)	8	Even	1
8-N-1	8	None	1
7-O-1	7	Odd	1
7-E-1	7	Even	1

- **Improvement:**
  A 5 second delay has been added before the Sync relay indicates "In Sync". This change has been made to bring the sync relay in alignment with the other sync indicators on the clock. The 5 second delay in announcing sync ensures that momentary acquisition and subsequent loss of sync (lasting less than 5 seconds) do not create multiple event logs.
- **Improvement:**
  The signal-to-noise ratio threshold used to define a 'good' timing satellite has been increased from 32dB to 35dB. By only accepting satellites which have a strong (and reliable) signal the precision of the clock is improved. Note that that a good antenna installation will see more than four satellites with signal level above 35db at all times. If your clock is reporting fewer than 4 satellites with signal strength greater than 35db then the antenna installation should be reviewed. See the Downloads page on the Tekron website for antenna installation information.

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- **Improvement:**
  GPS qualification checks have been strengthened to prevent the clock from attempting to sync to a poor GPS signal.

  A 'shadow clock' is now used, which is only updated from GPS after qualification has occurred, and a qualification timer is used to ensure that the GPS status remains 'good' for five consecutive seconds.

  If your antenna is installed at a site with poor signal quality these checks will put the clock into holdover during the periods of degraded GPS quality. If the GPS degradation lasts longer than the holdover period, the clock will signal that is out of sync. This improvement increases the accuracy of the clock during normal operation and improves the reporting of poor GPS synchronization.
- **Improvement:**
  If an antenna fault is detected and there is a valid IRIG-B input available, the clock will now sync to the IRIG-B even if GPS signal is still available. Previously, the clock would not fall back to an IRIG-B time source until the GPS receiver had lost synchronization. This ensures that the clock does not attempt to remain synchronized to an unreliable GPS signal when a suitable IRIG-B signal is available. All GPS information is ignored when in this state.
- **Improvement:**
  A configurable option to repeat the "59" second value, on the IRIG-B output, during a leap event has been added. Previously, a "60" second value was always produced during a leap event. This option allows compatibility with IEDs that do not correctly handle a "60" in the incoming IRIG-B time code.
- **Improvement:**
  GPS leap second acceptance has been altered to reject inconsistent leap second information and improve reliability. GPS leap second information requests are now made every 12.5 minutes, and the leap second information is accepted only if two consistent messages are received in a row.
- **Improvement:**
  The clock will now accept notification of an upcoming leap second event from the Ethernet module. This ensures that the clock will correctly handle a leap second event when operating as a PTP slave.
- **Bug Fix:**
  A configuration change made just prior to a leap second event, and after the leap second notifications are raised, will no longer cancel the leap second notification. Previously, the warm reset that occurs when a configuration is stored would reset the pending leap second indicator.
- **Improvement:**
  The acceptance of timing information from the Ethernet module has been altered to improve the accuracy of the clock when operating as a PTP slave.
- **Improvement:**
  The default TAI -> UTC offset has been updated to the current value of 36.

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- **Bug Fix:**
  The IRIG-B time quality is now determined in the same way as the synchronization state of the clock, ensuring that the IRIG-B time quality reflects the true sync state of the clock. This could cause the IRIG-B signal to indicate a high quality before the clock comes into sync.

  Previously, the time quality of the IRIG output signal was determined on the basis of the number of 'active' timing satellites, while the synchronization state of the clock was determined on the basis of the number of 'good' satellites ('good' satellites are active timing satellites with a signal-to-noise ratio greater than 35dB).
- **Bug Fix:**
  The state of the alarm relays is no longer altered when a configuration is stored. Previously, the sync alarm could be incorrectly cleared when a configuration is stored.
- **Bug Fix:**
  Test mode now works correctly for clocks fitted with two Ethernet modules. Previously, clocks fitted with two Ethernet modules were prevented from entering test mode.
- **Bug Fix:**
  "No IRIG-B Input" alarm is now cleared correctly. Previously, this alarm could incorrectly remain active when IRIG-B input monitoring is disabled.

