

## Features and Benefits

- **Overclocked to 17 MHz readout**  
Industry fastest frame rates; 56 fps full frame.
- **EX2 Technology**  
Extended QE response
- **TE cooling to -100°C**  
Critical for elimination of dark current detection limit
- **Fringe Suppression**  
Reduced etaloning in NIR
- **OptAcquire**  
Optimize the highly flexible iXon for different application requirements at the click of a button
- **Count Convert**  
Quantitatively capture and view data in electrons or incident photons. Real-time or post-processing
- **Optically Centred Crop Mode**  
(Live cell super resolution mode)  
Continuous imaging with fastest possible frame rate from centrally positioned ROIs; 569 fps with 128 x 128 ROI. Highly enabling for live cell super-resolution and much, much more.
- **RealGain™**  
Absolute EMCCD gain selectable directly from a linear and quantitative scale
- **EMCAL™**  
Patented user-initiated self-recalibration of EM Gain
- **Direct Data Access**  
Camera Link output port to facilitate direct access to data for 'on the fly' processing.
- **Spurious Noise Filters**  
Intelligent algorithms to filter clock induced charge events from the background. Real time or post-processing
- **iCam**  
The market-leading exposure time fast-switching software
- **UltraVac™ \*1**  
Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year
- **Selectable amplifier outputs – EMCCD and conventional**  
'2 in 1' flexibility. EMCCD for ultra-sensitivity at speed, conventional CCD for longer acquisitions
- **Superior Baseline Clamp and EM stability**  
Quantitative accuracy of dynamic measurements
- **USB 2.0**  
Universal plug and play capability
- **Built-in C-mount compatible shutter**  
Easy means to record reference dark images



## The market leading back-illuminated EMCCD, now accelerated to 56 fps.

The new iXon Ultra platform takes the popular back-illuminated 512 x 512 frame transfer sensor and overclocks readout to 17 MHz, pushing speed performance to an outstanding 56 fps (full frame), whilst maintaining single photon sensitivity and quantitative stability throughout. New Optically Centred Crop Mode unlocks unparalleled frame rate performance from centrally located ROIs, ideal for the particular speed and sensitivity requirements of super-resolution microscopy.

The iXon Ultra maintains all the advanced performance attributes that have defined the industry-leading iXon range, such as deep vacuum cooling to -100°C, extremely low spurious noise, and Andor's patented EM gain recalibration technology (EMCA™). Count Convert functionality allows real time data acquisition in units of electrons or incident photons and OptAcquire facilitates one-click optimization of this versatile camera to a variety of application conditions.

Additional new features of the iXon Ultra include plug and play USB connectivity, a lower noise conventional CCD mode and an additional Camera Link output, offering the unique ability to directly access data for 'on the fly' processing, ideally suited to data intensive applications such as adaptive optics or super-resolution microscopy.

## Specifications Summary <sup>\*2</sup>

|                                |                                 |
|--------------------------------|---------------------------------|
| Active pixels                  | 512 x 512                       |
| Pixel size (W x H)             | 16 x 16 µm                      |
| Active area pixel well depth   | 180,000 e <sup>-</sup>          |
| Gain register pixel well depth | 800,000 e <sup>-</sup>          |
| Maximum readout rate           | 17 MHz                          |
| Frame rate                     | 56 - 11,074 fps                 |
| Read noise                     | < 1 e <sup>-</sup> with EM gain |
| Maximum cooling                | -100°C                          |

