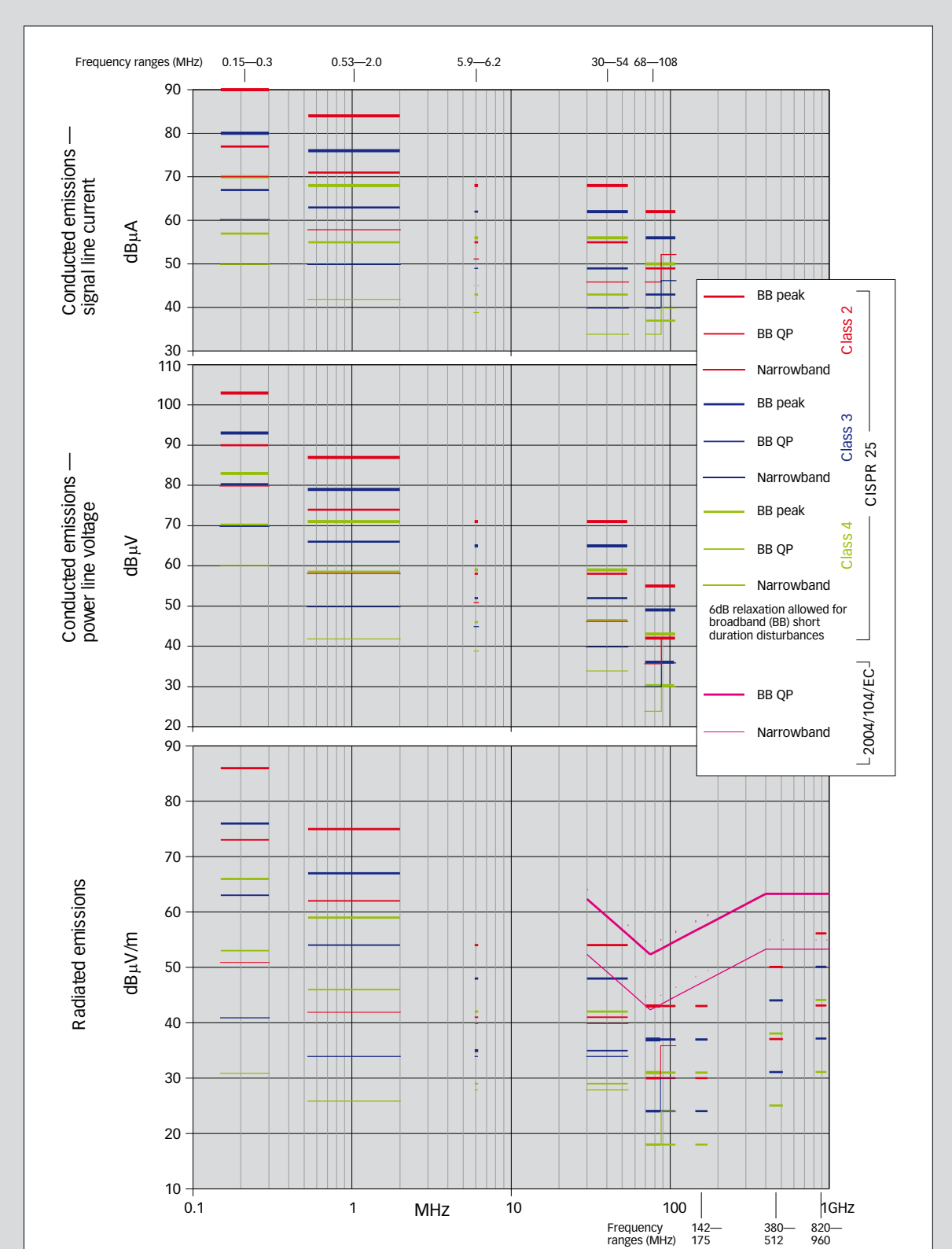
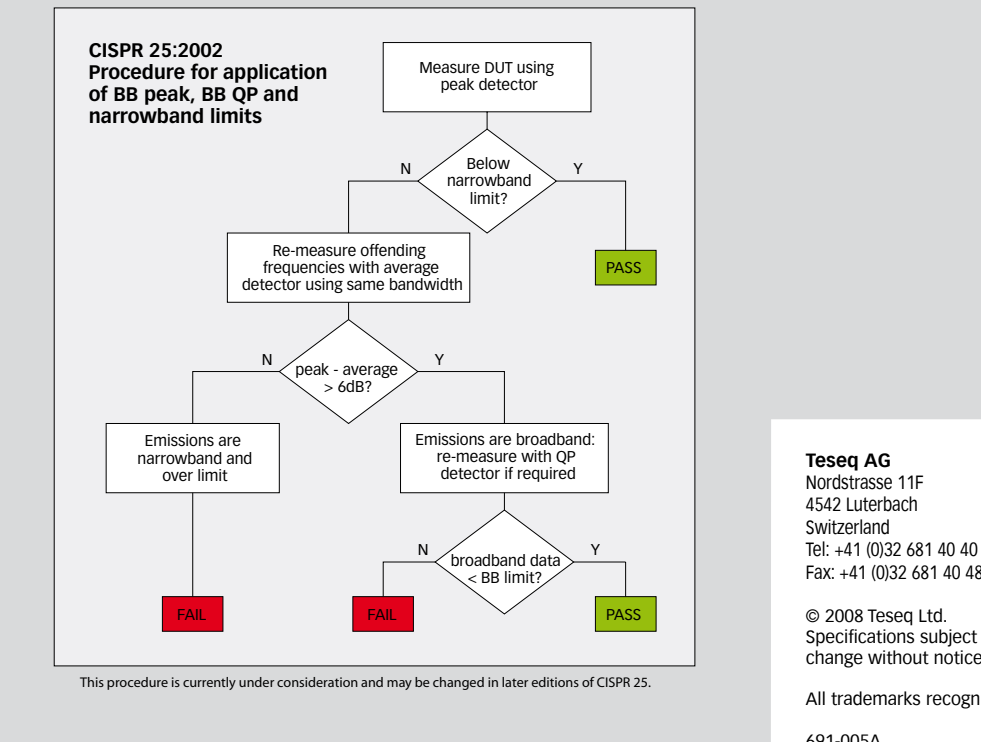
