

SCADE®

SCADE Suite® 2020 R2

SCADE Suite is part of the Ansys® Embedded Software product line, which empowers users with a Model-Based Development Environment for critical embedded software.

With native integration of the formally-defined SCADE language, SCADE Suite is the integrated design environment for critical applications spanning requirements management, model-based design, simulation, verification, qualifiable/certified code generation, and interoperability with other development tools and platforms.

SCADE Suite is tightly integrated with other Ansys SCADE® products and Ansys Twin Builder® to provide a design environment combining system and software engineering development, interactive HMI design, multiphysics simulation, application testing and lifecycle management, and code integration on target. SCADE Architect® is bundled with SCADE Suite, providing an integrated software engineering solution combining software architecture, simulation and software design in a single comprehensive user interface.

/ Tailored for Critical Applications

SCADE Suite drastically reduces project certification costs by simplifying critical control application design and automating verification, qualifiable/certified code generation, and documentation generation. SCADE Suite KCG Code Generator is qualifiable as a DO-330 TQL-1 development tool under DO-178C, and certified under ISO 26262:2011 at TCL3/ASIL D and C, IEC 61508:2010 at T3/SIL 3, and EN 50128:2011 at T3/SIL 3/4.

SCADE Suite KCG Certification Kits provide all material required by the certification authorities:

- Tool Qualification Plan (TQP).
- Tool Operational Requirements (TOR).
- Tool Accomplishment Summary (TAS) or Safety Case (SC).
- Compliance Analysis to certification standards.
- Software Installation Procedure (SIP).
- Tool Configuration Index (TCI).
- Other standard-specific documents.

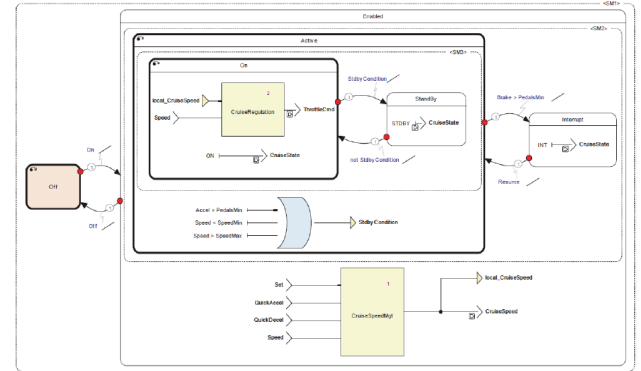
More information is available in the technical data sheets on SCADE Suite KCG Certification Kits. DO-178B and DO-178C Certification Plans for SCADE Suite Applications provide a set of generic plans supporting the certification of applications developed with SCADE Suite at levels A and B.



Software Prototyping and Design

Advanced Model-Based Design

- Intuitive and familiar graphical notation based on unlimited nesting of data flows and hierarchical state machines:
 - Graphical decision diagrams.
 - Array iterators to facilitate operator multi-instantiation and perform complex data processing.
 - Equation set features for quick highlighting/identification of model parts.
- Model completeness and determinism guaranteed:
 - Strongly-typed language.
 - Language and typing extensions (new iterators, bitwise operators, 8/16/32/64-bits numeric types (signed/unsigned), and 32/64-bits floats.
 - Static consistency checking.
 - Rule checker and metrics computation for company/project standards. Python-based framework allowing for user defined rules/metrics.
- Support for multi-core design with model-independent configurations.
- Easy reuse and readability of design.



Where Can SCADE Be Used?

SCADE Suite is used to design critical software, such as flight control and engine control systems, landing gear systems, automatic pilots, power and fuel management, cockpit displays, rail interlocking systems and signaling, automatic train operation, computer-based train control, emergency braking systems, over-speed protection, train vacancy detection, nuclear power plant controls, battery and power management control and many other aerospace, railway, energy, automotive and industrial applications.

- Efficient editing features, such as multiple connection drawing, navigation in model, search, unlimited undo.
- Multi-screen support enhances model navigation and more generally development activities.
- Semantic comparison of various versions of models, packages, operators or state machines with location and reporting features.
- SCADE Suite library components: integrators, hysteresis, quantizers, filters, flip-flops, truth tables, look-up tables, matrix operators, etc.
- Import of legacy code into designs.