## System Specifications <sup>\*2</sup>

|                                                                                                                                                                              |                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model number                                                                                                                                                                 | 897                                                                                                                                                                                                                                                                                          |
| Sensor QE options                                                                                                                                                            | BV: Back Illuminated, standard AR coated<br>BVF: Back Illuminated, standard AR coated with fringe suppression<br>UVB: Back Illuminated, standard AR with additional lumogen coating<br>EX: Back illuminated, dual AR coated<br>EXF: Back illuminated, dual AR coated with fringe suppression |
| Fringe Suppression                                                                                                                                                           | Available on EX2 and BV sensor options                                                                                                                                                                                                                                                       |
| Active pixels                                                                                                                                                                | 512 x 512                                                                                                                                                                                                                                                                                    |
| Pixel size                                                                                                                                                                   | 16 x 16 $\mu\text{m}$                                                                                                                                                                                                                                                                        |
| Image area                                                                                                                                                                   | 8.2 x 8.2 mm with 100% fill factor                                                                                                                                                                                                                                                           |
| Minimum temperature, air cooled, ambient 20°C <sup>*3</sup><br>Recirculator liquid cooling, coolant @ 22°C, >0.75l/min<br>Chiller liquid cooling, coolant @ 10°C, >0.75l/min | -80°C<br>-95°C<br>-100°C                                                                                                                                                                                                                                                                     |
| Thermostatic Precision                                                                                                                                                       | $\pm 0.01^\circ\text{C}$                                                                                                                                                                                                                                                                     |
| Digitization                                                                                                                                                                 | 16 bit @ all readout speeds                                                                                                                                                                                                                                                                  |
| Triggering                                                                                                                                                                   | Internal, External, External Start, External Exposure, Software Trigger                                                                                                                                                                                                                      |
| System window type                                                                                                                                                           | Single UV-grade fused silica window - AR coated or uncoated available                                                                                                                                                                                                                        |
| Blemish specification                                                                                                                                                        | Grade 1 sensor (CCD97), as defined by the sensor manufacturer e2v<br>For further details see <a href="http://e2v.com">e2v.com</a>                                                                                                                                                            |
| PC Interface                                                                                                                                                                 | USB 2.0                                                                                                                                                                                                                                                                                      |
| Lens Mount                                                                                                                                                                   | C-mount                                                                                                                                                                                                                                                                                      |
| Direct Data Access                                                                                                                                                           | Camera Link 3-tap output                                                                                                                                                                                                                                                                     |

## Advanced Performance Specifications <sup>\*2</sup>

|                                                       |                                                                               |                                     |
|-------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------|
| Dark current and background events <sup>*4, 5</sup>   |                                                                               |                                     |
| Dark current (e <sup>-</sup> /pixel/sec) @ -85°C      | 0.001                                                                         |                                     |
| Spurious background (events/pix) @ 1000x gain / -85°C | 0.0018                                                                        |                                     |
| Active area pixel well depth                          | 180,000 e <sup>-</sup>                                                        |                                     |
| Gain register pixel well depth <sup>*6</sup>          | 800,000 e <sup>-</sup>                                                        |                                     |
| Pixel readout rates                                   | Electron Multiplying Amplifier<br>Conventional Amplifier                      | 17, 10, 5, 1 MHz<br>3, 1 & 0.08 MHz |
| Read noise (e <sup>-</sup> ) <sup>*7</sup>            | Without Electron Multiplication                                               | With Electron Multiplication        |
| 17 MHz through EMCCD amplifier                        | 89                                                                            | < 1                                 |
| 10 MHz through EMCCD amplifier                        | 65                                                                            | < 1                                 |
| 5 MHz through EMCCD amplifier                         | 37                                                                            | < 1                                 |
| 1 MHz through EMCCD amplifier                         | 15                                                                            | < 1                                 |
| 3 MHz through conventional amplifier                  | 9.6                                                                           | -                                   |
| 1 MHz through conventional amplifier                  | 5.3                                                                           | -                                   |
| 80 kHz through conventional amplifier                 | 2.7                                                                           | -                                   |
| Linear absolute Electron Multiplier gain              | 1 - 1000 times via RealGain™ (calibration stable at all cooling temperatures) |                                     |
| Linearity <sup>*8</sup>                               | Better than 99%                                                               |                                     |
| Vertical clock speed                                  | 0.3 to 3.3 $\mu\text{s}$ (variable)                                           |                                     |
| Timestamp accuracy                                    | 10 ns                                                                         |                                     |