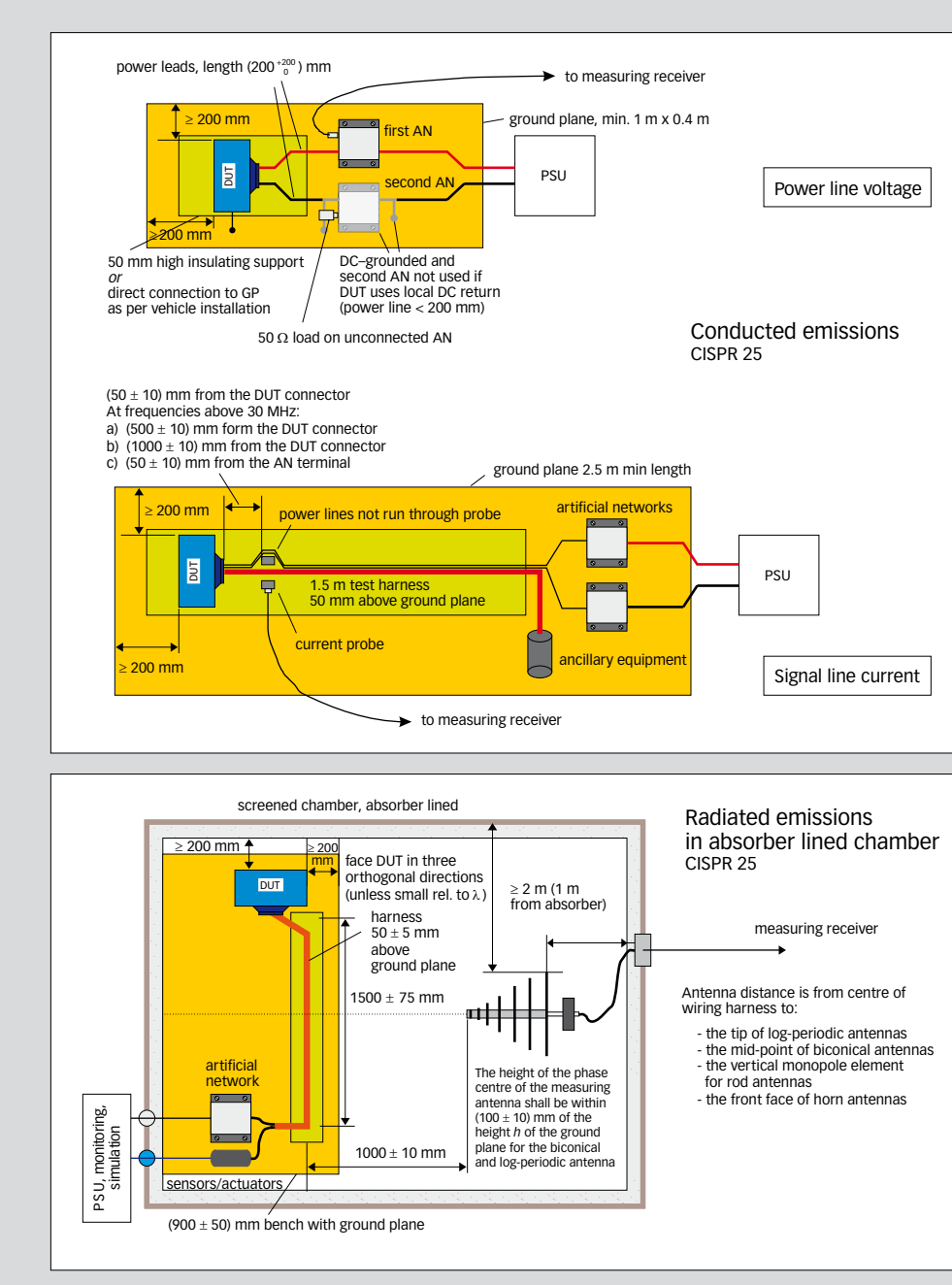


