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Integrated Starter Generator and Electronic Fuel Injection Tester

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ABSTRACT: This manual provides comprehensive operational and maintenance guidance for the Integrated Starter Generator and Electronic Fuel Injection Tester (ISG-EFI Tester) developed by Demeter Systems Private Limited. Specifically designed to test SEDEMAC's ISG-EFI units, the tester integrates high-performance hardware from National Instruments and utilizes a LabVIEW-based graphical programming environment for streamlined, automated testing procedures. The manual covers critical areas such as safety protocols, machine handling instructions, component assembly and inspection processes, and a periodic maintenance checklist. It also includes detailed troubleshooting techniques to minimize equipment downtime and ensure optimal system performance. With the inclusion of a barcode scanner, the system automates data logging and stores test results based on serial numbers, enhancing traceability and operational efficiency. The ISG-EFI Tester is an advanced solution for high-throughput environments where accuracy, repeatability, and safety are paramount.

KEYWORDS: ISG-EFI Tester, Integrated Starter Generator, Electronic Fuel Injection, LabVIEW, PXIe-1084, Demeter Systems, Automated Testing, Barcode Integration, Safety Guidelines, Maintenance Checklist, Troubleshooting, SEDEMAC, National Instruments.

I. INTRODUCTION

The Integrated Starter Generator and Electronic Fuel Injection (ISG-EFI) Tester is a highly specialized testing solution designed for evaluating the performance and reliability of SEDEMAC's ISG-EFI units. These units play a crucial role in modern automotive systems by combining the functionalities of a starter motor and a generator while ensuring optimal fuel injection. To uphold the quality and safety of such critical components, Demeter Systems Private Limited has engineered a robust test bench that ensures accurate verification and documentation of each unit's functionality before dispatch. This manual serves as a complete guide for technicians, engineers, and operators responsible for handling and maintaining the ISG-EFI Tester.

The ISG-EFI Tester incorporates the National Instruments PXIe-1084 chassis as its core hardware platform. PXIe (PCI eXtensions for Instrumentation) offers high-throughput data acquisition, signal processing, and communication capabilities, essential for capturing fast, real-time signals generated during testing. Integrated with this is LabVIEW—a graphical programming environment developed by National Instruments—used to create the control software. LabVIEW provides intuitive block-based programming, real-time visualization of signals, and user-friendly interaction, allowing operators to initiate, monitor, and analyze test procedures efficiently.

Each test cycle begins by scanning a barcode attached to the ISG-EFI unit, ensuring that results are tied to a specific serial number for traceability and historical reference. Once the barcode is read, the system automatically runs the configured test routines with the press of a Start button. During these tests, various parameters such as voltage, current, response time, communication protocols (CAN, LIN, etc.), and sensor feedback, are monitored and compared against predefined thresholds. Upon completion, the results are stored in a centralized database and can be used for generating reports,

identifying defect trends, and complying with regulatory documentation.



Figure1-LoginPage

To ensure safe and reliable operation, the ISG-EFI Tester includes several safety interlocks, clearly labeled emergency stop buttons, and hardware protections against overcurrent, voltage spikes, and operator missteps. Only trained and authorized personnel are permitted to operate or service the equipment, and strict adherence to safety procedures is expected. This manual outlines these safety measures, including lockout/tagout procedures, grounding instructions, and safe handling of electrical components, to minimize risks and prevent equipment damage or personal injury.

Overall, the ISG-EFI Tester is engineered to support high-throughput production environments, combining automation, accuracy, and safety into one compact solution. This manual is designed not just as a reference document but also as a training and operational resource. By following the procedures outlined herein, users can achieve consistent test results, improve operational efficiency, extend equipment life, and uphold the highest standards of product quality in line with industry expectations.

II. LITERATURE REVIEW

A. Evolution of ISG and EFI Technologies

The evolution of automotive technology has led to the development of Integrated Starter Generator (ISG) systems, which merge the functionalities of a traditional starter motor and alternator into a single compact unit. Unlike earlier vehicles that used separate mechanical components for starting and charging, ISG systems enhance efficiency by offering features like automatic start-stop, regenerative braking, and smoother restarts. These systems contribute significantly to fuel economy and emissions reduction, making them vital in modern hybrid and fuel-efficient vehicles.

