Beckhoff Vision

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Complete vision portfolio

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VCS20xx | Vision Camera Standard

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EtherCAT P connection for power and synchronization

grounding screw

2.5 Gbit LAN connection

status LEDs

six threads for flexible and robust mounting

lens protection tube (IP65/67)

C-mount thread

anodized aluminum housing (IP65/67) for optimum heat dissipation

EtherCAT P

Accessories | Lens protection tube

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anodized aluminum
(similar to camera)

thermally hardened and
anti-reflective glass

IP65/67 housing with
lens protection tube

Optics

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VOS2000, VOS3000 | Optics for various sensor sizes

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- shock and vibration resistant for industrial use
- high resolution lens (up to 2 µm)
- VIS and NIR AR coating

VOS2000

- largest image circle diameter: 2/3 inch or 11 mm

VOS3000

- largest image circle diameter: 1.2 inch or 19.3 mm
- advanced chromatic correction up to 1000 nm

VIP2000 | Vision Illumination Panel

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EtherCAT P connection for power and synchronization

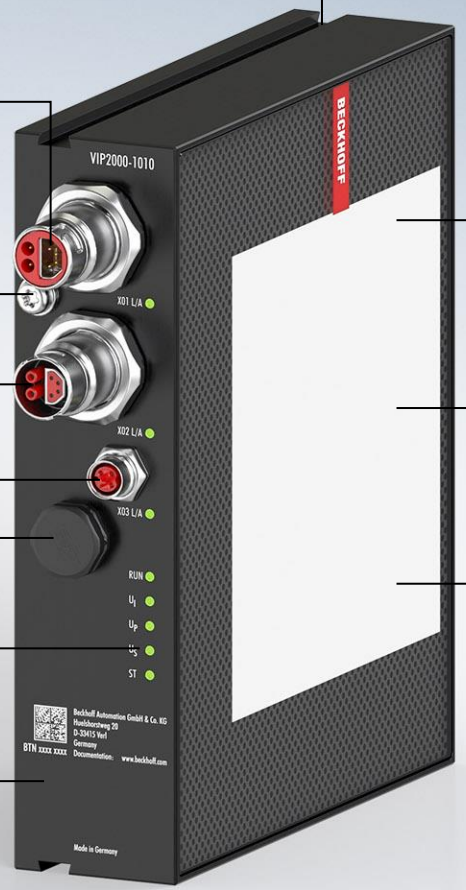
grounding screw

additional EtherCAT P outputs

pressure compensation membrane

status LEDs

anodized aluminum housing for optimum heat dissipation (IP65/67)



groove for flexible mounting

variable light color from blue to IR850

integrated control for pulse operation

thermally hardened and anti-reflective glass

EtherCAT P

Illumination | Generation of the light colors

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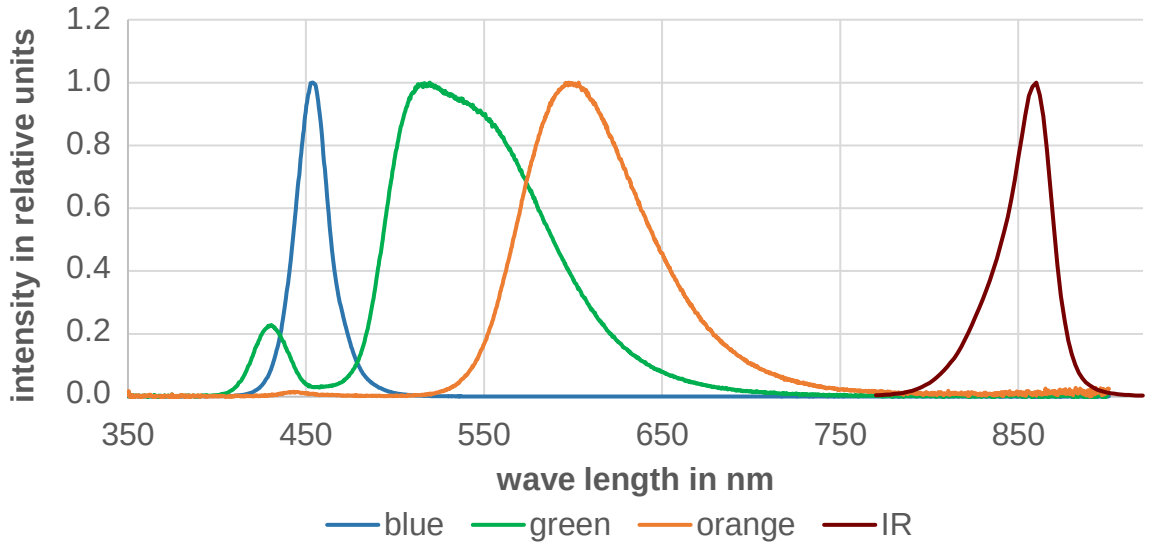
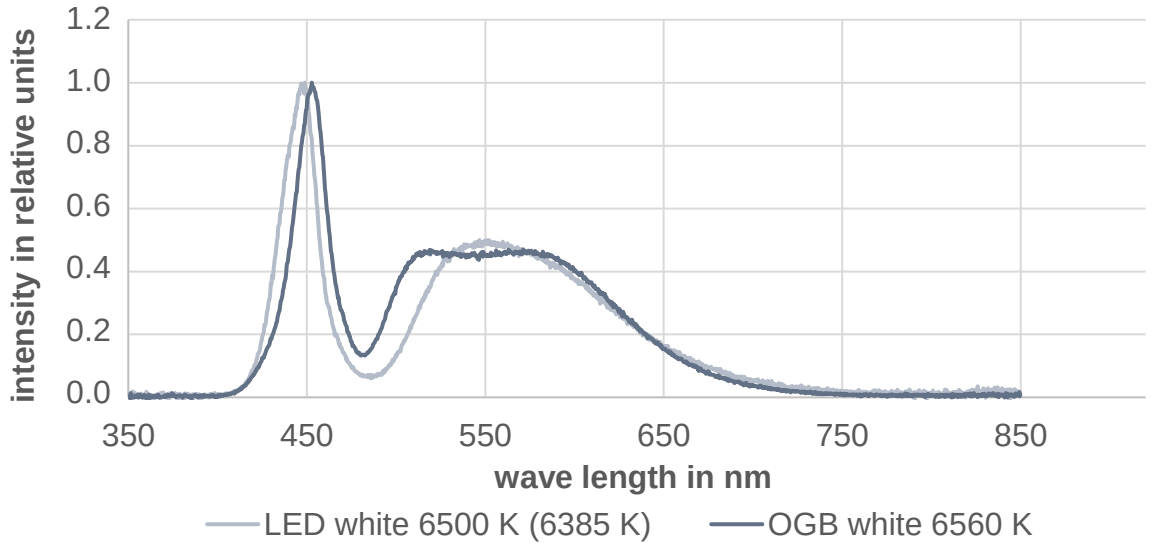
- use of high-performance LEDs
- multicolor lighting
  - white via mix of three color LEDs
  - additional IR channel (850 nm)
- use of converted light colors
  - complete coverage of the visible spectrum via blue LED semiconductors
  - best possible temperature stability in relation to the intensity
  - orange-red and green through conversion (similar to white LEDs)
  - no spectral gap, comparable to white LED → CRI >80