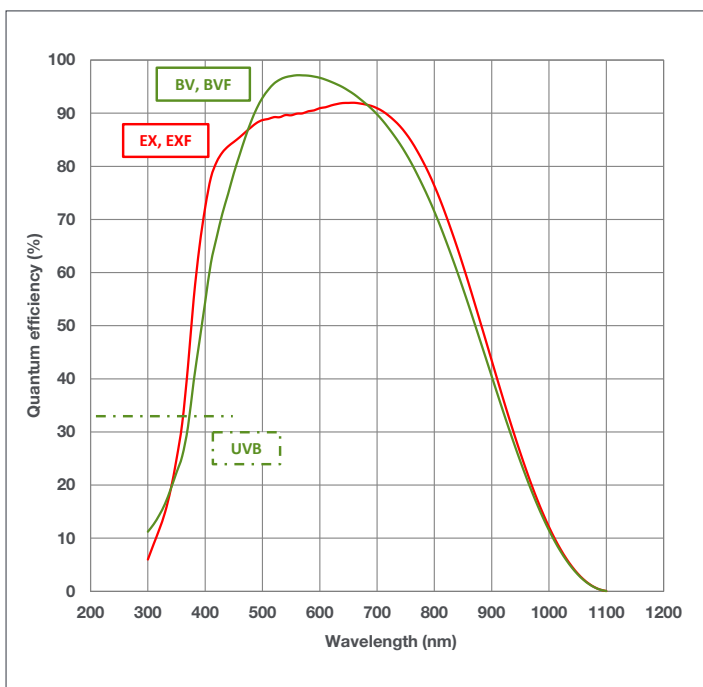
## Frame Rates (Standard Mode) <sup>\*9</sup>

| Binning | Array size |           |           |         |           |          |         |
|---------|------------|-----------|-----------|---------|-----------|----------|---------|
|         | 512 x 512  | 256 x 256 | 128 x 128 | 64 x 64 | 512 x 100 | 512 x 32 | 512 x 1 |
| 1 x 1   | 56         | 110       | 212       | 397     | 277       | 704      | 2,857   |
| 2 x 2   | 109        | 210       | 394       | 699     | 503       | 1,136    | -       |
| 4 x 4   | 206        | 385       | 680       | 1,099   | 840       | 1,613    | -       |

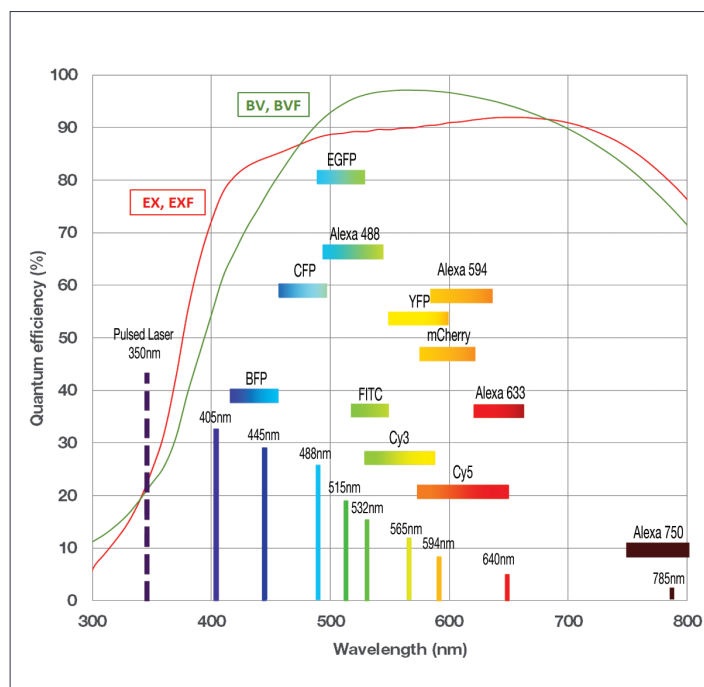
## Frame Rates (Crop Mode) - Optically Centred frame rates in brackets <sup>\*9</sup>

| Binning | Array size |               |               |               |           |          |         |
|---------|------------|---------------|---------------|---------------|-----------|----------|---------|
|         | 256 x 256  | 128 x 128     | 64 x 64       | 32 x 32       | 512 x 100 | 512 x 32 | 512 x 1 |
| 1 x 1   | 111 (174)  | 595 (569)     | 1,433 (1,492) | 3,532 (3,024) | 296       | 857      | 11,074  |
| 2 x 2   | 215 (329)  | 1,085 (1,014) | 2,433 (2,329) | 5,325 (4,054) | 570       | 1,589    | -       |
| 4 x 4   | 402 (594)  | 1,802 (1,662) | 3,577 (3,237) | 6,579 (5,252) | 1,050     | 2,682    | -       |