RF Emissions

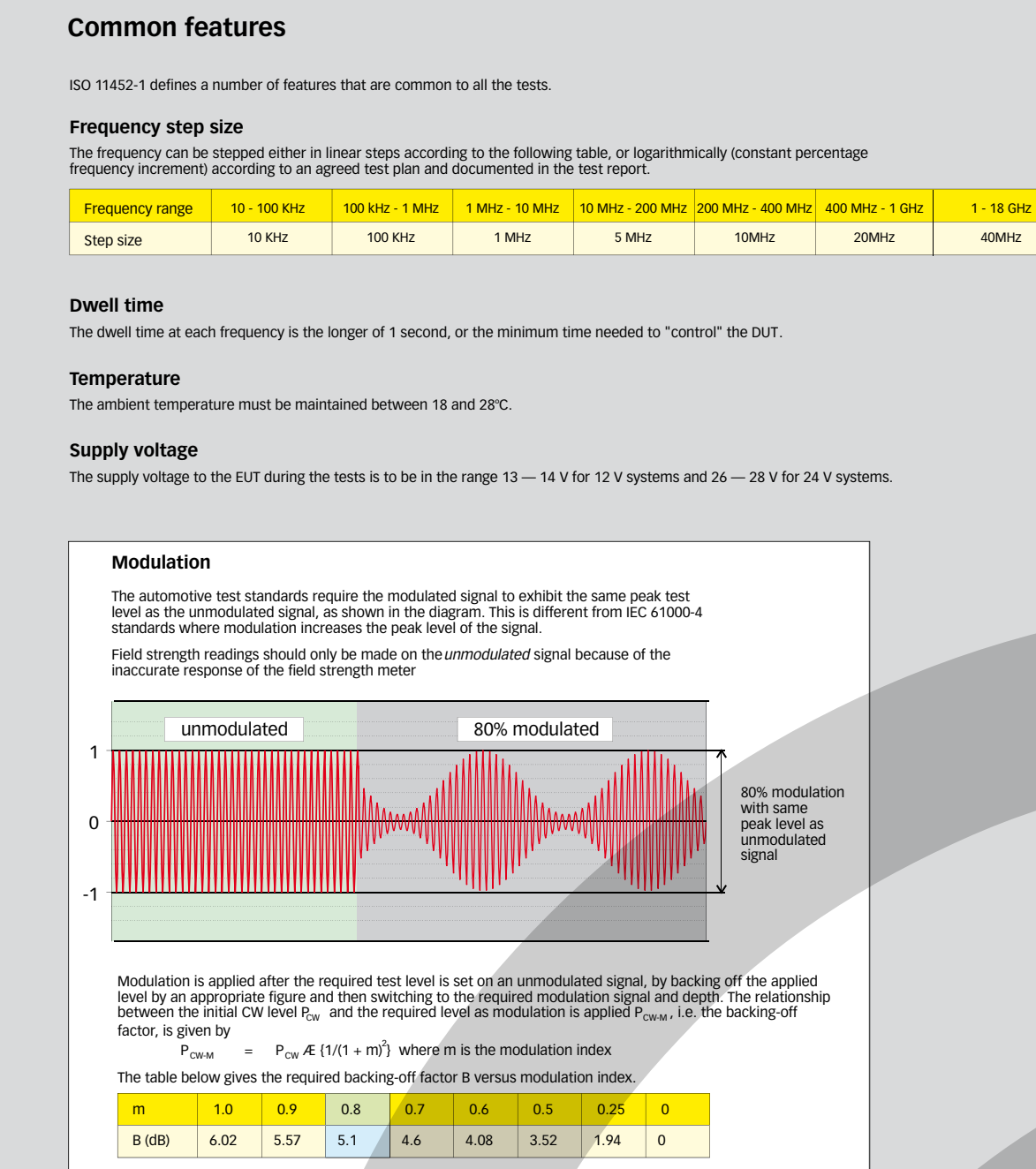


RF emissions: CISPR 25, 2004/104/EC
 RF emissions limits as specified in CISPR 25 and 2004/104/EC. For items only class 2, 3 and 4 of CISPR 25 are shown. The class to be used is for agreement between the vehicle manufacturer and the component supplier.

Tested AG Nordstrasse 11F 452 Lutterbach Switzerland Tel: +41 (0)52 481 40 40 Fax: +41 (0)52 481 40 48

© 2008 Teseq Ltd Specifications subject to change without notice. All trademarks recognised. 671-05A

Free Field Tests



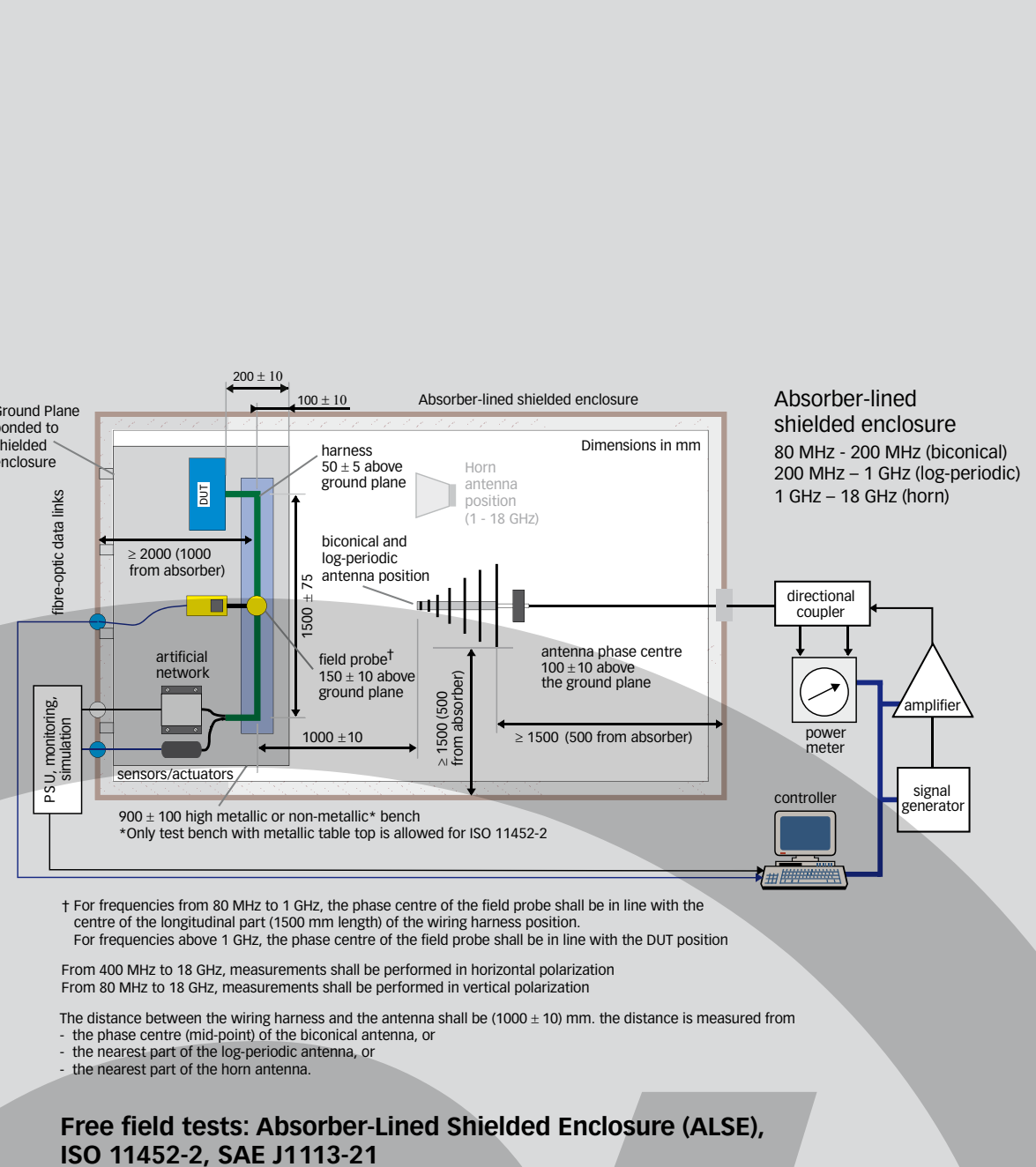
Free field tests: Absorber-Lined Shielded Enclosure (ALSE), ISO 11452-2, SAE J1113-21