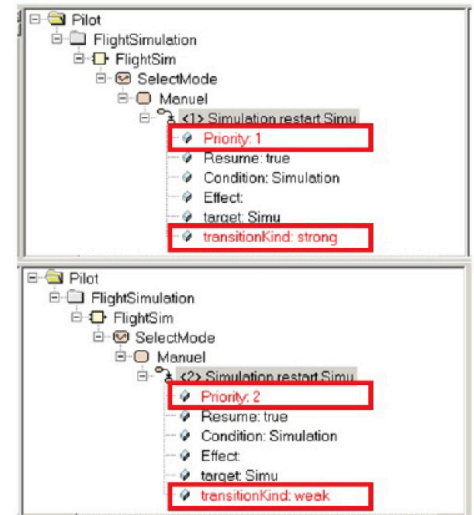


Synchronization with Software Architecture Design

Integration of SCADE Architect and SCADE Suite allows for the complete software design process, from architecture to detailed design of components:

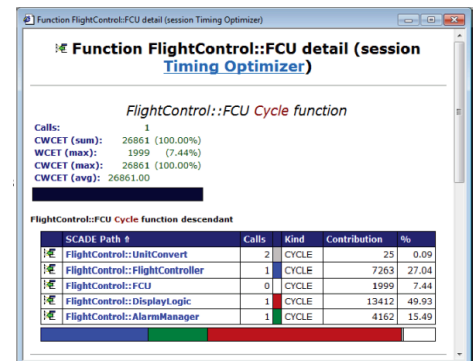
- Evolution of architecture and design of software components in parallel and resynchronization upon request at chosen project milestones.
- Bi-directional synchronization between architecture models and design models.
- Consistent and efficient management of I/Os and data definitions and changes.
- No duplication of efforts in synchronizing interfaces defined at architecture level and refined at design level.
- Multirate application support at architecture and design levels with dedicated generic or specific configuration¹.

For more information on the SCADE Architect product line, see the SCADE Architect technical data sheet.



Timing and Stack Size Optimization with Timing and Stack Optimizer²

- Analysis of Worst-Case Execution Time (WCET) and stack usage of a SCADE Suite application independently from the actual target platform.
- Iterative process to focus on application parts causing long execution times or unsatisfactory stack usage, and to refine the application profiling by optimizing SCADE Suite models.
- Easy comparison of results between optimization sessions reported in SCADE.
- Suite design environment and fast round-trip between modeling and optimizations.
- Automatic and customizable detailed reporting.



Application Programming Interfaces (APIs)

- Python-based API:
 - Read/write access to SCADE Suite project and model files.
 - Wizard for quick and easy creation of Python (or TCL) scripts.
- Java Based Eclipse API:
 - Read/write access to SCADE Suite project and model files via Eclipse Modeling Framework (EMF).
 - Interactive use of SCADE Suite projects from Eclipse via basic Project and Model Explorers.

¹SCADE Architect and SCADE Suite integration with ASTERIOS(r), a product of Krono-Safe SA.

²Powered by aIT, a product of AbsInt GmbH

Configuration Management

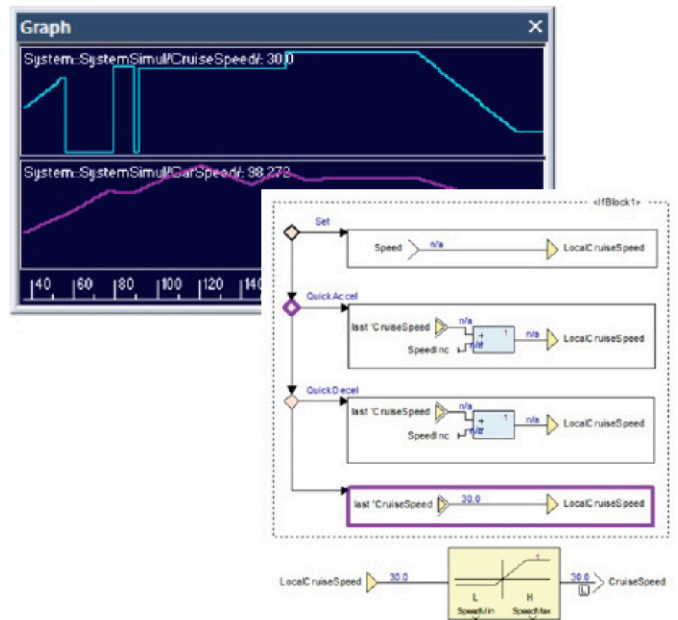
- Built-in integration with Configuration Management Tools through.
- Configuration Management Gateway.
- Granularity at operator and package levels based on multi-file storage.

