

EMC in Malaysia: The First 10-Meter Semi-Anechoic Chamber (SAC) — Inception, Approach and Challenges

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Abstract— In this paper, we provide an insight to the inception and approach used in the establishment of Malaysia’s first public Electromagnetic Compatibility (EMC) Laboratory that is equipped with a 10-meter test range semi-anechoic chamber (SAC), and the challenges of EMC development in Malaysia. The PSDC EMC Laboratory, pioneered by Khazanah Nasional Berhad (a Government investment arm), PSDC (a non-profit society) and Cisspr Sdn. Bhd. (an entrepreneur enterprise), is a Malaysian government initiative to invest 30 million ringgit to establish a Shared Services Centre in Penang Skills Development Centre (PSDC). As the Electrical and Electronics (E&E) industry in Malaysia shifted from the lower value-added assembly and machining, to the higher value-added activities in test, manufacturing, and design and development (D&D), EMC test and measurement capability is vital to meet global regulatory compliance requirements in creating a situation of functional and safe operation in a common electromagnetic environment. A tri-partite approach was used to establish PSDC EMC Laboratory from concept to reality, based on well-defined objectives, voice of the industry, state-of-the-art test systems, competent people and internationally recognized ISO/IEC 17025 accreditation.

1. INTRODUCTION

Electrical and Electronics (E&E) sector is a significant contributor to Malaysia’s national economy, accounting for 37 billion ringgit in gross national income (GNI) which is 6 percent of national GNI, 522,000 jobs and 41 percent of Malaysia’s total exports in 2009 [1]. The E&E sector has been identified as one of the 12 National Key Economic Areas (NKEAs) as key growth engines of the nation’s economic performance, under Malaysian government’s New Economic Model as a comprehensive effort to transform Malaysia into a developed high-income nation by 2020.

In 1972, Malaysia’s first Free Industrial Zone (FIZ) was set up in Penang to promote and facilitate the development of export-oriented electronics manufacturing. The first eight multinational corporations (MNC) in the E&E industry which set up offshore bases on the island in 1970s are Advanced Micro Devices Products, Agilent Technologies, Clarion, Fairchild Semiconductor, Hitachi Semiconductor, Intel, Osram Opto Semiconductor and Robert Bosch [2]. These anchor companies played a crucial role in seeding the growth and development of the nation’s industry, by spurring local small and medium enterprises (SME) and acting as magnets for other major firms to invest in the country.

Malaysia has undergone intensive industrial and technological transformation over the past 40 years, from labor-intensive assembly and machining, into high technology, skilled, capital-intensive test and manufacturing operations, and design and development (D&D), which significantly contributes to the nation’s technological enhancement and talent development. Today, Penang is known as the “Silicon Valley of the East” [3].

2. INCEPTION

The rapid growth of Malaysia’s E&E industry and the necessity to enable global market access created the need for EMC test facilities that can fulfill global regulatory compliance requirements. Prior to this, there was no publicly available EMC test facility with a compliant 10-meter semi-anechoic chamber (SAC) in the country. Companies that require the test facility have to either send their products abroad for EMC testing or to build their own test facility. Sending their products abroad incurs extraneous transportation cycle time, high expenditure, loss of engineering design efficiency, while building their own test facility is simply too cost prohibitive.

In the effort to bridge this missing link, the Malaysian government took the initiative to invest 30 million ringgit to establish a Shared Services Centre in Penang Skills Development Centre (PSDC), which houses Malaysia’s first public Electromagnetic Compatibility (EMC) Laboratory equipped with a 10-meter semi-anechoic chamber.

The objectives of setting up this EMC test facility are threefold. First, it is to strengthen the existing D&D ecosystem. Second is to support talent development for MNCs and local SMEs. Third

is to provide state-of-the-art testing services to foster the growth of the nation's E&E industry. For local firms, the provision of this testing capability becomes an enabler for product design. For multinational companies, it is an extension of their in-house capacity.

By providing a locally accessible public test facility, this Malaysian government enabled project will boost business confidence, minimize outflow of currency abroad for EMC testing services, and attract more foreign investments into the nation. Malaysia stands to save on a potential outflow of at least RM3.2 million a year with the establishment of this test facility [4].

PSDC was selected for this mission due to its strategic role in promoting shared learning, accelerating talent development, strategic locality right in the heart of the Bayan Lepas Free Industrial Zone, and a large portfolio of members comprising of over 150 local and multinational companies.

3. APPROACH

3.1. Tripartite Approach

To pioneer this initiative, the Malaysian government took a tripartite approach, involving Khazanah Nasional Berhad (a Government investment arm), PSDC (a non-profit society) and Cisspr Sdn. Bhd. (an entrepreneur enterprise).

Khazanah Nasional Berhad is the investment holding arm of the government of Malaysia and is empowered to nurture the development of new industries and markets [5]. PSDC is a non-profit training and educational centre built on a tri-partied partnership model between the Government, Industry and Academia that embodies a dynamic and sustainable human capital development institution [6]. Cisspr Sdn. Bhd. is a premier test services and solutions provider in Malaysia, engaged to setup, operate and manage the daily operations of the PSDC EMC Laboratory and bring it to international recognition through ISO/IEC17025 accreditation [7].