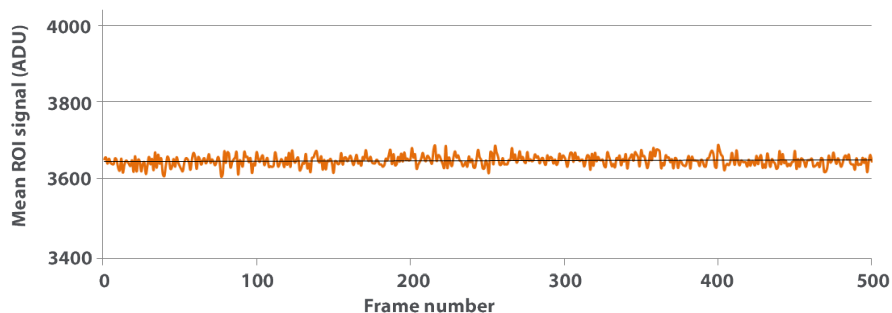
## Quantum Efficiency Curves <sup>\*10</sup>



## QE v Fluorophores Curve



## Stability Plot



EM Gain stability in the iXon Ultra 897 @ 55 fps.  
500 frame kinetic series; frame transfer (overlapped)  
acquisition; 17.8 ms exposure time; x300 EM gain.

## Creating The Optimum Product for You

How to customize the iXon Ultra 897:

### Step 1.

The iXon Ultra 897 comes with 5 options for sensor types. Please select the sensor which best suits your needs.

### Step 2.

Please indicate alternative window option if required.

### Step 3.

Please indicate which software you require.

### Step 4.

For compatibility, please indicate which accessories are required.

DU-897U-CS0-**EXF**

example shown

### Step 1.

#### Choose sensor finish option

**#BV:** Back-illuminated, standard AR coated

**BVF:** Back-illuminated, standard AR coated with fringe suppression

**UVB:** Back Illuminated, standard AR with additional lumogen coating

**#EX:** Back-illuminated, EX2 dual AR coated

**EXF:** Back-illuminated, EX2 dual AR coated with fringe suppression

### Step 2.

(Optional)

The iXon Ultra 897 with #BV and BVF sensors are supplied with an AR coated UV-grade fused silica window with 0.5 degree wedge as standard, optimized for the 400 to 900 nm. The #EX, EXF and UVB sensors are supplied with an uncoated UV-grade fused silica window.

The following **alternative** AR coated window choices are available and must be ordered at time of build (if selected):

WIN-35MM-400/900-W UV-grade fused silica window, AR coated for 400-900 nm. 99% transmission at 600 nm

WIN-35MM-250/450-W UV-grade fused silica window, AR coated for 250-450 nm. 97% transmission at 260 nm

WIN-35MM-600/1100-W UV-grade fused silica window, AR coated for 600-1100 nm. 98% transmission at 1000 nm

### Step 3.

#### The iXon Ultra requires at least one of the following software options:

**Solis Imaging** A 32-bit application compatible with 32 and 64-bit Windows (XP, Vista, 7 and 8) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export.

**Andor SDK** A software development kit that allows you to control the Andor range of cameras from your own application. Available as 32 and 64-bit libraries for Windows (XP, Vista, 7 and 8), compatible with C/C++, C#, Delphi, VB6, VB.NET, LabVIEW and Matlab. Linux SDK compatible with C/C++.

**Andor iQ** A comprehensive multi-dimensional imaging software package. Offers tight synchronization of EMCCD with a comprehensive range of microscopy hardware, along with comprehensive rendering and analysis functionality. Modular architecture for best price/performance package on the market.