Modulation is applied after the required test level is set on an unmodulated signal, by backing off the applied level by an appropriate figure and then switching to the required modulation signal and depth. The relationship between the small CW level P_{small} and the required level P_{mod} is given by the following equation:

$$P_{mod} = P_{small} \cdot 4 \cdot (1 + m^2)$$

where m is the modulation index. The table below gives the required backing-off factor B versus modulation index.

m	1.0	0.9	0.8	0.7	0.6	0.5	0.25	0
B (dB)	6.02	5.57	5.1	4.6	4.08	3.52	1.94	0



Common features
 ISO 11452-1 defines a number of features that are common to all the tests.

Frequency step size
 The frequency can be stepped either in linear steps according to the following table, or logarithmically constant percentage frequency increment according to an agreed test plan and documented in the test report.

Frequency range	10 - 100 kHz	100 kHz - 1 MHz	1 MHz - 10 MHz	10 MHz - 200 MHz	200 MHz - 400 MHz	400 MHz - 1 GHz	1 - 18 GHz
Step size	10 kHz	100 kHz	1 MHz	5 MHz	10 MHz	20 MHz	40 MHz

Dwell time
 The dwell time at each frequency is the longer of 1 second, or the minimum time needed to "control" the DUT.

Temperature
 The ambient temperature must be maintained between 18 and 28°C.

Supply voltage
 The supply voltage to the EUT during the tests is to be in the range 13 - 14 V for 12 V systems and 26 - 28 V for 24 V systems.

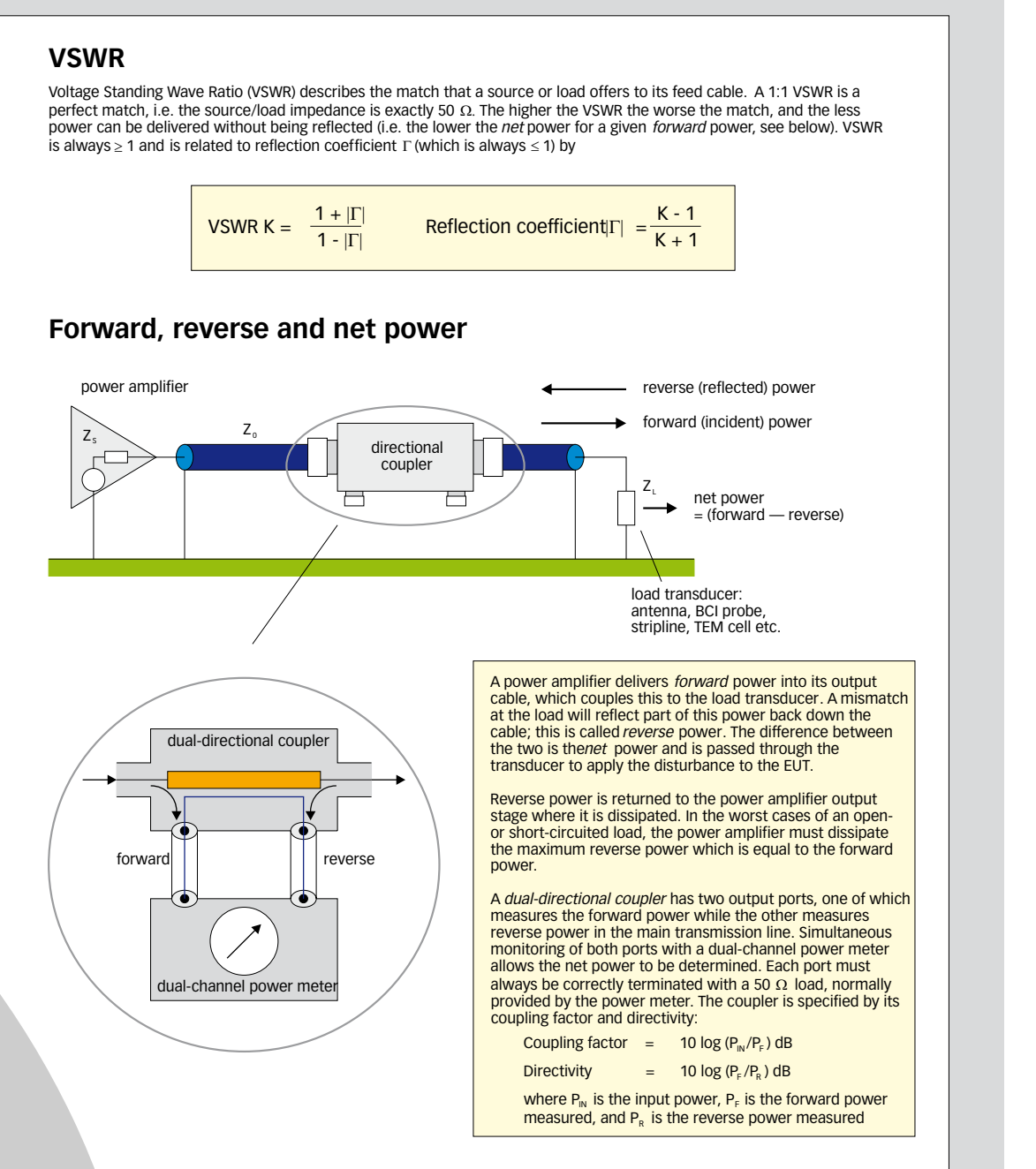
Modulation
 The automotive test standards require the modulated signal to exhibit the same peak test level as the unmodulated signal, as shown in the diagram. This is different from IEC 41000-4 standards where modulation increases the peak level of the signal. Field strength readings should only be made on the unmodulated signal because of the inaccurate response of the field strength meter.