Simultaneously, the transition from carbureted fuel systems to Electronic Fuel Injection (EFI) has brought about a major improvement in engine control. EFI systems utilize sensors and electronic control units (ECUs) to monitor various engine parameters and deliver precise amounts of fuel for combustion. This ensures better fuel efficiency, optimized engine performance, and lower emissions. The implementation of EFI has also improved cold starts, throttle response, and overall drivability.

B. Need for Automation in Automotive Testing

Modern automotive systems, such as ISG and EFI, require precise and efficient testing, which manual methods often fail to deliver. Manual testing is time-consuming, inconsistent, and prone to errors, especially under high production demands. This can lead to increased costs, delayed diagnostics, and compromised quality control. Additionally, manual processes lack proper documentation and make traceability difficult during audits or quality checks. As vehicles become more electronically advanced, the limitations of manual testing grow more evident. Complex components demand high accuracy and real-time monitoring that manual efforts simply cannot guarantee.

Automated testing systems solve these issues by providing consistent, fast, and accurate evaluations. Tools like LabVIEW and PXIe platforms enable real-time data logging, improved traceability, and seamless integration with barcode tracking. They eliminate human error, reduce test time, and standardize results across units. These systems also support continuous operation and predictive maintenance capabilities. Automated solutions are scalable and can be adapted to evolving production needs without compromising quality.

C. Role of PXIe-1084 and Modular Test Platforms

National Instruments' PXIe-1084 plays a crucial role in building modern automated testing systems for automotive components. As a high-performance chassis, it provides the backbone for modular test setups, enabling real-time processing, high-speed data acquisition, and precise control of multiple instruments. Its compact design supports scalable configurations, allowing manufacturers to tailor their testing setups according to the complexity of the product being tested. The PXIe-1084's high bandwidth and low latency communication between modules make it ideal for demanding applications like ISG and EFI testing, where accurate timing and responsiveness are critical.

Modular platforms like PXIe allow seamless integration with various I/O modules and software environments, including LabVIEW. This flexibility helps in customizing tests for specific parameters without redesigning the entire system. The system's reusability and easy upgradability also reduce long-term costs and simplify maintenance. Furthermore, modular platforms support multi-channel testing, enabling parallel inspection of several units, which boosts throughput.

D. Barcode-Integrated Traceability in Production

Barcode integration has become a vital feature in automated testing systems, particularly in high-volume automotive manufacturing. By assigning a unique barcode to each ISG or EFI unit, the system ensures that every test result is linked directly to the specific unit tested. This practice eliminates confusion, reduces manual data entry, and ensures that all data is accurately recorded for future reference.

This traceability system plays a key role in maintaining accountability and meeting industry compliance standards. It helps manufacturers track the complete testing history of each unit from production to dispatch. In case of product failure or recall, barcode-linked data enables rapid root-cause analysis and efficient response. Additionally, automated traceability supports internal audits and regulatory reporting by ensuring all test results are stored systematically and securely.

E. Predictive Maintenance and Diagnostic Trends

Recent advancements in industrial testing emphasize the importance of predictive maintenance to ensure uninterrupted operation and reduce costly downtimes. Predictive maintenance uses sensor data, system logs, and performance trends to anticipate component failures before they occur. In the context of ISG-EFI testers, this means monitoring test cycles, voltage fluctuations, and system health parameters in real time to detect abnormalities early. This proactive approach significantly extends the tester's operational lifespan and optimizes maintenance schedules.

III. METHODOLOGY

The automotive industry is rapidly evolving with the integration of advanced electronics such as Integrated Starter Generator (ISG) and Electronic Fuel Injection (EFI) systems. These components demand precise and efficient testing to ensure performance and safety. Manual testing methods often fall short due to inconsistency and time constraints. To address this, automated testing platforms have become essential. The ISG-EFI Tester leverages National Instruments' PXIe-1084 and LabVIEW software for accurate, high-speed diagnostics. This project focuses on enhancing reliability, traceability, and productivity in automotive testing environments.