VIx200x | Panel illumination, ring illumination and bar light

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VIP2000 | Panel illumination

multicolor LED panels, especially optimized for backlight applications

VIR2000 | Ring illumination

multicolor LED ring, also suitable for dark-field setups

VIB2000 | Bar light

universally applicable multicolor LED bar light with homogenous illumination for backlight applications

VUI200x | Vision Unit Illuminated

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anodized aluminum housing (IP65/67)
for optimum heat dissipation

six threads for
flexible and robust mounting

EtherCAT P connection for
power and synchronization

grounding screw

2.5 Gbit LAN connection

status LEDs

variable light color
from blue to IR850

optics with integrated
liquid lens focusing

thermally hardened and
anti-reflective glass

EtherCAT P

VUI200x | Focus adjustment during runtime

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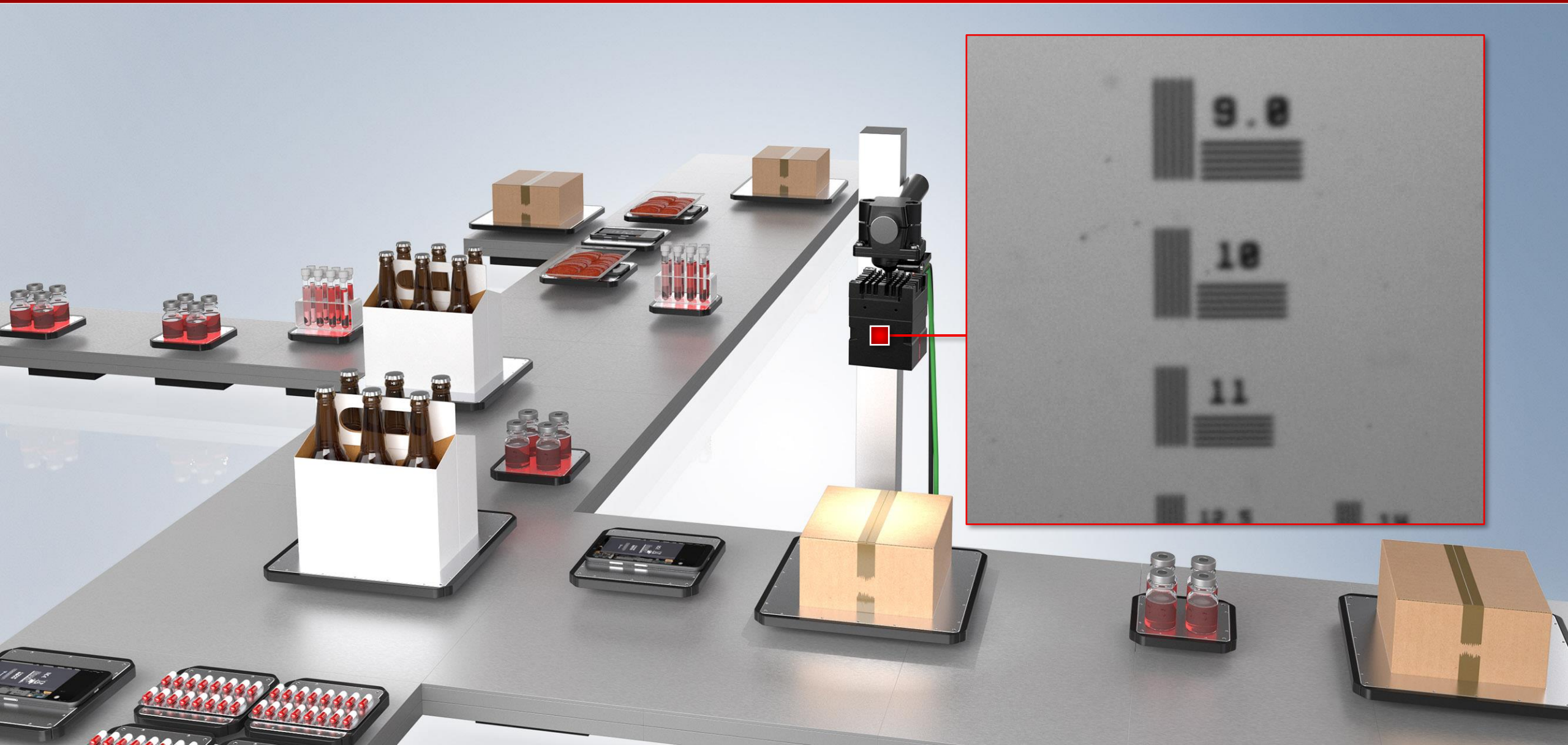