Modulation is applied after the required test level is set on an unmodulated signal, by backing off the applied level by an appropriate figure and then switching to the required modulation signal and depth. The relationship between the small CW level P_{small} and the required level P_{mod} is given by the following equation:

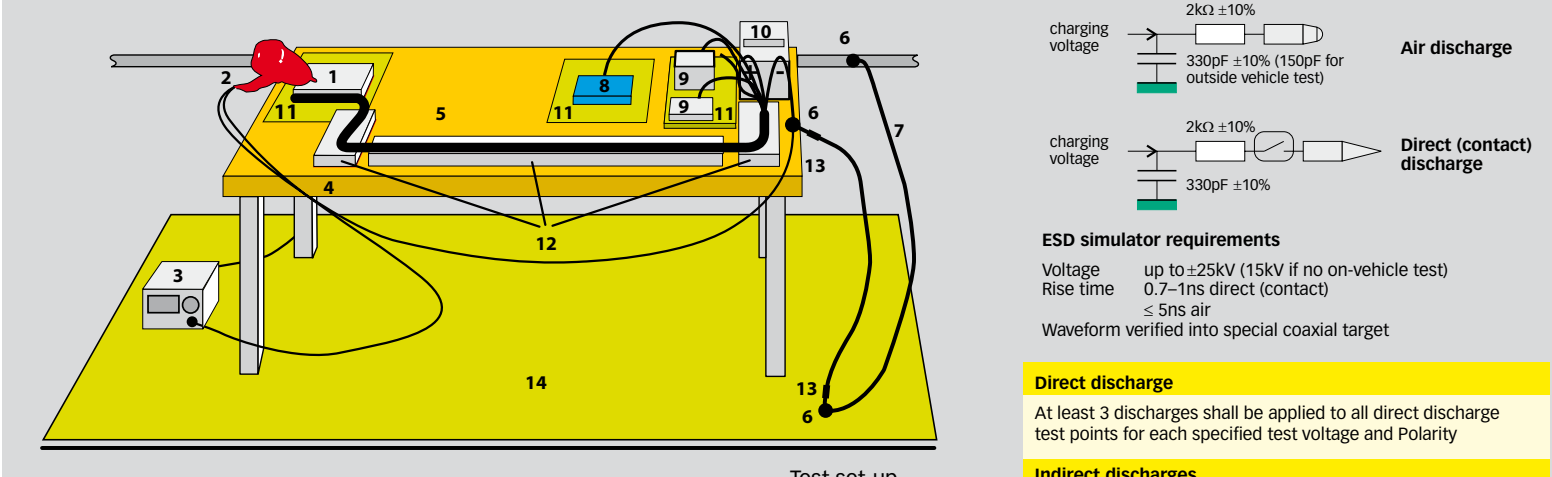
$$P_{mod} = P_{small} \cdot 4 \cdot (1 + m^2)$$

where m is the modulation index. The table below gives the required backing-off factor B versus modulation index.

m	1.0	0.9	0.8	0.7	0.6	0.5	0.25	0
B (dB)	6.02	5.57	5.1	4.6	4.08	3.52	1.94	0



ESD and Transients



ESD simulator requirements
 Voltage: up to 25kV (15kV if no on-vehicle tests)
 Rise time: 0.7-ns direct contact
 5-ns air
 Waveform verified into special coaxial target

Direct discharge
 At least 3 discharges shall be applied to all direct discharge test points for each specified test voltage and Polarity