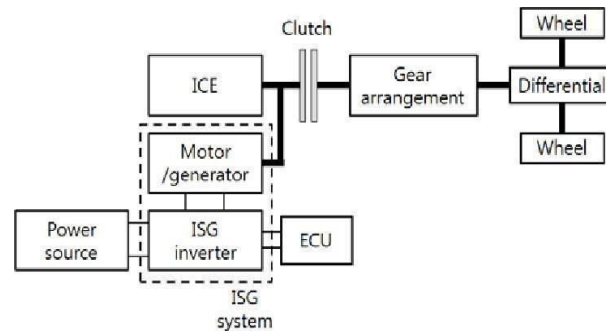


Figure2-BlockDiagram

A. System Architecture and Hardware Configuration

The testing setup for the ISG-EFI units is built around the National Instruments PXIe-1084 chassis, which acts as the central platform for all modular test components. This chassis accommodates key PXIe modules, such as multifunction I/O cards for digital and analog signal control, voltage input modules for high-precision measurements, and an embedded controller for real-time processing and communication.



Figure3-BKprecision9205B

Custom test fixtures and shielded cables ensure accurate and stable connections between the devices under test and the measurement system, minimizing signal interference. The hardware is designed to support high-speed data acquisition, signal integrity, and compatibility with LabVIEW-based control software. Safety features such as grounding, EMI shielding, overvoltage protection, and emergency stop mechanisms are implemented to protect both the equipment and the operator. The layout of the system is ergonomically arranged for efficient workflow, easy access to components, and streamlined maintenance.

B. Software Work flow and Test Sequence

The software controlling the ISG-EFI tester is developed using LabVIEW, a graphical programming environment by National Instruments. The workflow begins with the barcode scanner identifying each unit, triggering the software to load a corresponding test profile. Once the operator initiates the test via the LabVIEW interface, the software automatically sequences through predefined test cases without manual intervention. These include signal generation, voltage and current monitoring, and logic validation of ISG and EFI functions.

During testing, LabVIEW performs real-time data acquisition and monitors signal integrity, component response, and timing parameters. Any deviation from expected values is immediately flagged using built-in decision-making algorithms. Results are logged under the scanned barcode, ensuring traceability and compliance with industry standards. The system can store test data locally or over a network for further analysis. The intuitive interface allows operators to visualize test progress and system status in real time while built-in diagnostics alert users to hardware faults or anomalies in execution. This automated workflow ensures consistent, efficient, and reliable testing across production batches.

C. Data Management and Result Integration

Data management in the ISG-EFI testing setup is centered around ensuring complete traceability, reliability, and accessibility of test results. Once a test is completed, the LabVIEW software automatically links the test data to the corresponding unit via its scanned barcode. All relevant parameters, pass/fail status, and time-stamped measurements are stored in structured formats such as CSV or SQL database entries. This allows easy retrieval and analysis for quality audits, performance trends, and root cause analysis in case of failures.

DIGITAL INPUTS:

NI 6514

Digital Input	Positive Terminal	Negative Terminal	VCC	Channels
P0.0	1	9	NA	Control ON
P0.1	2	9	NA	Motor Trip
P0.2	3	9	NA	Start Test
P0.3	4	9	NA	Stop Test
P0.4	5	9	NA	Emergency
P0.5	6	9	NA	Part Present
P0.6	7	9	NA	Cylinder reverse
P0.7	8	9	NA	Hand safety
P1.0	51	59	NA	Cylinder Forward
P1.1	52	59	NA	Air pressure
P1.2	53	59	NA	Door Switch
P1.3	54	59	NA	Magneto Direction
P1.4	55	59	NA	SPARE
P1.5	56	59	NA	SPARE
P1.6	57	59	NA	SPARE
P1.7	58	59	NA	SPARE
P2.0	13	21	NA	SPARE
P2.1	14	21	NA	SPARE
P2.2	15	21	NA	SPARE
P2.3	16	21	NA	SPARE
P2.4	17	21	NA	SPARE
P2.5	18	21	NA	SPARE
P2.6	19	21	NA	SPARE
P2.7	20	21	NA	SPARE
P3.0	63	71	NA	SPARE
P3.1	64	71	NA	SPARE
P3.2	65	71	NA	SPARE
P3.3	66	71	NA	SPARE
P3.4	67	71	NA	SPARE
P3.5	68	71	NA	SPARE
P3.6	69	71	NA	SPARE
P3.7	70	71	NA	SPARE