TwinCAT Vision – Update

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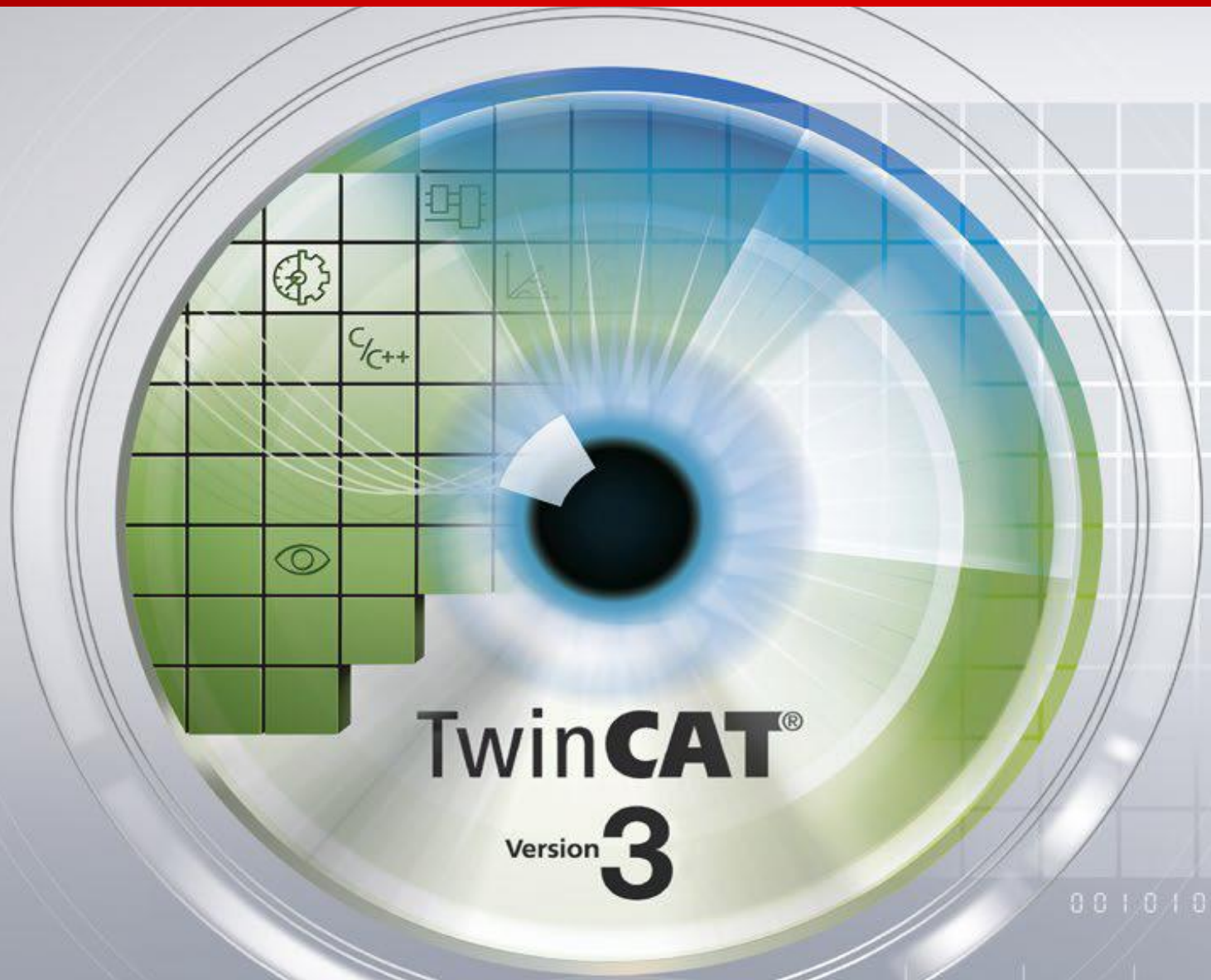

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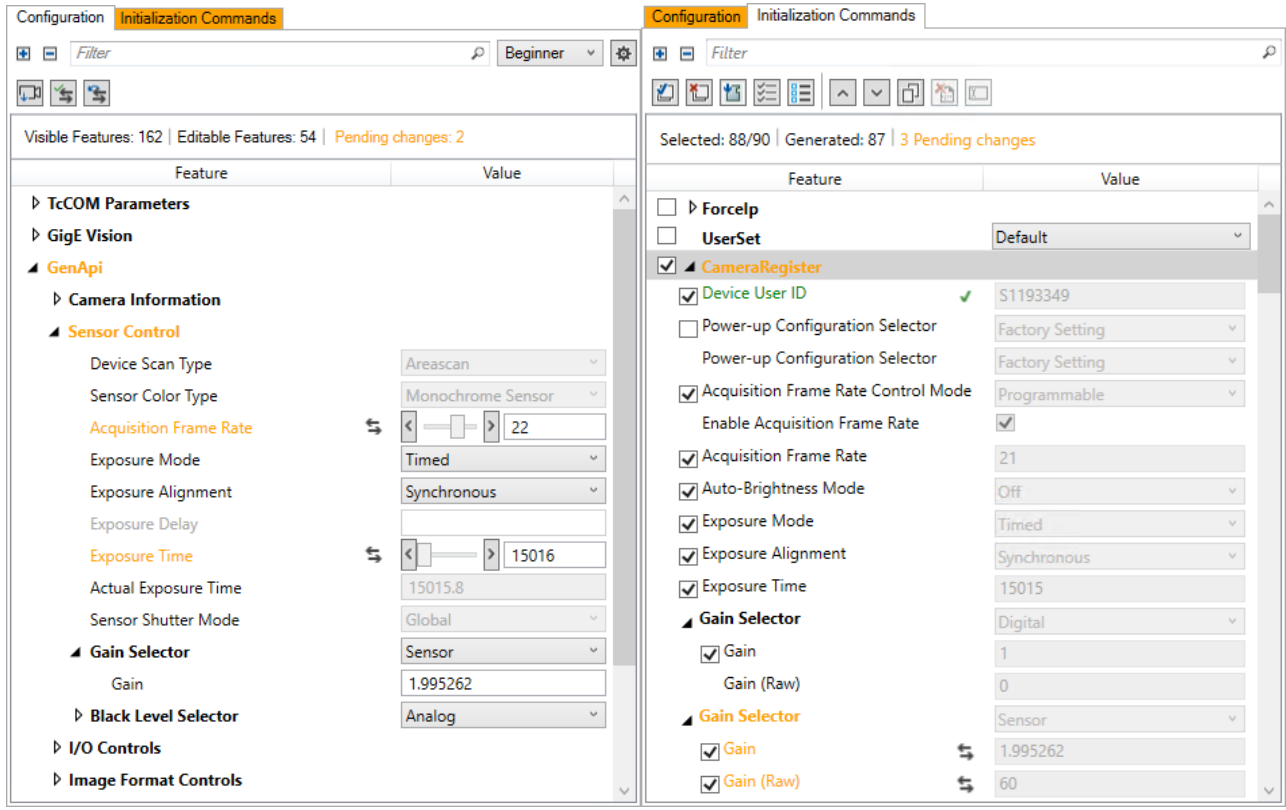
Release 4.0.4.x in 12/2023

- TF7800 | TC3 Vision Machine Learning
- TF7260 | TC3 Vision OCR
- Integration into TwinCAT 3 C++
- 38 new PLC library functions / function blocks
- Optimized GenApi register handling
- Optimized camera init command assistant
- Graphical revision of the configuration assistant tabs