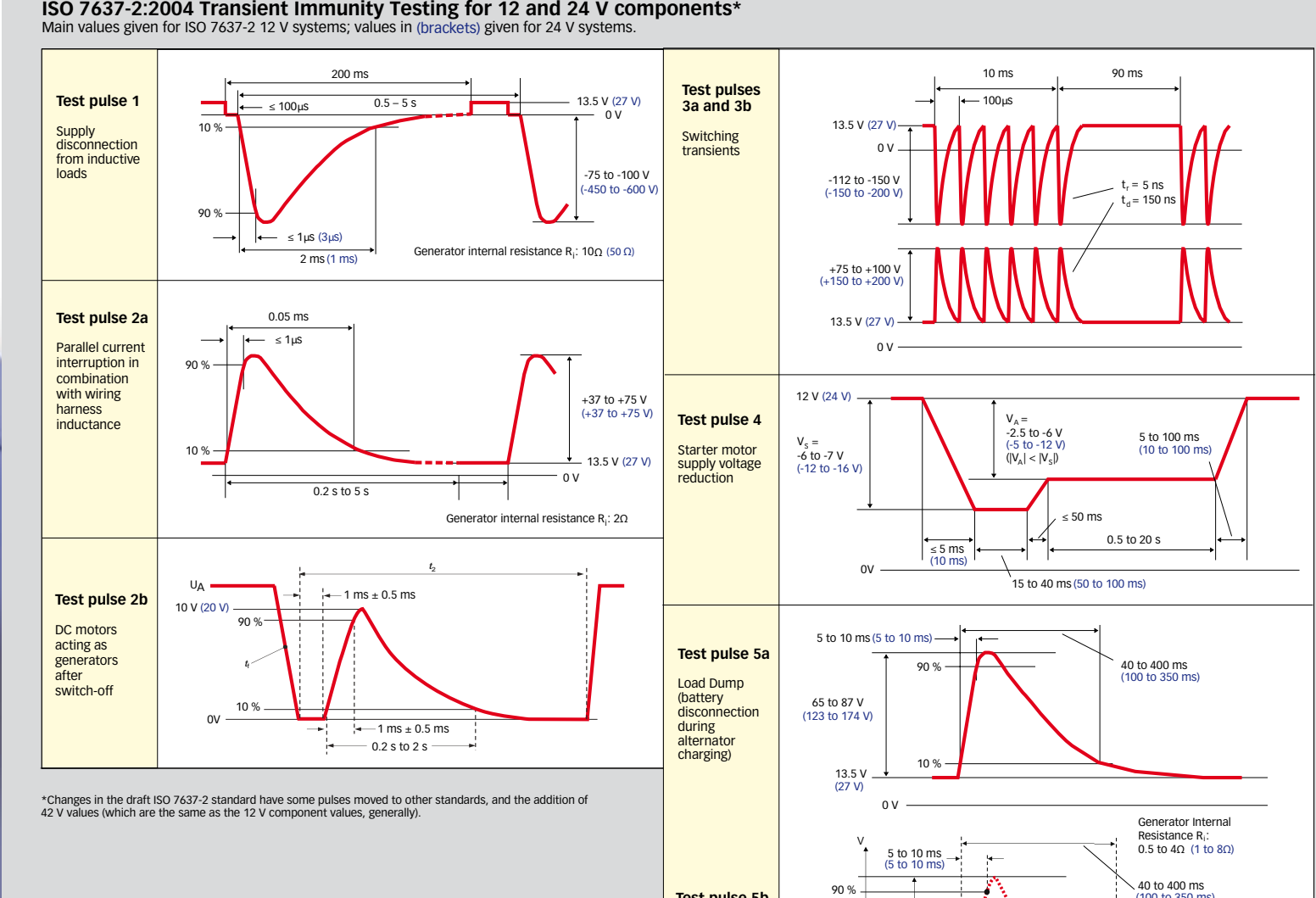
Indirect discharges
 50 discharges shall be applied to all indirect discharge test points for each specified test voltage and Polarity

Speed of approach for air discharge method and angle
 The speed of approach should be between 0.1 - 0.5 m/s for any test. For discharges direct to DUT, the ESD generator's discharge tip is held perpendicular to the surface of the DUT when possible. If not possible an angle of at least 45° to the surface of the DUT is preferred.

Test procedure and requirements:
 Minimum 3 positive and 3 negative polarity discharges at each voltage level, minus 25kV (15kV if no on-vehicle tests)
 direct: all accessible contact discharge points
 indirect: holding probe finger perpendicular to the discharge location, move slowly towards EUT until discharge occurs or contact is made