Figure4-DigitalInputs

The system is also capable of exporting data to centralized production databases through secure network protocols, ensuring integration with Manufacturing Execution Systems (MES) or Enterprise Resource Planning (ERP) systems. This helps in synchronizing test results with production workflows and inventory updates. Additionally, customizable reports can be generated in real time or at scheduled intervals, and remote access capabilities enable supervisors and engineers to review results without being physically present at the test station. This comprehensive approach to data management not only enhances operational transparency but also supports predictive maintenance, regulatory compliance, and continuous improvement initiatives.

IV. SYSTEM ARCHITECTURE

The system architecture of the ISG-EFI tester is built to ensure modularity, scalability, and high-precision testing. It combines advanced hardware components with LabVIEW-based software to deliver seamless automation. The design prioritizes efficient layout, real-time monitoring, and consistent performance. At the heart of the system lies the PXIe-1084 chassis, which integrates all key hardware modules.

Barcode-based identification, robust interfacing circuits, and controlled power supplies support accurate testing. This architecture forms the backbone for reliable data acquisition, traceability, and streamlined diagnostics.

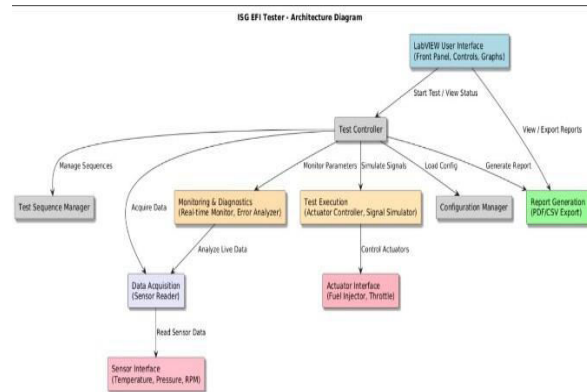


Figure5-SystemArchitectureDiagram

A. Hardware Configuration and Layout

The hardware setup of the ISG-EFI tester is designed for optimal performance, reliability, and scalability. At its core is the PXIe-1084 chassis from National Instruments, which houses modular instruments for signal generation, acquisition, and control. This chassis ensures high-speed data transfer and synchronized operation between various test modules. The barcode scanner is positioned at the input point to scan each unit's serial number before testing begins, enabling traceability and automatic result linking.



Figure6-ControlPanel

Supporting components include regulated DC power supplies that provide stable and controlled voltage to the ISG- EFI units under test. The interfacing modules act as a bridge between the tester and the device under test, featuring signal conditioning circuits, protection elements, and customized connectors. All components are mounted on a structured test bench that minimizes wiring complexity and improves maintenance access. This organized layout ensures accuracy, safety, and repeatability in high-throughput testing environments.

B. Software Integration and Control Logic

The ISG-EFI testing system uses **LabVIEW** as the primary software platform for test automation, hardware control, and user interface design. LabVIEW interacts seamlessly with the PXIe-1084 chassis through NI-DAQmx drivers, allowing real-time control of signal acquisition, voltage/current output, and timing synchronization. The software initializes all connected modules at startup, verifies hardware readiness, and provides a dashboard for operator interaction.