This unique KHAZANAH-PSDC-CISSPR partnership fits seamlessly into the tripartite model, with KHAZANAH facilitating government capital funding, PSDC providing operational seed funding and laboratory building, and CISSPR offering EMC subject matter expertise and laboratory management.

3.2. Voice of the Industry

As this is an industry-driven initiative designed to serve the needs of the industry, a strong voice from the industry is crucial. To provide this voice, an EMC Expert Group was formed with representatives from diverse industries, ranging from audio-video, automotive, embedded systems, lighting, power tools, telecommunications to test and measurement. It includes MNCs and SMEs such as Aemulus, Affinex Technology, Agilent Technologies, Blaupunkt, Robert Bosch, Ceedtech Technology, Motorola Solutions and Sony. The Expert Group proved to be an effective steering committee that helps in defining appropriate specifications for the laboratory and ensures that industry requirements as well as national, regional and international standards are met.

3.3. Test Systems

3.3.1. Selection

In order to achieve a fine balance between the needs of the industry with the latest technical requirements of the standards and the constraints of the allocated budget, the laboratory engaged one competent, experienced and internationally recognized turn-key solutions provider with a reputable track record to provide a complete solution for the entire test systems, incorporating system integration, calibration and training.

Using this approach, an invitation was sent to several renowned professional EMC test solutions providers to submit their proposals for review and evaluation by the Expert Group. Selection was based on a number of criteria, such as technical specifications of the chambers, compliant test equipment and software, quality and reliability, calibration and maintenance, technical training, customer service and support, cost, delivery time, etc.

3.3.2. Setup

PSDC EMC Laboratory was setup to offer a comprehensive range of EMC testing to meet the requirements of various industries. It comprises of five main test systems designed to support over 50 national, regional and international standards. This is defined in Table 1.

3.3.3. Site Validation and System Verification

Upon completion of the construction of the anechoic chambers and shielded enclosures, a competent, experienced and internationally recognized site validation test provider was engaged to

Table 1: Types of test systems.

Test System	Test Measurement	Industry
10 m Semi-Anechoic Chamber (SAC)	Radiated Emissions	<ul style="list-style-type: none"> • Automotive Components • Broadcast Receivers and Associated Equipment • Electrical Equipment for Measurement, Control and Laboratory Use • Household Appliances • Industrial, Scientific, and Medical (ISM) • Information Technology Equipment (ITE) • Land Mobile Radio (LMR) <ul style="list-style-type: none"> • Lighting • Medical
3 m Compact Anechoic Chamber (CAC)	Radiated RF EM Field Immunity	
Electrostatic Discharge (ESD)	Electrostatic Discharge	
Conducted Emission (CE)	Conducted Emissions; Harmonic Current Emissions; Voltage Changes, Fluctuations & Flicker	
Conducted Immunity (CI)	Conducted RF Fields Disturbances; Electrical Fast Transient / Burst; Surge; Voltage Dips, Short Interruptions & Voltage Variations; Power Frequency Magnetic Field	

Table 2: Site validation measurements.

Measurement	Standard	Frequency Range
Shielding Effectiveness (SE)	EN 50147-1	10 kHz–40 GHz
Normalized Site Attenuation (NSA)	ANSI C63.4, CISPR 16-1-4	30 MHz–1 GHz
Site Voltage Standing Wave Ratio (SVSWR)	CISPR 16-1-4	1 GHz–18 GHz
Field Uniformity (FU)	IEC 61000-4-3	80 MHz–18 GHz

perform site validation for the laboratory as a test site qualification. System verification was conducted by proficient laboratory staff to ensure test equipment and software are capable to meet standard specifications as a complete test system. This includes ambient noise and reference source measurement, test pulse verification, as well as field calibration and verification. All test equipment are calibrated by competent ISO/IEC 17025 accredited calibration provider to assure test data accuracy and traceability. Site validation and system verification are crucial to ensure test results produced are valid and repeatable. Table 2 shows a list of validation measurements that were carried out.

3.4. People

Commissioning the first public EMC laboratory in Malaysia equipped with a 10-meter semi-anechoic chamber, furnished with hundreds of new equipment capable to support over 50 test standards, and bring it from ground zero to an internationally recognized level is tremendously challenging. Engaging the right people, with the right expertise, experience and dedication is the key to success.

To startup requires a highly competent Technical Manager with a team of Test Engineers and Specialists, well versed in the latest EMC test methods, systems and standards, including hardware, software, calibration, validation, verification and troubleshooting capabilities. This is crucial to overcome all the technical hurdles faced during the startup phase, and to keep laboratory up-to-date with the latest EMC requirements.