#### Third party software compatibility

Drivers are available so that the iXon range can be operated through a large variety of third party imaging packages. See Andor web site for detail: [andor.com/software](http://andor.com/software)

### Step 4.

#### The following accessories are available:

**OPTOMASK** Optomask microscopy accessory, used to mask unwanted sensor area during Crop Mode acquisition.

**XW-RECR** Re-circulator for enhanced cooling performance

**ACC-XW-CHIL-160** Oasis 160 Ultra compact chiller unit

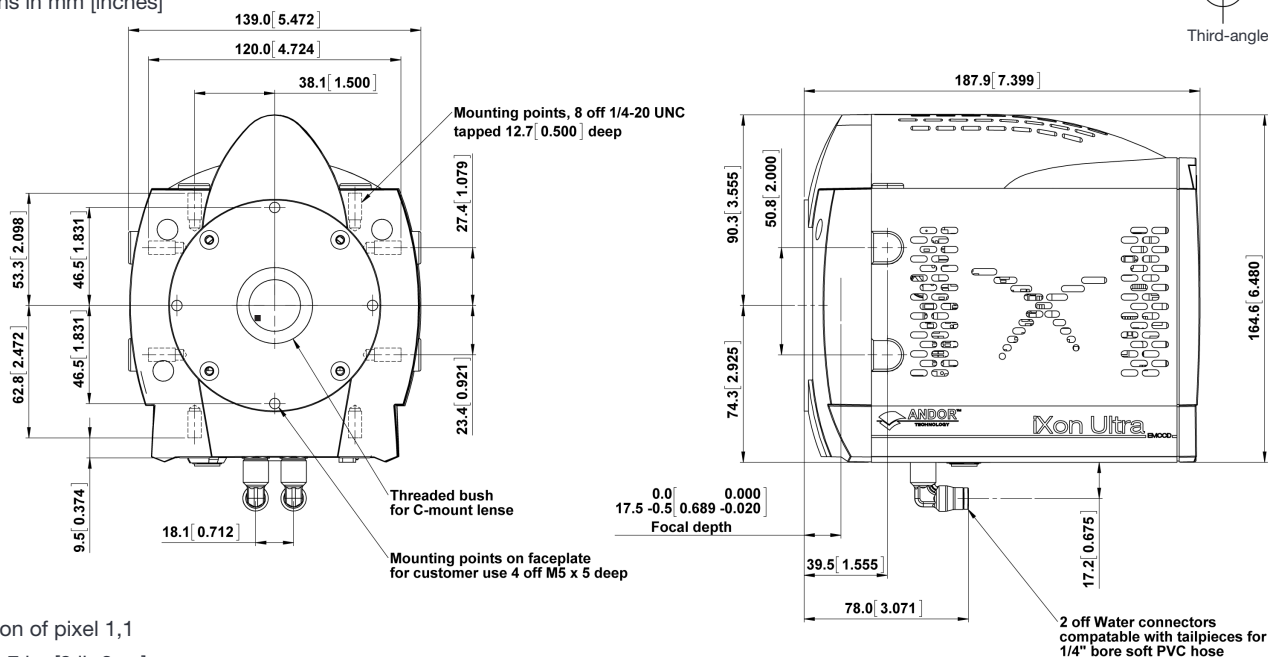
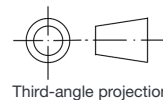
**OA-CNAF** C-mount to Nikon F-mount adapter

**OA-COFM** C-mount to Olympus adapter

**OA-CTOT** C-mount to T-mount adapter

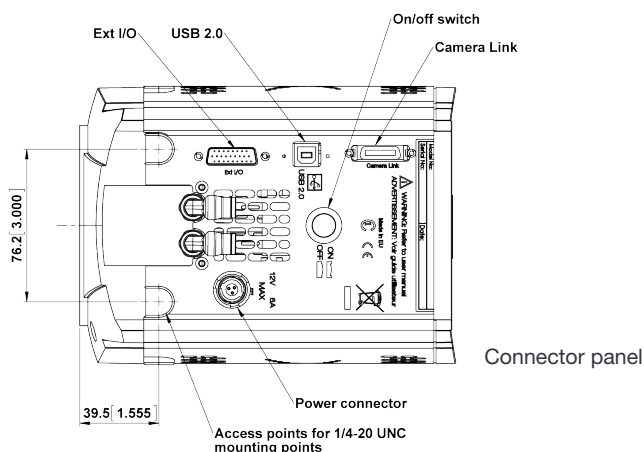
## Product Drawings

Dimensions in mm [inches]



■ = position of pixel 1,1

Weight: 3.7 kg [8 lb 3 oz]



## Connecting to the iXon Ultra

### Camera Control

Connector type: USB 2.0

### Logic

Connector type: 26 way D Type with 8 programmable digital inputs or outputs for control and sensing of up to 8 external device

### Camera Link Out

Base 3-tap output (MDR 26 connector). Used as a parallel output for embedded applications.