TF7800 | TwinCAT 3 Vision Machine Learning

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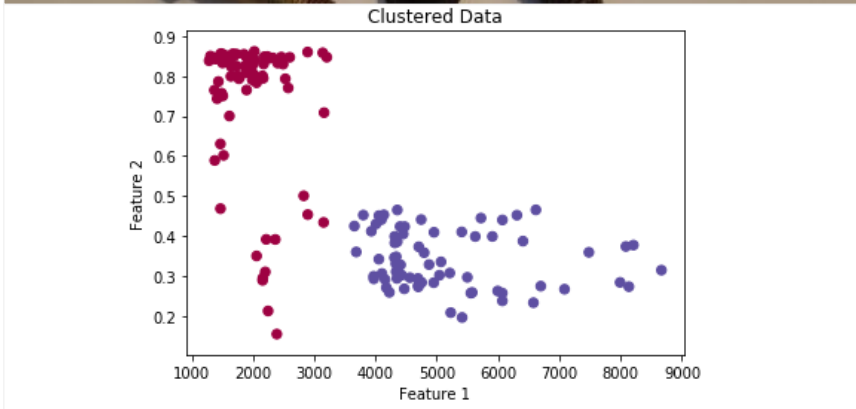
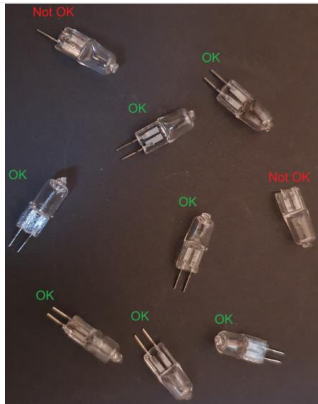
NEW

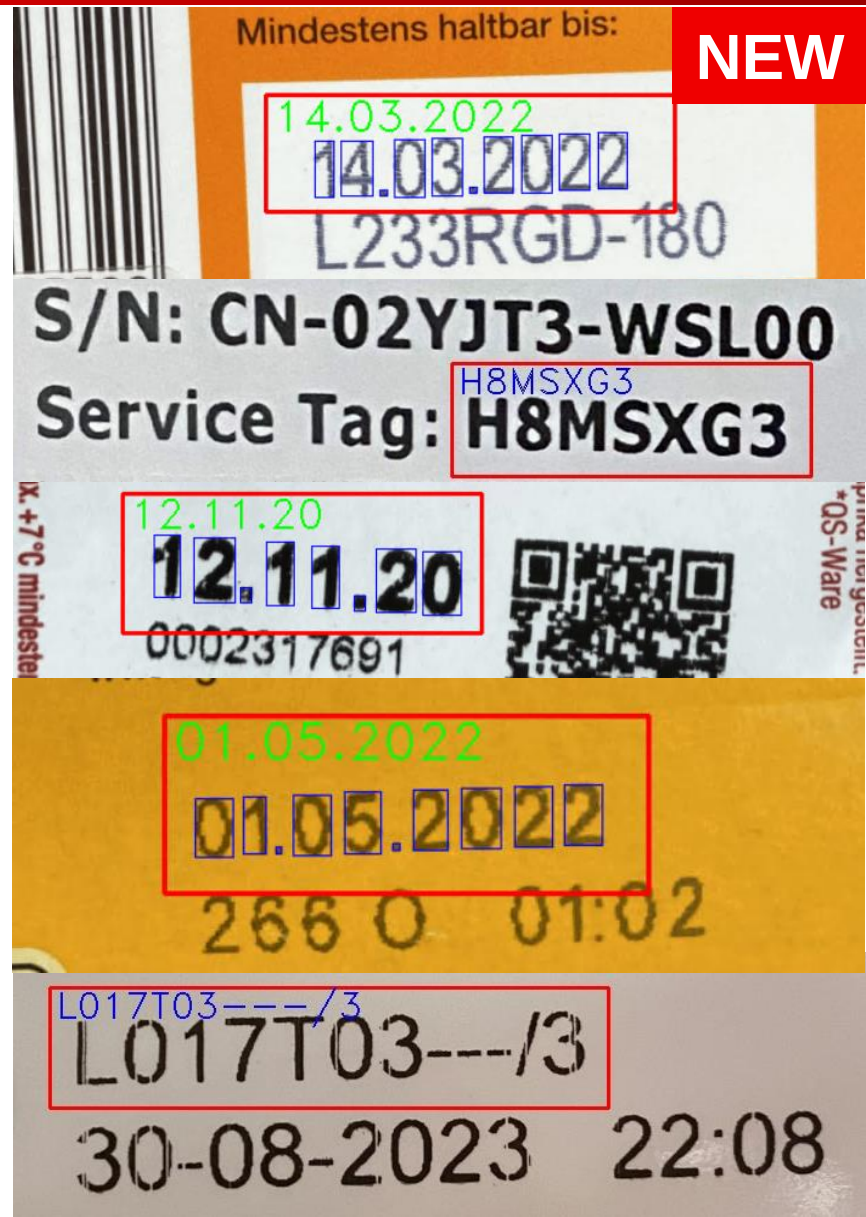
- Training and execution in real time
- classic ML models e.g.:
  - Support Vector Machine (SVM)
  - Random Forest (RTrees)
  - k-Means++
  - Principal Component Analysis (PCA)
- Classification, regression, cluster analysis and anomaly detection
- Application examples: object recognition/detection, sorting, quality control or process monitoring





OCR (Optical Character Recognition)

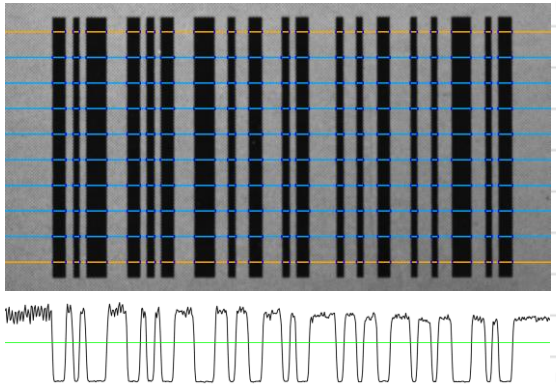
- Supported characters
  - Numbers 0-9
  - Special character . / - : =
  - Capital letters A-Z
- Provision of pre-trained models:
  - for non-proportional, sans serif fonts
  - no dot prints or mixed fonts
- Use cases:
  - Best before date
  - Batch number



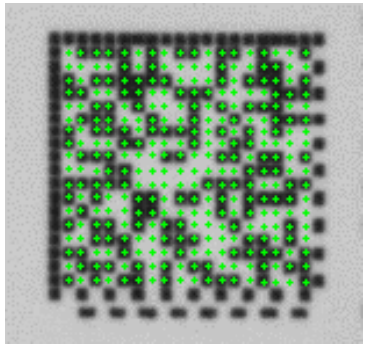
NEW

TF7255 | TC 3 Vision Code Quality

- Expected market release Q1/2024
- Quality assessment of codes
- Evaluation of various criteria such as defects, contrast and modulation
- The lowest individual grade results in the overall grade (0-4)
- 1D-barcode according to ISO/IEC 15416:2016
  - Code39, Code128, EAN8, EAN13, ITF, UPCA, UPCE
- 2D-code according to ISO/IEC 15415:2011
  - Data Matrix code, QR code



stGrades	TcVnCodeGrades1D	
fDecode	REAL	4
fSymbolContrast	REAL	3.5
fMinReflectance	REAL	4
fMinEdgeContrast	REAL	4
fModulation	REAL	4
fDefects	REAL	2.2
fDecodability	REAL	4
fOverall	REAL	2.2
sCode	STRING	'046608'



stGrades	TcVnCodeGradesDM	
nDecode	USINT	4
nSymbolContrast	USINT	3
nModulation	USINT	4
nReflectanceMargin	USINT	4
nFixedPatternDamage	USINT	1
nAxialNonuniformity	USINT	4
nGridNonuniformity	USINT	4
nUnusedErrorCorrection	USINT	4
nOverall	USINT	1
sCode	STRING	'01123...