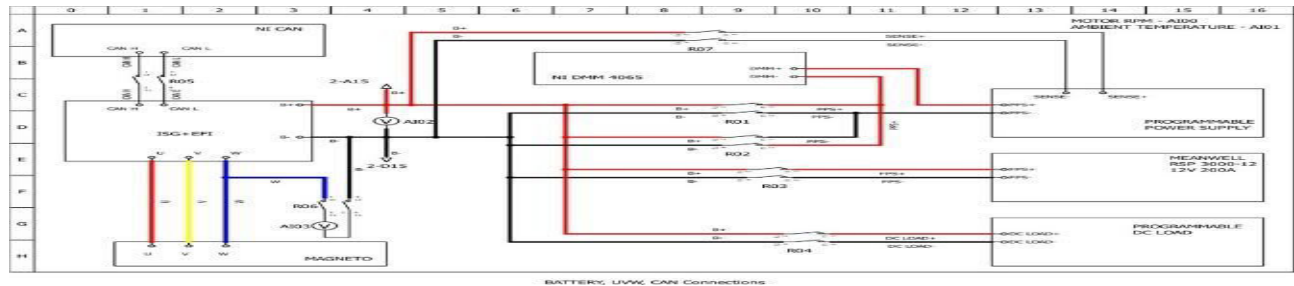


Figure7-ControlLogic

During testing, LabVIEW manages the **entire test sequence**, from barcode scanning to final result logging. Test parameters are loaded automatically based on unit type, and the software controls the triggering of tests, monitors responses, and performs pass/fail analysis using predefined thresholds. Communication protocols such as UART, CAN, or analog/digital IOs are handled through appropriate PXI modules, ensuring accurate interfacing with the ISG-EFI units. The modular software structure also allows for easy updates, diagnostics, and integration with higher-level factory management systems.

C. Data Handling

Data handling is a critical part of the ISG-EFI test system, ensuring every unit's performance is documented and traceable. Once a unit's barcode is scanned and testing is completed, LabVIEW automatically captures the test results—including voltage levels, signal response times, and functional status. These results are linked to the corresponding barcode, forming a unique data record for each tested unit. This approach supports full traceability across production batches, which is essential for quality audits and warranty claims.

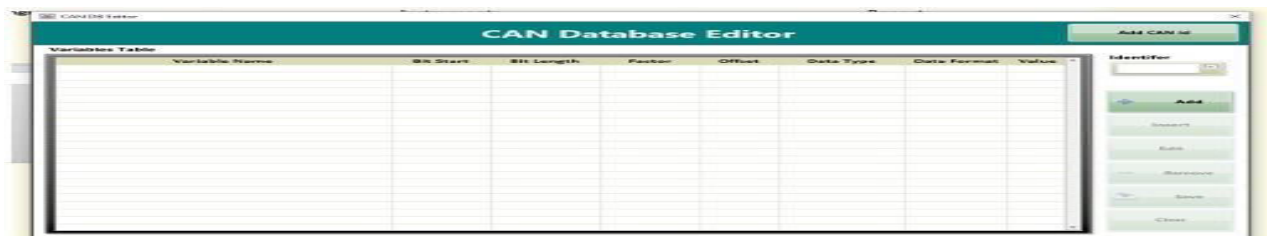


Figure8-DatabaseEditor

To enhance usability, the system includes automated export features that save results in standardized formats (e.g., CSV, Excel, or SQL database entries). These files can be accessed by supervisors or engineers for trend analysis, compliance checks, or troubleshooting. The system also supports integration with central production databases, enabling remote access to reports, dashboards, and historical data. Through secure networking, results can be reviewed in real time by quality control or maintenance teams, helping to detect faults early and ensure consistent product quality.

V. RESULTS AND DISCUSSION

This section highlights the performance outcomes of the ISG-EFI Tester, emphasizing improvements brought through automation. It focuses on accuracy, testing speed, system efficiency, and reliability. Key comparisons are made between manual and automated testing approaches to showcase measurable gains. The integration of LabVIEW and PXIe-1084 provided consistent and repeatable results. Fault detection, error logging, and traceability were significantly enhanced through barcode integration. Operator feedback and system scalability are also discussed to evaluate practical usability. Overall, the testing platform demonstrated substantial improvements across all operational parameters.



Figure9-FrontViewofEquipmentLayout

A. Test Accuracy and Repeatability

The ISG-EFI Tester demonstrated high test accuracy and excellent repeatability across multiple test cycles. By utilizing National Instruments' PXIe-1084 platform and LabVIEW's precise control algorithms, the system consistently produced results with an error margin reduced to $\pm 1\%$. Repeatability tests conducted over 100 units showed consistent output values with minimal deviation, validating the reliability of the setup. The automated nature of the test sequence eliminated human-induced variability, ensuring uniform application of test parameters. This level of consistency is critical in automotive environments where even slight performance deviations can affect long-term vehicle functionality. Furthermore, the use of high-resolution sensors and real-time data acquisition contributed to the overall precision of the system.