### Minimum cable clearance required

90 mm

## Typical Applications

|                                                       |                                                  |
|-------------------------------------------------------|--------------------------------------------------|
| Single molecule detection                             | Cell Motility                                    |
| Super resolution (PALM, STORM)                        | Whole genome sequencing                          |
| TIRF microscopy                                       | FRET / FRAP                                      |
| Spinning disk confocal microscopy                     | Fluorescence Correlation Microscopy (multi-beam) |
| Vesicle trafficking                                   | Microspectroscopy / Hyperspectral imaging        |
| Selective/single plane illumination microscopy (SPIM) | Lucky astronomy                                  |
| Ion signalling (Calcium flux)                         | Adaptive Optics                                  |
| Voltage sensitive dyes                                | Single Photon Counting                           |



## Order Today

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### Items shipped with your camera:

- 1x Andor ACZ-03463: 2m Multi I/O timing cable, offering Fire, External Trigger, Shutter and Arm
- 1x 3m USB 2.0 cable Type A to Type B
- 1x Power supply with mains cable
- 1x Quick launch guide
- 1x CD containing Andor user manuals

### Footnotes: Specifications are subject to change without notice

1. Assembled in a state-of-the-art cleanroom facility, Andor's UltraVac™ vacuum process combines a permanent hermetic vacuum seal (no o-rings), with a stringent protocol to minimize outgassing, including use of proprietary materials.
2. Figures are typical unless otherwise stated.
3. Full Frame readout, fastest unbracketed vertical shift speed with no vertical clock amplitude boost
4. The dark current measurement is averaged over the sensor area excluding any regions of blemishes.
5. Using Electron Multiplication the iXon is capable of detecting single photons, therefore the true camera detection limit is set by the number of 'dark' background events. These events consist of both residual thermally generated electrons and Clock Induced Charge (CIC) electrons (also referred to as Spurious Noise), each appearing as random single spikes above the read noise floor.  
A thresholding scheme is employed to count these single electron events and is quoted as a probability of an event per pixel. Acquisition conditions are full resolution and max frame rate (17 MHz readout; frame-transfer mode; 0.5  $\mu$ s vertical clock speed; x 1000 EM gain; 10 ms exposure; -85°C).
6. The EM register on CCD97 sensors has a linear response up to ~400,000 electrons and a full well depth of ~800,000 electrons.
7. Readout noise is for the entire system. It is a combination of sensor readout noise and A/D noise. Measurement is for Single Pixel readout with the sensor at a temperature of -75°C and minimum exposure time under dark conditions. Under Electron Multiplying conditions, the effective system readout noise is reduced to sub 1 e<sup>-</sup> levels.
8. Linearity is measured from a plot of counts vs. exposure time under constant photon flux up to the saturation point of the system.
9. All measurements are made at 17 MHz pixel readout speed with 0.3  $\mu$ s vertical clock speed. It also assumes internal trigger mode of operation. Frame rates shown are for 'Corner Tethered' ROIs, with 'Optically Centred' ROI frame rates shown within brackets.
10. Quantum efficiency of the sensor at 20°C, as supplied by the sensor manufacturer.

### Recommended Computer Requirements:

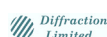
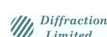
- 3.0 GHz single core or 2.6 GHz multi core processor
- 2 GB RAM
- 100 MB free hard disc to install software (at least 1 GB recommended for data spooling)
- USB 2.0 High Speed Host Controller capable of sustained rate of 40MB/s
- 10,000 rpm SATA hard drive preferred for extended kinetic series
- Windows (XP, Vista, 7 and 8) or Linux

### Operating & Storage Conditions

- Operating Temperature: 0°C to 30°C ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -25°C to 50°C

### Power Requirements

- 110 - 240 VAC, 50/60 Hz



LiXonU897SS 0713 R1