Test levels

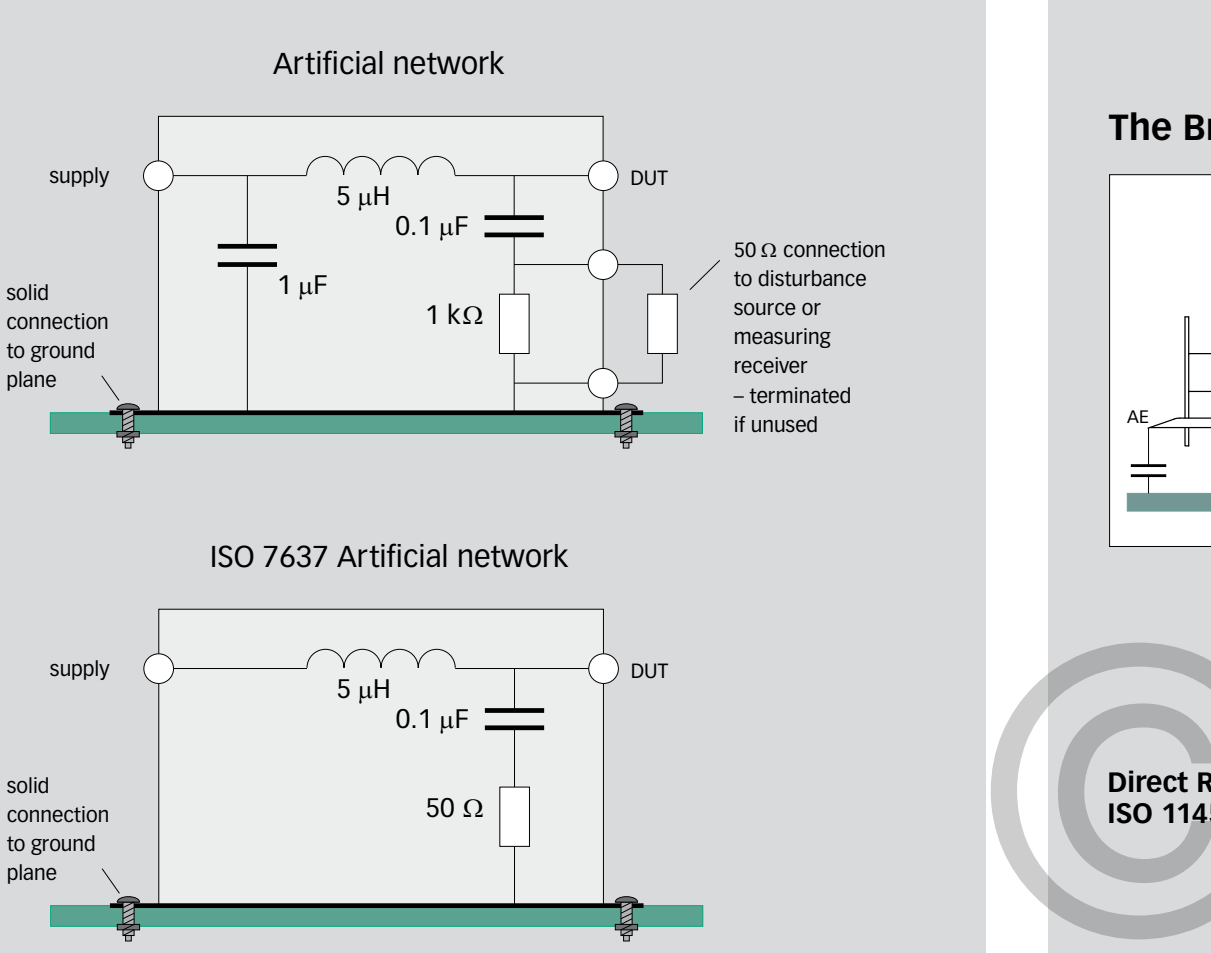
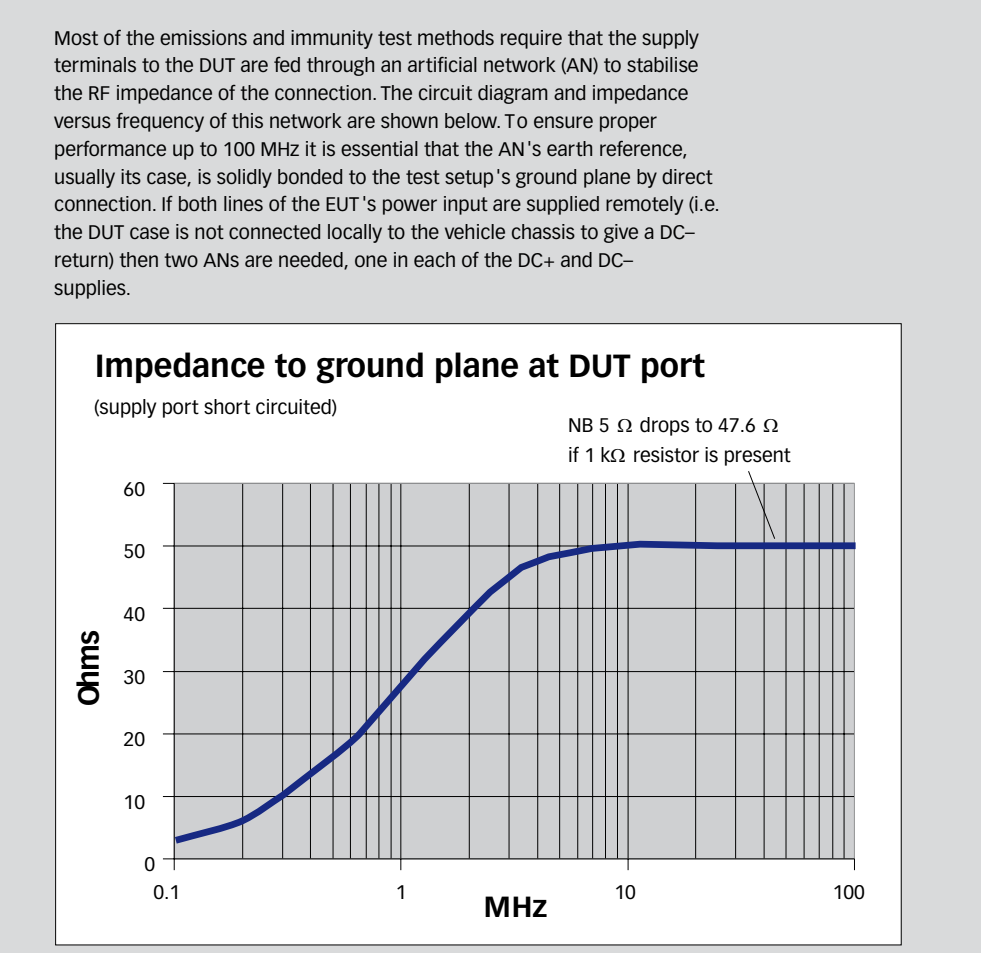
Test level	I	II	III	IV
Direct	±1.5kV	±8kV	±7kV	±8kV
Air	±4.5kV	±18kV	±14kV	±15kV