VERSION F2.24 (Not Released for TCG 01-G or TCG 02-G)

VERSION F2.23 (13 February 2015)

- **Bug Fix:**
  Corrected the default number of leap seconds.

  Due to consistency checks on the incoming GPS signal, Tekron clocks will only store the value of leap seconds (the offset between GPS time and UTC time) if the reported 'present_#_leapsecs', and 'future_#_leapsecs' values, retrieved from the internal GPS receiver, are equal. If these two values are different, as occurs when an upcoming leap second adjustment is advertised in the GPS signal, then the clock will use its previously stored value (or a default value "hardwired" in the firmware if no previous value has yet been stored). This strategy ensures that clocks that are installed and operating before a new leap second transition is advertised will always operate with the correct UTC time, and will execute the new leap second correctly.

  When clock firmware is upgraded the stored leap-second value is reset to a default. This default leap second value is used to calculate UTC time until the clock can retrieve new data from the GPS receiver. It follows that, if the firmware default value is not correct, then the UTC time reported by the clock will be incorrect until the true value is retrieved - that is within 15 minutes usually. However, if a firmware upgrade is carried out when a new leap second is being advertised, then the default value will remain in use until the new leap second occurs.

  A new leap second, to come into effect at midnight on June 30 2015, has been advertised in the GPS data since January 21 2015. Tekron Clocks that have had a firmware upgrade since that date will have an incorrect default leap second value and will therefore show their UTC time outputs

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as leading by 1 second. If no corrective action is taken the clock will execute the new leap second 1 second early and will remain 1 second early until approximately 7 hours into July 1 2015. At this time, they will lose another second (by repeating a second at an arbitrary time) and will revert to correct UTC time. They will operate correctly from that point on.

VERSION F2.22 Limited Release (13 January 2015)

- **Improvement:**
  Added customer specific license.

VERSION F2.21 (9 January 2015)

- **Bug Fix:**
  Corrected 16-bit overflow error, which resulted in all Ethernet based timing packets providing a date 16,384 days prior to the correct date e.g. the 1st of Jan 2015, the date was shown as the 22nd Feb 1970. This overflow error only occurs after the 31st of December 2014.

  The LCD display on the clock reported the correct time and date and all other timing outputs continued to provide accurate and correct date and time, and were not affected by this anomaly in any way.

  This bug also affects the time reported to the configuration software. When connected to a clock, the software reports "Time Unavailable". This applies to all clocks even those which do not have NTP or PTP licenses enabled.

  This bug was introduced in firmware version F:2.00.

- **Improvement:**
  Improvement made to the GPS reset routine, in the event of a '*' bug. The clock will complete a seamless reset, with no interruption to the IRIG-B timing outputs. Previously, incomplete IRIG-B timing frames may have been presented whilst the reset occurred.

VERSION F2.18 - F2.20 (Not Released)

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VERSION F2.17 Limited Release (9 October 2014)

- **New feature:**
  Add support for ETH2 to be configure form ADMIN/ETH1 (Requires Ethernet module firmware 3.11r and above).
- **New feature:**
  Add ability to sync from either Ethernet port when more than one Ethernet module is fitted.
- **New feature:**
  Firmware support for OCXO option added.
- **Bug Fix:**
  Removed duplicated satellite data from FLAR reports.

VERSION F2.16 Limited Release (1 June 2014)

- **Improvement:**
  Show 'SL?' not '00*' on fiber slave if no source available.
- **Bug Fix:**
  Programmable pulse offsets hundredths setting was common to all programmable ports. It is now independently configurable.
- **Bug Fix:**
  Suppress antenna and GNSS alarms when Fiber Slave module is fitted in lieu of a GNSS receiver.

VERSION F2.15 First Release (10th June 2014)

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