Support for Requirements Traceability

- Traceability to requirements available with SCADE LifeCycle® ALM Gateway.

Legacy Algorithm Design Capture

- Translation of discrete controllers prototyped with MathWorks® Simulink® and Stateflow® charts into SCADE Suite models.



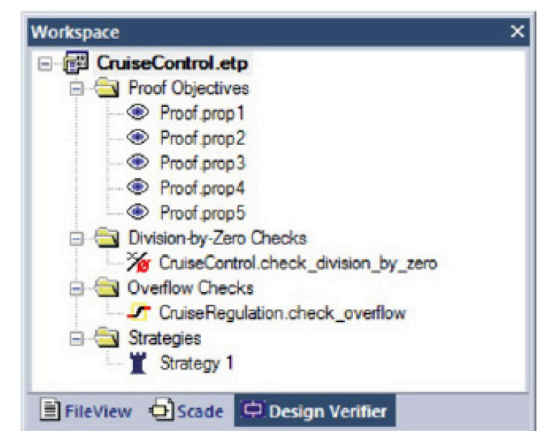
Verification and Validation

Debugging/Simulation

- Executable SCADE Suite designs:
 - Support for full simulation of C or Ada code.
 - Complete integration of C or Ada imported code.
- Scenario recording and play back:
 - Early detection of specification errors.
 - Automatic non-regression tests.
- Interactive and batch modes:
 - Clean and easy data tracking (access to variables and probes for debugging, values displayed in the graphical model).
 - Breakpoints on control, data and time criteria.
- Support of SCADE Test Environment input formats:
 - Co-simulation with MathWorks® Simulink® and MATLAB®.
 - Co-simulation mode for connection to your simulation environment and tools.

Formal Verification with Design Verifier³

- Verification of safety properties expressed in models.
- Automatic counter-example production in case of property failure.
- Early detection of division-by-zero, overflow and underflow errors.
- Full support of floating-point computation in models.
- Proof engine exploits multi-cores for best performances.
- Consistent check of hypothesis, easy and intuitive use of proof or bug-chasing modes.



³Powered by PROVER-SL Plug-in@ Prover Technology.

Connectivity with System Simulation Tools

SCADE Suite integrates seamlessly with Ansys® Twin Builder® through the FMI/FMU co-simulation standard to enable interactive E/E and multiphysics simulation sessions.

- Functional Mock-up Unit (FMU) export out of SCADE Suite models for connection to Ansys Twin Builder and all FMI-compliant system simulation tools. Generated C sources can be exported or not to protect IP.
- Support for FMI 2.0 Model Exchange Export.

Model-in-the-Loop and Hardware-in-the-Loop Simulation

- Interactive simulation of SCADE Suite models in National Instruments VeriStand™ environment.
- dSPACE MicroAutoBox 1513 support using extensible and customizable library. Other models can be supported.

Worst-Case Execution Time (WCET) and Stack Size Analysis with Timing and Stack Verifiers