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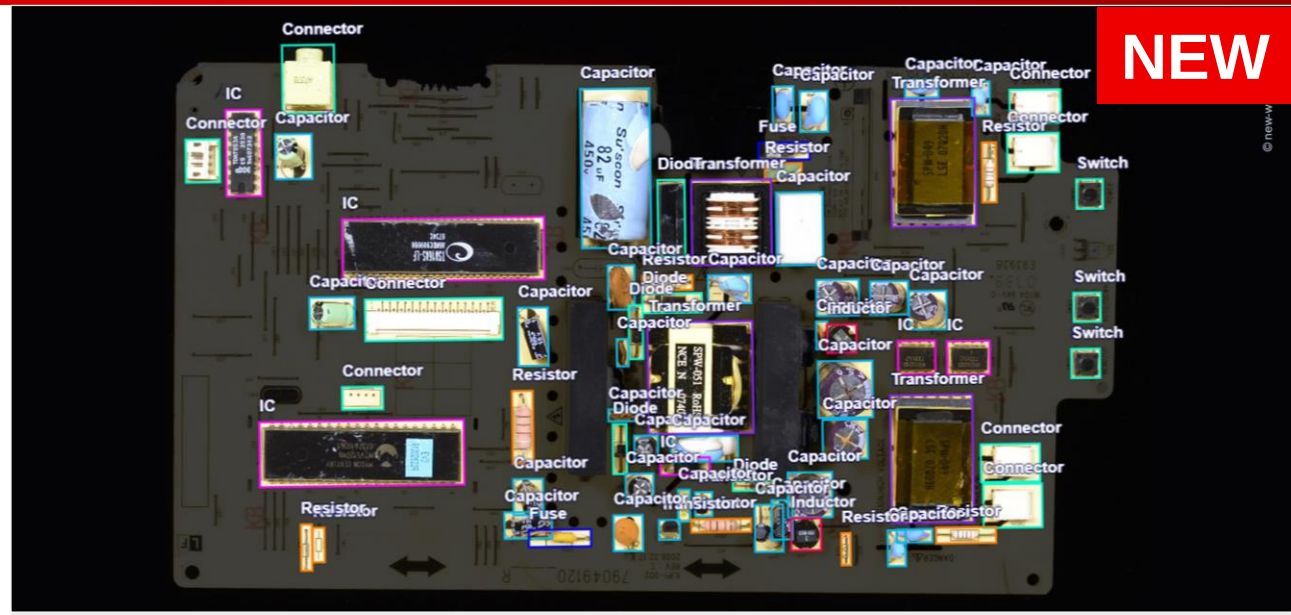
NEW

TF7810 | TC 3 Vision Neural Network

- Expected market release Q3/2024
- Execution of trained neural networks in real time
- Training in established frameworks such as PyTorch, TensorFlow or MATLAB ®
- Loading the trained model via ONNX (Open Neural Network Exchange)
- Application examples:
  - Classification, segmentation, object and anomaly detection
- Model examples:
  - MobileNet, EfficientNet, RESNet, UNet, RCNN, YOLO, Autoencoder



Products for running AI models in TwinCAT 3

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TF3800 TwinCAT Machine Learning Inference Engine TF3810 TwinCAT Neural Network Inference Engine TF3820 TwinCAT Machine Learning Server	▪ generic for all kind of PLC data ▪ requires ONNX file as input ▪ optional GPU support
TF7800 TwinCAT Vision Machine Learning TF7810 TwinCAT Vision Neural Network	▪ TwinCAT Vision library interfaces (ITcVn) ▪ TF7800 | learning method in TwinCAT ▪ TF7810 | requires ONNX file as input
TE1401 TwinCAT Target for MATLAB TE1400 TwinCAT Target for Simulink	▪ MATLAB coders only ▪ requires MATLAB Coder support of model
TF3510 TwinCAT Analytics Library	▪ time series clustering ▪ online unsupervised learning in TwinCAT

Differentiation TF38xx and TF78xx

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Feature	TF3800 ML Engine	TF7800 Vision ML	TF3810 NN Engine	TF7810 Vision NN	TF3820 ML-Server
Execution	XAR	XAR	XAR	XAR	separate process(es)
Hardware	CPU	CPU	CPU	CPU	CPU, GPU
Parallelization	no	partially	yes	yes	yes
AI models	Classic	Classic	Neural Nets	Neural Nets	All
Model training	offline, ONNX required	online training in TwinCAT	offline, ONNX required	offline, ONNX required	offline, ONNX required
PLC data-interface	autogenerated PLC datatype	ITcVnContainer	autogenerated PLC datatype	ITcVnImage	autogenerated PLC datatype and ITcVnImage
Availability	Released	Beta: 08/2023 Release: Q4/2023	MLP: Released CNN: Beta Q1/2024 CNN: Rel. Q3/2024	Beta: Q1/2024 Release: Q3/2024	Beta: 01/2024 Release: 04/2024