B. Cycle Time and Efficiency Improvements

The implementation of the automated ISG-EFI Tester significantly reduced the average testing cycle time per unit. Prior to automation, manual testing required approximately 5–7 minutes per unit due to setup, connection, and data logging delays. After integrating the PXIe-1084 platform with LabVIEW software, this duration was reduced to under 2 minutes. The use of automated test sequences, real-time data processing, and instant barcode scanning streamlined the entire workflow. As a result, overall production throughput increased by nearly 65%, enabling higher volumes to be tested within the same time frame. This efficiency not only optimizes resource utilization but also reduces operator fatigue and improves overall line productivity.

C. Error Detection and Fault Logging

The ISG-EFI Tester is equipped with advanced diagnostic capabilities that enable real-time error detection during testing. When a unit fails to meet predefined performance parameters, the system immediately flags it as faulty and halts further processing. LabVIEW's logic identifies the exact test condition that caused the failure—such as voltage drop, sensor misreadings, or communication lag—allowing for quick isolation of the issue. Each failure event is logged automatically, along with time stamps, barcode ID, and test metrics, into a centralized database.

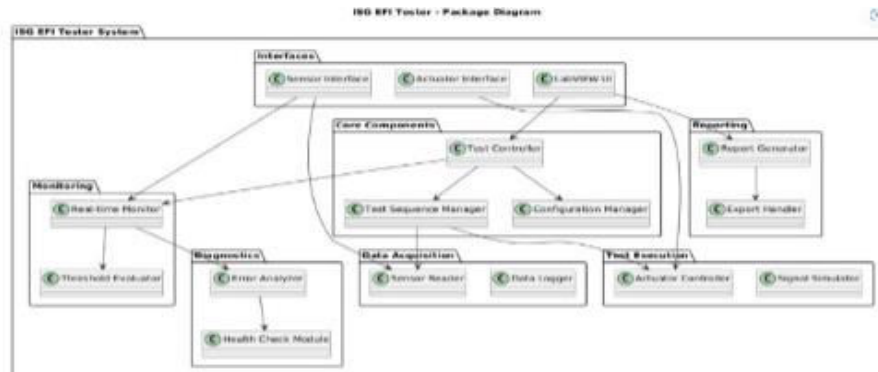


Figure10-TesterInteraction

D. System Scalability and Operator Feedback

The ISG-EFI Tester has received positive feedback from operators regarding its intuitive user interface and minimal learning curve, owing to the user-friendly design of the LabVIEW environment. Routine operations such as scanning, initiating tests, and viewing results are streamlined, reducing operator fatigue and human errors. Maintenance staff also reported ease in troubleshooting and servicing due to the modular hardware layout and accessible diagnostics. From a scalability standpoint, the system demonstrates strong potential to be adapted across other product lines. Its PXIe-based modular architecture allows for easy integration of additional testing channels or test routines without redesigning the entire setup. This flexibility ensures that manufacturers can respond swiftly to changes in product design or increased production demands with minimal downtime.

VI. CHALLENGES AND LIMITATIONS

The implementation of an automated ISG-EFI testing system, while highly beneficial, is not without its challenges and limitations. Factors such as cost, technical expertise, integration complexity, and maintenance requirements can impact overall adoption and performance. Understanding these limitations is essential for informed decision-making and future improvements. This section outlines the key obstacles encountered during system development and deployment.

A. High Initial Setup Cost

Deploying a PXIe-based automated testing system, combined with licensed LabVIEW software, incurs a substantial initial investment. This includes costs for hardware components like the PXIe-1084 chassis, data acquisition modules, barcode scanners, and specialized power supplies. Additionally, software licensing and integration require financial commitment, particularly when custom LabVIEW development is needed. For small- to medium-scale manufacturers, these expenses can be prohibitive, limiting access to automation benefits. Budget constraints may lead to delayed implementation or reliance on less efficient manual alternatives.