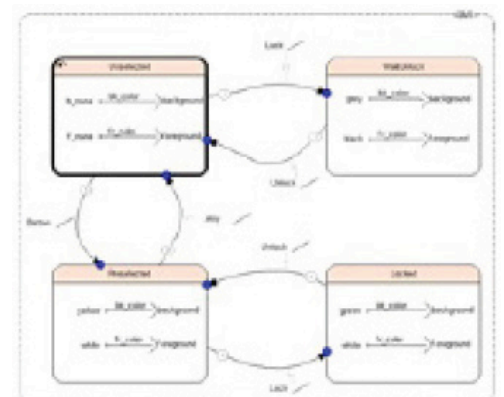
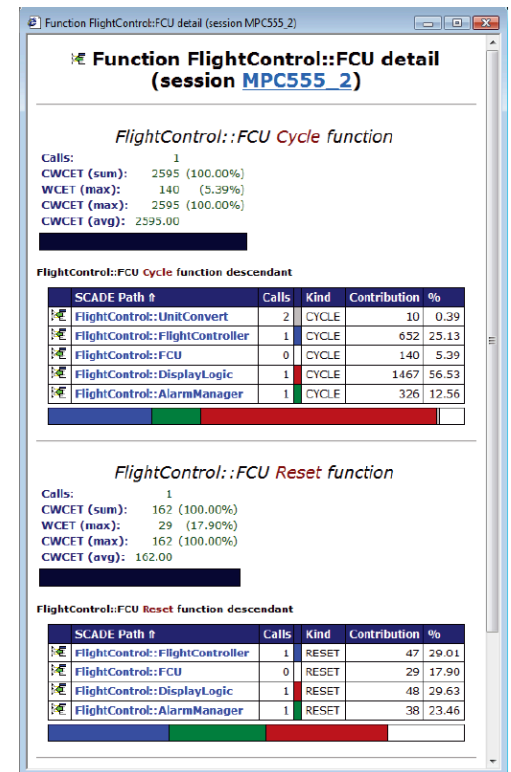
- Computation of WCET and stack usage of a SCADE Suite application for a specific target.
- Aggregation of results from different code generation settings and comparison at model level.
- Fully automated process.
- Fully customizable from SCADE Suite or by Tcl scripts.
- Supported processor targets for WCET analysis: PowerPC e200 family, PowerPC MPC 5xx family, PowerPC e300, PowerPC MPC 755s and ARM Cortex-R4F.
- Supported processor targets for stack analysis: all PowerPC and ARM Cortex.
- Available on request: LEON2, LEON3, NEC V850E1/PHO3, TriCores 1766/1796/1797.

Testing Environment

The development of applications in SCADE Suite can be extended with testing activities supported by SCADE Test:

- Creating and managing test cases, setting up and launching test execution from SCADE Test Environment for Host.
- Measuring coverage at models and generated code level with SCADE Test Model Coverage.
- Generating test harnesses for target testing with SCADE Test Target Execution.

For more information on testing environment capabilities, see the SCADE Test technical data sheet.



```
void Button_ABC_MPC_Buton_ABC_N*inC,
state_Buton_ABC_M*outC)
{
  /* ABC_N:Button-SM1-SM1_dispatch_set */
  SSM_Buton_SM1_ST_SSM_SM1_dispatch_set
  if (outC->init)
  {
    outC->init = true;
    SSM_SM1_dispatch_set = SSM_SM1_Unselected_ABC_N;
  }
  else
  {
    SSM_SM1_dispatch_set = outC->M_pre;
  }
  switch(SSM_SM1_dispatch_set)
  {
    case SSM_SM1_Locked_ABC_N:
      outC->foreground = white_ABC_N;
      outC->background = green_ABC_N;
      if (inC->Unlock)
      {
        outC->M_pre = SSM_SM1_Unselected_ABC_N;
      }
      else
      {
        outC->M_pre = SSM_SM1_Locked_ABC_N;
      }
      break;
    case SSM_SM1_WaitUnlock_ABC_N:
      outC->foreground = black_ABC_N;
      outC->background = grey_ABC_N;
      if (inC->Unlock)
      {
        outC->M_pre = SSM_SM1_Unselected_ABC_N;
      }
      else
      {
        outC->M_pre = SSM_SM1_WaitUnlock_ABC_N;
      }
      break;
  }
}
```

Automatic Code Generation

Automatic Generation of C and Ada codes

- Generated code properties:
 - Fulfillment of embeddable code constraints: static memory allocation, static bounded loops, no recursion, no dead code introduced by KCG.
 - High quality and safe C and Ada production code: optimized, customizable, readable, and traceable.
 - Portable Ansys Code.
- Qualifiable/certified SCADE Suite KCG 6.6:
 - Qualifiable as DO-330 TQL-1 tool under DO-178C.
 - Certified under ISO 26262:2011 at ASIL D and C.
 - Certified under IEC 61508:2010 at SIL 3.
 - Certified under EN 50128:2011 at SIL 3/4.
- SCADE Suite Multi-core Code Generator:
 - Produces retargetable KPN.
 - Multicore toolbox for final target integration.