4 questions to rule them all

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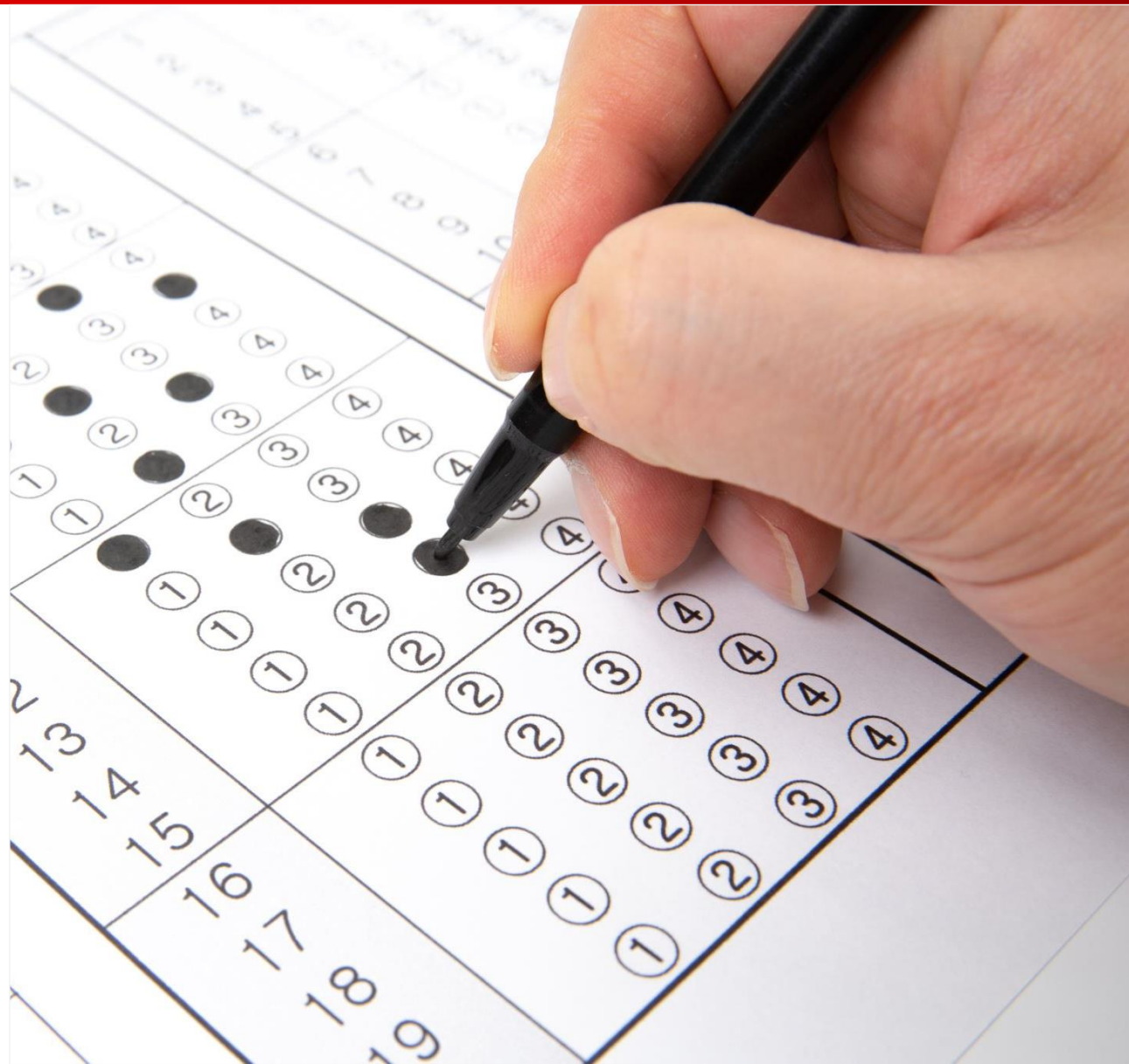
- Is GPU acceleration required?
  - Yes | TF3820
  - No | TF3800, TF3810 or TF78xx
- Is hard deterministic execution of AI required?
  - Yes | TF3800, TF3810 or TF78xx
  - No | TF3820
- Do you want to use TwinCAT Vision together with the AI model?
  - Yes | TF78xx or TF3820
  - No | TF3800, TF3810 or TF3820
- What kind of AI model do you want to run?
  - Model known | check supported models in documentation of TF3800, TF3810, TF78xx
  - Model currently unknown | highest flexibility is provided by TF3820