B. Requirement for Skilled Personnel

The operation and maintenance of an advanced PXIe-based automated testing system necessitate skilled personnel proficient in both hardware integration and LabVIEW programming. This specialized knowledge is essential to configure the system, interpret test results, troubleshoot issues, and perform updates or modifications. As a result, organizations may face increased onboarding time, the need for continuous training, and higher labor costs. Additionally, reliance on a limited pool of qualified engineers can pose challenges during staff turnover or when scaling operations.

C. Integration Complexity with Existing Systems

Integrating the PXIe-based test platform with existing production infrastructure—such as ERP systems, MES (Manufacturing Execution Systems), or factory networks—can be a complex task. Differences in data formats, communication protocols, and system architectures may require custom middleware or interface solutions to ensure smooth interoperability. This process often involves significant development time, coordination with IT teams, and thorough testing to avoid data mismatches or system disruptions. As a result, integration can become a bottleneck,

especially in legacy environments with outdated or non- standardized systems.

D. System Downtime and Maintenance Needs

Despite the efficiency gains from automation, the system's reliance on specialized hardware components like PXI cards and barcode scanners introduces a risk of downtime if any component fails. Unlike manual setups where quick fixes may be possible, automated systems often require expert intervention for troubleshooting and repair. Additionally, regular calibration of measurement instruments and scheduled maintenance are essential to sustain accuracy and prevent performance drift over time. These maintenance routines, if not managed effectively, can interrupt production flow and impact throughput, highlighting the need for proactive maintenance planning and support infrastructure.

VII. FUTURE WORK AND IMPROVEMENTS

The continuous advancement of automotive technologies necessitates ongoing enhancements to testing systems. Future work will focus on increasing system intelligence, flexibility, and accessibility. These improvements aim to streamline operations further, reduce costs, and expand the tester's applicability across diverse automotive platforms.

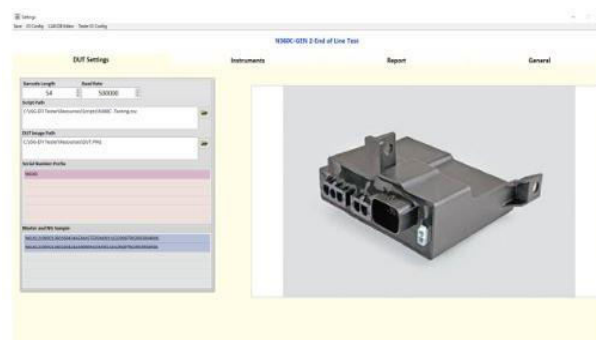


Figure 11-Future Device Settings

A. Enhanced AI-Based Diagnostic Algorithms

Future testing systems can be significantly improved by incorporating artificial intelligence and machine learning algorithms. These technologies can analyze large datasets generated during testing to identify patterns, predict failures, and suggest corrective actions in real time. AI can also learn from historical data to refine test criteria and decision-making over time, thereby increasing the accuracy of diagnostics. By enabling self-learning capabilities, the system becomes more adaptive to new ISG and EFI models and their varying behaviors, reducing false positives and improving fault classification.

B. Expansion to Other Automotive Components

The current testing framework, while designed for ISG and EFI units, can be extended to validate other critical electronic components in vehicles. Systems such as Anti-lock Braking Systems (ABS), Electronic Control Units (ECUs), and various in-vehicle sensors share similar testing needs in terms of accuracy, traceability, and automation. By leveraging the modularity of the PXI platform and the flexibility of LabVIEW software, the setup can be scaled or reconfigured for these components with minimal structural changes. This expansion would promote standardization across testing processes and improve overall quality assurance across the production line.

C. Cloud-Based Data Management and Analytics

To enhance accessibility and scalability, integrating cloud-based data management into the testing framework offers significant advantages. Test results and logs can be automatically uploaded to secure cloud servers, enabling remote access, real-time monitoring, and centralized data storage. Advanced analytics dashboards can be implemented to visualize performance trends, identify recurring faults, and monitor quality metrics across different shifts or production lines. This transition to cloud infrastructure not only improves data traceability and compliance but also supports predictive analytics and decision-making, fostering proactive maintenance and continuous improvement in manufacturing processes.