Easy handling of generated code: access to generated data and model elements through dedicated Python-based API.

Code Integration

- Automatic integration of the generated code to DDC-I Deos™, Green Hills® Software INTEGRITY™-178B, QNX, SYSGO PikeOS, Wind River® VxWorks® 653 and VxWorks® CERT, and other RTOSes.
- Customizable RTOS Adaptors for generated code.
- Code calibration linked to model. Direct use within FMU or National Instruments VeriStand™.

Object Code Verification with Compiler Verification Kit

- Supports early verification of the correctness and consistency between the development tools chain and the target platform.
- Demonstrates that the C code generated by SCADE Suite KCG is correctly compiled by the C target compiler and resulting code executes correctly on a given target platform.
- Consists of a test suite that performs normal low-level testing of code structures generated by SCADE Suite KCG and compiled with user C compiler.
- The test suite consists of a C sample containing all elementary C constructs (including combinations) generated by SCADE Suite KCG from a SCADE Suite model. Input vectors exercising C sample code and producing 100% MC/DC coverage are also provided.
- Supports customizable automation execution scripts.

/ SCADE Automotive Package

The SCADE Suite Automotive package extends and simplifies system design capabilities for the automotive market.

AUTOSAR R 4.2.2 Support

- Import/export of ARXML inter-exchange format.
- AUTOSAR configuration for Software Component (SWC) support, including Timing Annex.
- Synchronization of “runnables” with Scade models.
- AUTOSAR Code Generator to generate AUTOSAR RTE-compliant code for “runnables”.

Calibration and Fixed Point Support

- ASAM MCD-2 DC support.
- Library generator for fixed-point conversion.

Certified Code Generation

- SCADE Suite and SCADE Display KCG Code Generators have been certified by TÜV SÜD at ISO 26262 TCL3 for ASIL D Software Development.

The dSPACE MicroAutoBox support is provided with the SCADE Automotive package.

/ SCADE Tools Integration

Development of Embedded Human-Machine Interfaces (HMI)

SCADE Suite allows for designing the control logic associated with graphical HMIs designed in SCADE Display:

- **Co-design:** Tight design-level integration of critical logic and graphic components in embedded applications.
- **Co-Simulation:** Early prototyping and validation in white-box and black-box modes between display application logic and graphical components.
- **Co-reporting:** Integration of report generation between SCADE Suite models and SCADE Display graphical specifications.
- **Co-generation:** Integrated deployment of SCADE Suite and SCADE Display generated code.

For more information on the SCADE Display product line, see the SCADE Display technical data sheet.

Application Life Cycle Management

The life cycle management of applications developed in SCADE Suite can be supported by SCADE LifeCycle by:

- Connecting Application Lifecycle Management (ALM) tools and setting requirements traceability from models.
- Generating documentation automatically from models.

For more information on the SCADE LifeCycle product line, see the SCADE LifeCycle technical data sheet.

SCADE Suite Product Line

SCADE Suite Advanced Modeler:

- Editor.
- Checker.
- Simulator.
- Configuration Management Gateway.
- Python API and Eclipse Plug-In.
- Code Integration for FMI and Twin Builder®.
- Application Lifecycle Management Gateway.
- SCADE Display Integration.
- SCADE Architect Integration
- Simulink® Wrapper (S-functions).
- Gateway for National Instruments VeriStand™.
- RTOS Adaptors and “user definable” Adaptors.
- SCADE Automotive Package.
- User documentation and online help.

SCADE Suite Timing and Stack Optimizer

SCADE Suite Design Verifier

SCADE Suite Timing and Stack Verifier

SCADE Suite Gateway for Simulink®

SCADE Suite KCG Code Generator

SCADE Suite KCG Certification Kits:

- DO-178C/DO-330C Certification Kits.
- ISO 26262 Certification Kit.
- IEC 61508 Certification Kit.
- IEN 50128 Certification Kit.
- IEC 60880 Certification Kit.

SCADE Suite Compiler Verification Kit

SCADE Suite Multicore Code Generator

ANSYS, Inc.
www.ansys.com
ansysinfo@ansys.com
866.267.9724

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