To bring it to the next level for international recognition the laboratory requires a proficient Quality Manager, well versed in the demand of ISO/IEC 17025 Quality Management System, with the experience, knowledge and skills of setting up a new quality system, managing document control, management reviews, audits, training, etc. and finally achieving ISO/IEC 17025 accreditation by an internationally reputable accreditation body.

The laboratory organization was structured with minimum hierarchy layers to reduce complexity, maximize learning and people development. Roles and responsibilities are clearly defined, covering both technical and quality areas. Figure 1 illustrates the laboratory organization structure.

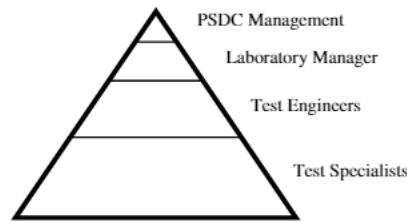


Figure 1: PSDC EMC laboratory organization structure.

- **PSDC Management:** Responsible to allocate sufficient funding and resources to ensure high quality, continuous improvement and an effective ISO/IEC 17025 laboratory management system.
- **Laboratory Manager:** Responsible to manage overall laboratory operations, and ensure laboratory remains in compliance with ISO/IEC 17025 standard requirements.
- **Test Engineers:** Responsible to understand customer requirements, to develop test plans and ensure testing performed fulfill standard and customer requirements.
- **Test Specialists:** Responsible to perform testing in accordance with test plan and laboratory procedures.

3.5. Accreditation

PSDC EMC Laboratory is ISO/IEC-17025 accredited by the American Association for Laboratory Accreditation (A2LA). The laboratory received the ISO/IEC-17025 accreditation certificate from A2LA on 5th January 2012, with certificate number 3185.01. Achieving accreditation to this international standard is proof that the laboratory has demonstrated its technical competency to produce valid and accurate test results. This allows the laboratory to provide compliance EMC testing for type approvals, and pre-compliance testing for prototype evaluations. The laboratory's accredited test reports are recognized worldwide for E&E products or components which are locally-designed and set for export to the European and US markets [8].

A2LA was chosen as the laboratory's accreditation body owing to its international recognition, high reputation and signatory to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). These agreements facilitate the acceptance of test reports between various governmental and regulatory organizations on national, regional and international levels and ensure test results meet the same minimum standards for quality regardless of the laboratory's accreditation body.

4. CHALLENGES

While the rise of emerging technologies is desirable and essential to bring advancement to the modern world, it poses an increased challenge to the field of electromagnetic compatibility compliance. The following are the challenges faced by the EMC testing laboratories and design engineers in Malaysia.

Standard Requirements — One of the major challenges today for EMC laboratories is in managing and keeping up-to-date with the latest test standards. Changes are rapid, mainly driven by the accelerated development of E&E industry, in particularly multimedia and wireless technologies. The addition of new EMC requirements, stringent customer specifications and standard up-revisions, require tremendous efforts and financial resources to enhance laboratory test capabilities so that it always remains current.

Inter-laboratory Comparison — Inter-laboratory comparison is crucial to minimize site-to-site variation between laboratories. This is to ensure test results from different laboratories are comparable which in turn ease product design efforts and product quality control when multiple test sites are used. Inter-laboratory comparison activities between laboratories should be encouraged and conducted at regular interval.

Standards Harmonization — To date, EMC standards are still not fully harmonized in all regions of the world. This leads to a significant increase of time, effort and cost to perform multiple testing on the same product to cater for different standards in the effort to enable global market access. The process to achieve EMC compliance can be daunting and perplexing, especially for those who are new to EMC. Further standard harmonization efforts at international level will definitely benefit the industry.

EMC Community — An EMC Community comprises of various industry players in providing a common platform for EMC technical knowledge sharing and exchange will enhance EMC awareness, as well as to strengthen EMC expertise in the nation. Active involvements and strong commitments from diverse EMC industry players are indispensable for the realization and success of such community.

5. CONCLUSIONS

The tri-partite approach used proved to be very successful based on the laboratory's outstanding achievement to establish the laboratory from concept to reality in a mere two-year period, as depicted in the following roadmap. The realization of the PSDC EMC Laboratory as the country's first public EMC Laboratory furnished with a 10-meter semi-anechoic chamber represents a significant milestone in Malaysia's EMC development.

- **Mar 2009:** Industry roundtable held.
- **Apr 2009:** EMC Expert Group formed.
- **May 2009:** Grant of 30 million ringgit announced by Tan Sri Nor Mohamed Yakcop, Minister in the Prime Minister's Department.
- **Nov 2009:** Building construction began.
- **June 2010:** Building construction completed.
- **Aug 2010:** EMC anechoic chambers ready.
- **Oct 2010:** PSDC EMC Laboratory launching by Tan Sri Nor Mohamed Yakcop.
- **Nov 2010:** Laboratory started trial testing.
- **Jan 2011:** Laboratory started pre-compliance testing services to serve the industry.
- **Jan 2012:** PSDC EMC Laboratory obtained ISO/IEC-17025 accreditation and international recognition. Started offering compliance testing services to serve the industry.

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