D. User Interface and Experience Enhancements

Improving the user interface and experience (UI/UX) is essential for ensuring that operators can interact with the test system efficiently and intuitively. Future improvements may include the development of a more streamlined, user-friendly dashboard with real-time visual feedback, guided workflows, and context-based help prompts. Operator alerts, such as color-coded warnings and auditory signals, can enhance response times to issues during testing. Simplified navigation and touchscreen compatibility can further reduce training requirements and minimize the chance of human error, ultimately increasing productivity and operational accuracy.

E. Cost Optimization and Scalable Design

Future improvements will focus on reducing the overall system cost without compromising testing accuracy and reliability. This includes redesigning certain hardware modules with cost-effective alternatives and optimizing the use of PXIe resources. Modular architecture will enable easy expansion or contraction of the tester based on production scale, making it viable for small to mid-size manufacturers. Scalable design also supports future upgrades, allowing additional test features or component compatibility without major infrastructure changes, ensuring long-term adaptability and investment protection.

VIII. CONCLUSION

The development of an Integrated Starter Generator (ISG) and Electronic Fuel Injection (EFI) Tester represents a significant advancement in automotive testing methodologies. By integrating National Instruments' PXIe-1084 chassis, barcode-based traceability, and LabVIEW-controlled automation, the system delivers high accuracy, consistency, and efficiency across production lines. Automated diagnostics, real-time monitoring, and data logging not only enhance product quality but also streamline the workflow, reduce human error, and support predictive maintenance strategies. The modular and scalable architecture allows for future expansion to accommodate additional automotive components and integration with modern Industry 4.0 practices. While there are challenges such as high initial costs and the need for skilled personnel, the long-term benefits in quality assurance, traceability, and throughput make this solution a valuable asset. Continuous improvement through AI integration, cloud analytics, and user experience upgrades promises to further elevate the capabilities and impact of this advanced testing platform in the automotive sector.

REFERENCES

- [1] Agarwal, R. K. (2017). *Automobile Engineering*. Khanna Publishers.
- [2] Bissell, D. (2019). *Real-Time Systems Design and Analysis: Tools for the Practitioner*. Wiley.
- [3] Bosch Automotive Handbook. (2022). Robert Bosch GmbH, 10th Edition.
- [4] Chanchal, D. & Kumar, R. (2020). "Automation in Automotive Testing Using LabVIEW," *International Journal of Engineering Research & Technology*, 9(5), pp. 120–125.
- [5] Ganesan, V. (2012). *Internal Combustion Engines*. McGraw-Hill Education.
- [6] Kapoor, K. (2021). "Smart Testing Systems for Automotive ECUs," *Journal of Automotive Electronics*, 14(3), pp. 88–96.
- [7] Kumar, S., & Verma, P. (2020). "Modern Trends in Automotive Diagnostics," *International Journal of Scientific Research in Engineering*, 8(6), pp. 45–49.
- [8] LabVIEW User Manual. (2021). National Instruments Corporation.
- [9] NIPXIe-1084 Chassis Datasheet. (2023). National Instruments.
- [10] Prakash, M., & Singh, R. (2022). "Role of Automation in Reducing Production Downtime," *Manufacturing Review*, 10(2), pp. 61–67.
- [11] Rajput, R. K. (2013). *A Textbook of Automobile Engineering*. Laxmi Publications.
- [12] Saxena, A. (2020). "Integration of PXI Systems in Modern Manufacturing," *Industrial Automation Journal*, 27(8), pp. 74–80.
- [13] Sharma, T. & Gupta, M. (2021). "Traceability in Automotive Assembly Lines," *International Journal of Quality Assurance in Engineering*, 11(1), pp. 19–26.
- [14] Singh, R. (2018). *Automotive Mechanics*. Tata McGraw-Hill Education.
- [15] Srinivasan, S. (2023). "Predictive Maintenance in Automated Test Equipment," *Engineering Review Letters*, 15(4), pp. 33–39.



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