TwinCAT 3 Analytics with TwinCAT Vision

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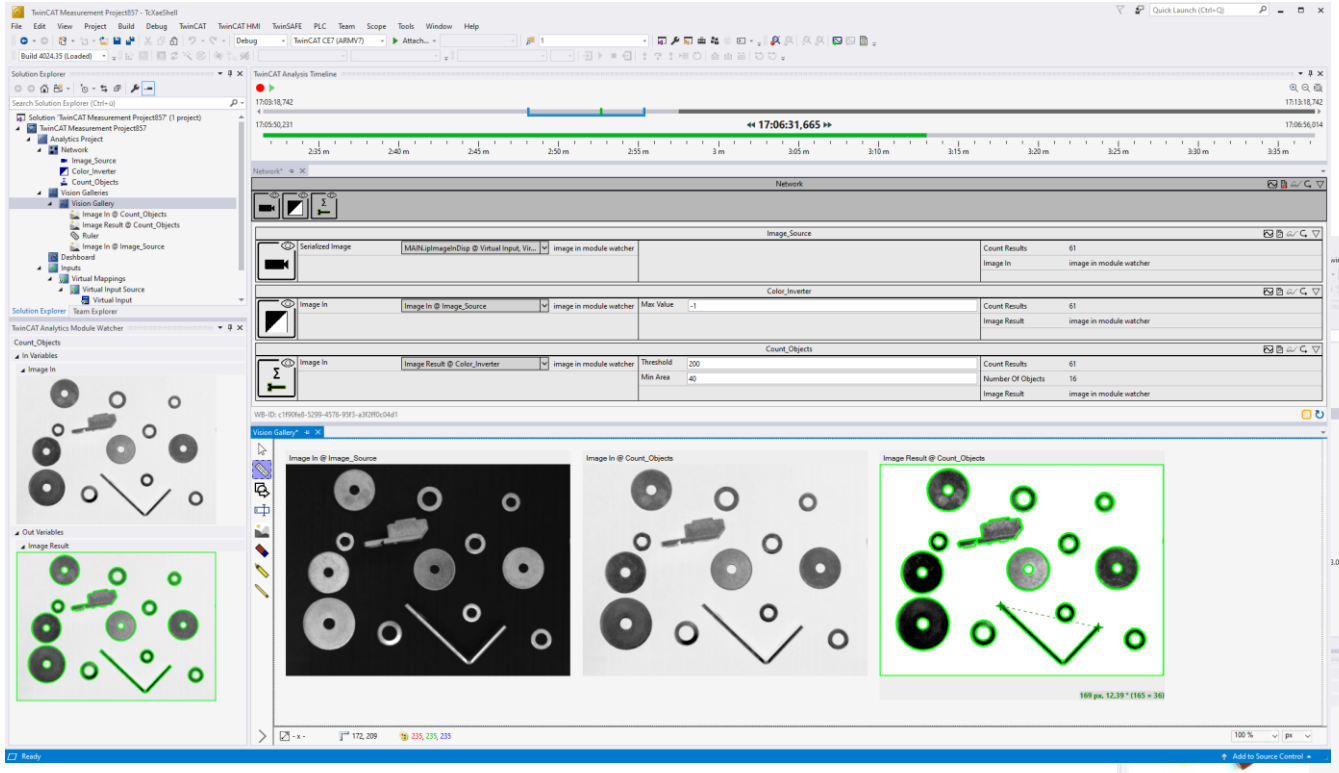
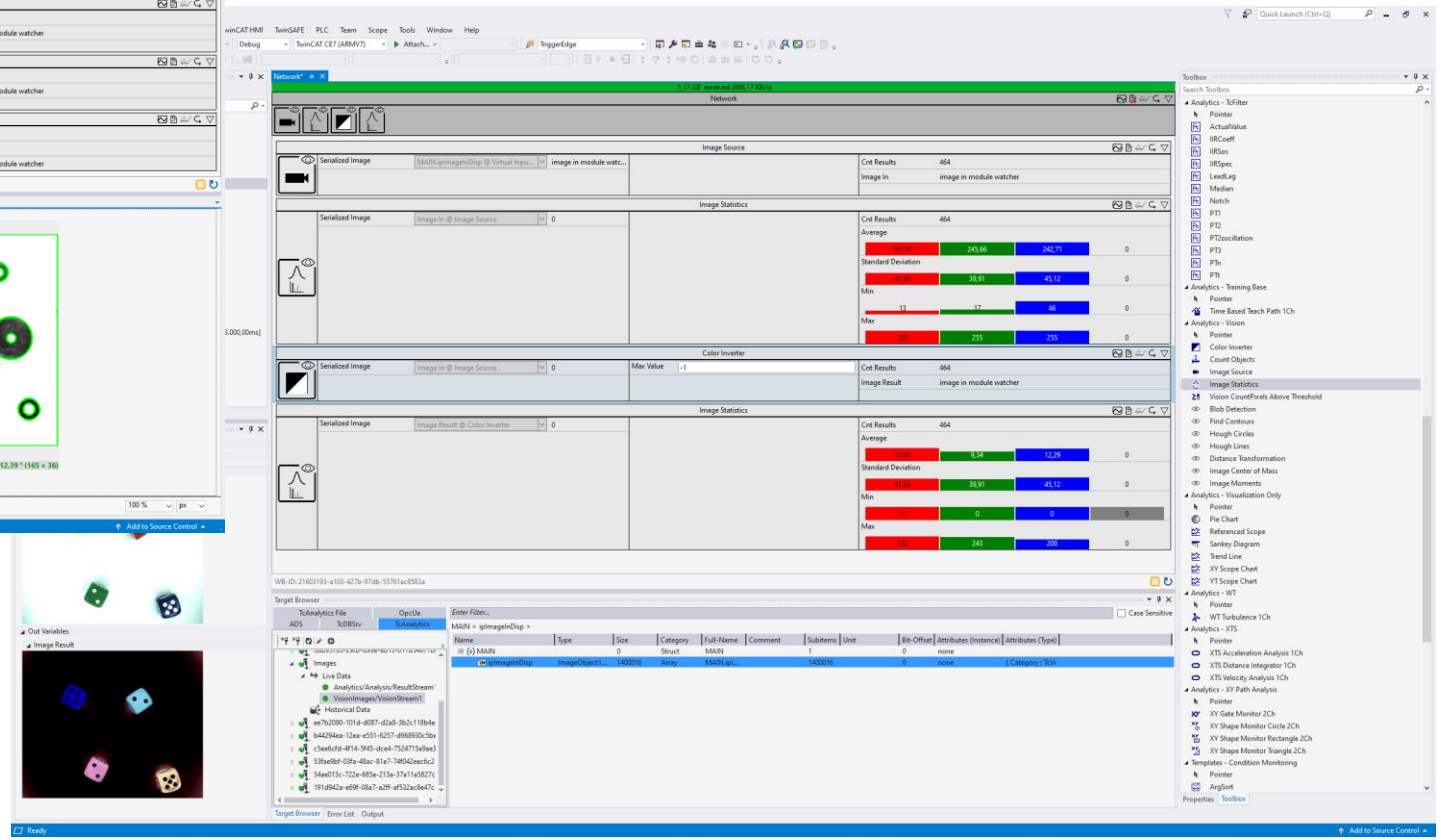
Configuring instead of programming – TwinCAT Analytics with TwinCAT Vision





TwinCAT 3 Analytics with TwinCAT Vision

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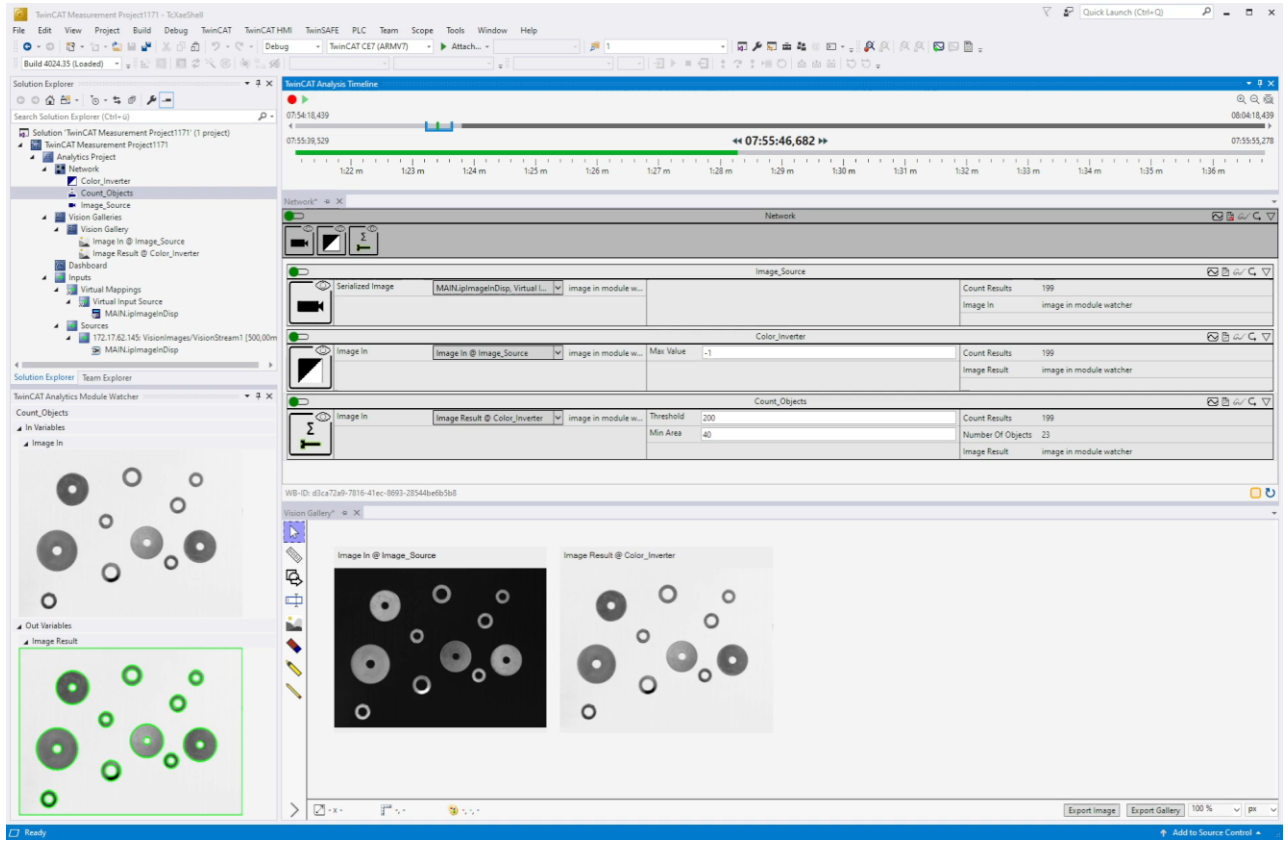
Range of algorithm is growing…

- Median Filter
- Morphological Operator
- Clahe
- Color Inverter
- Count Objects
- Count Pixel Above Threshold
- Image Histogram
- Image Statistics
- Read Barcode
- Read QR-Code
- Detect Blobs
- Match Shapes
- Match Contours
- Extract ROI From Contour
- Set ROI
- OCR



TwinCAT 3 Analytics with TwinCAT Vision

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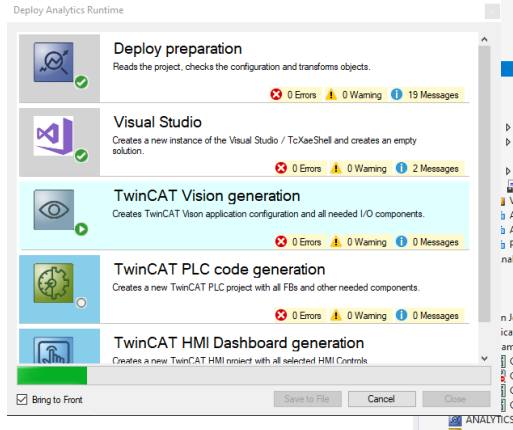
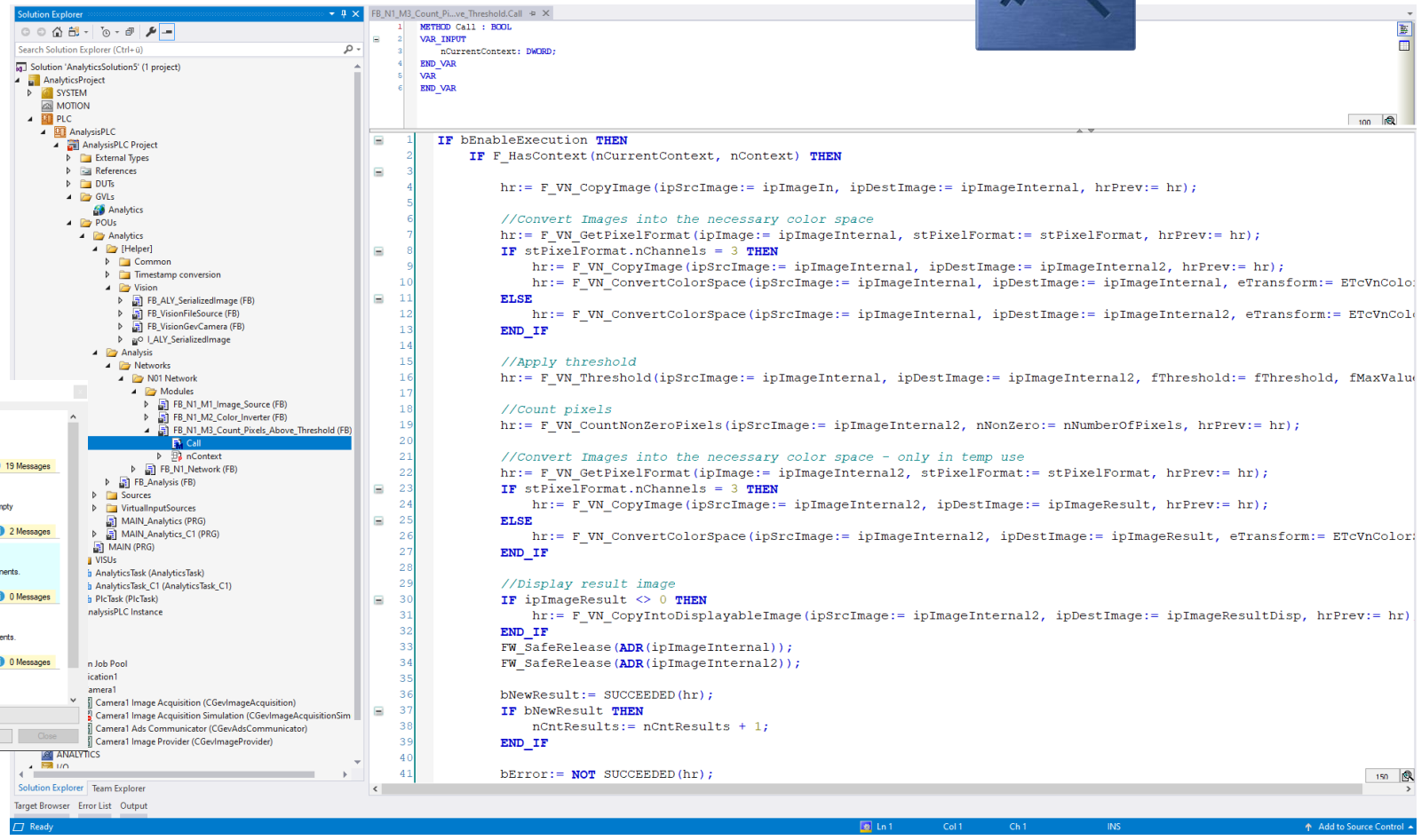
Automatic PLC code generation

- Transparent PLC code based on TwinCAT Vision library
- For remote analysis via MQTT
- For local Vision application integrated in machine control
  - Include FB CameraControl