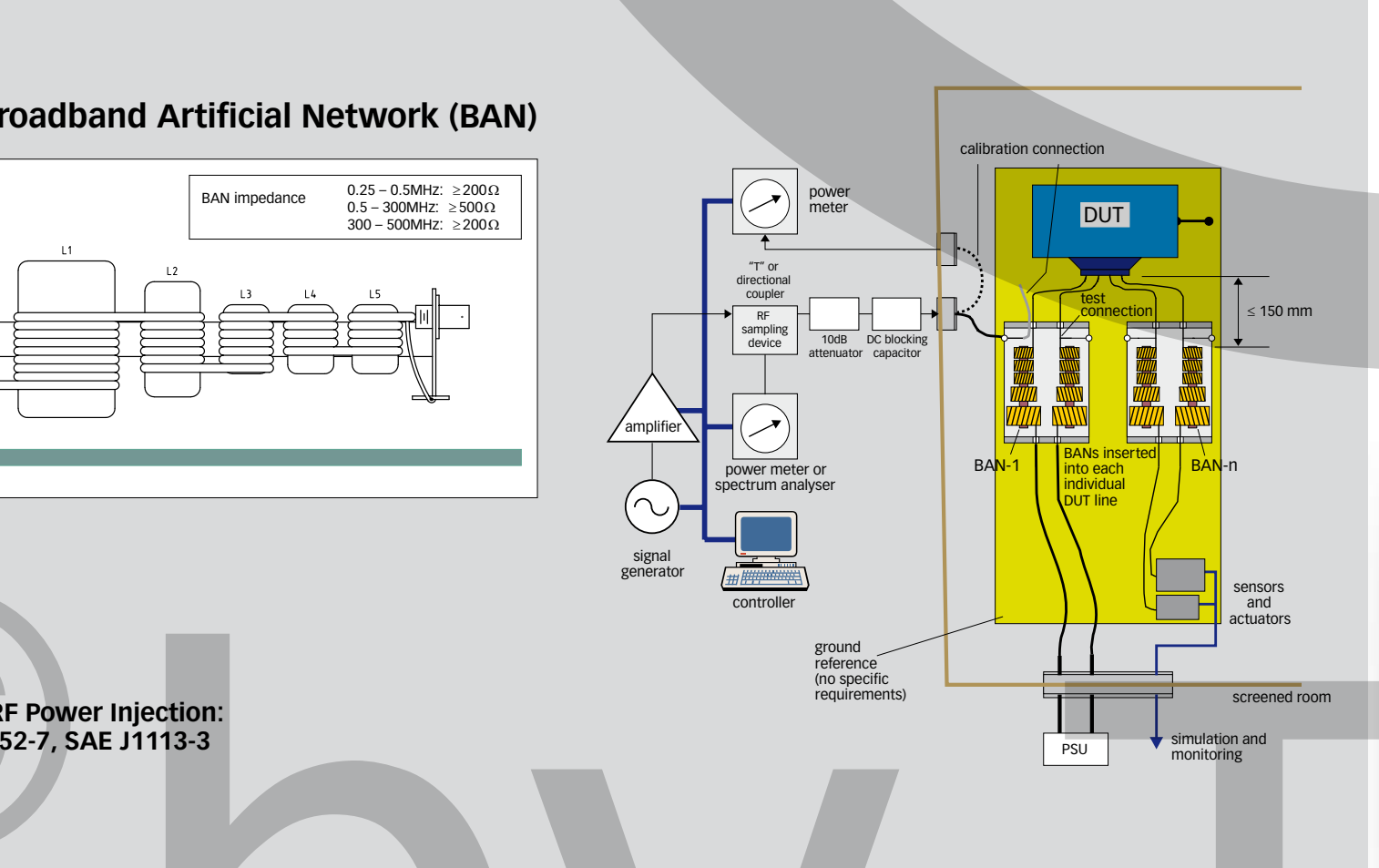
Automotive component testing

3 of a series of wallchart guides

Artificial Network



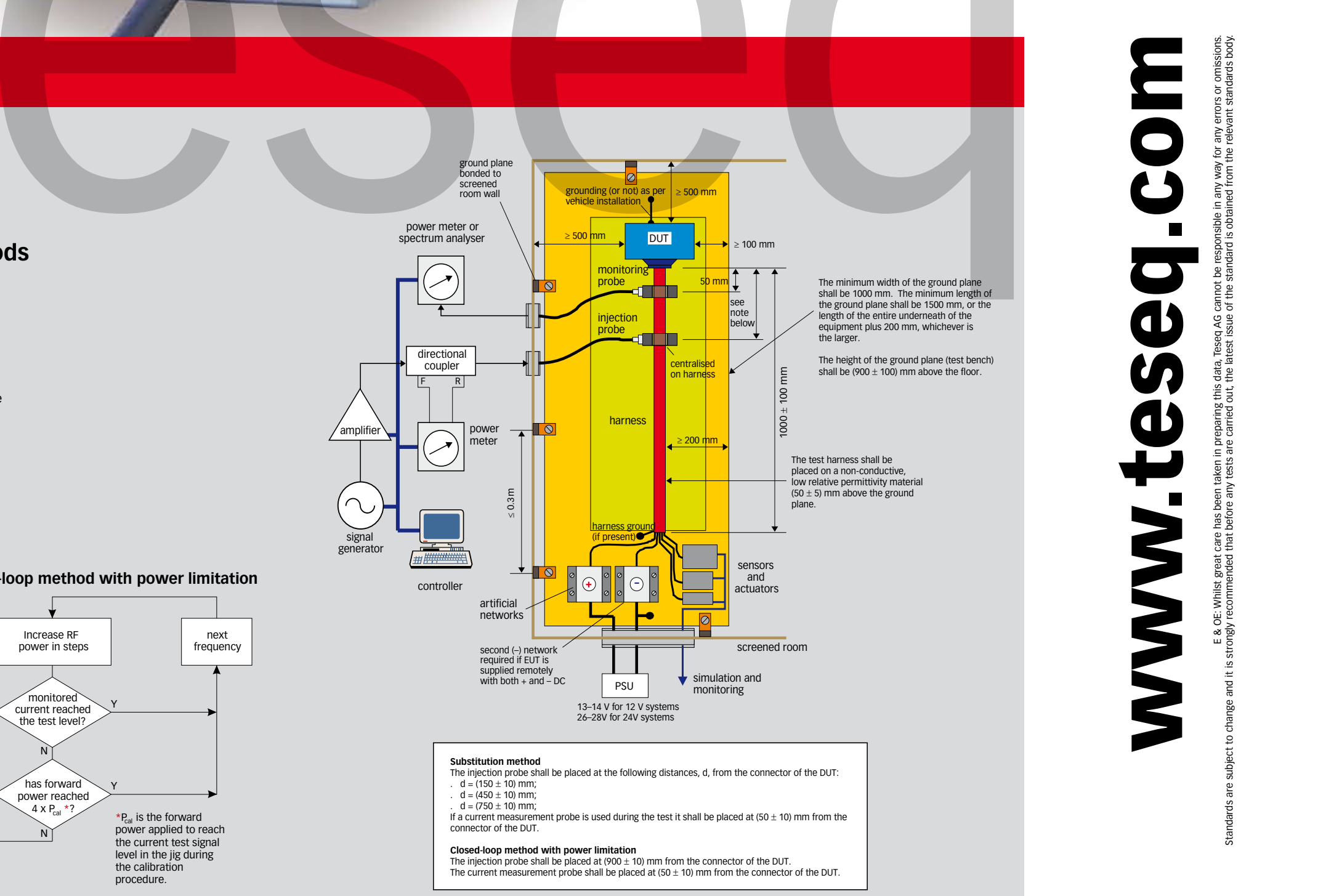
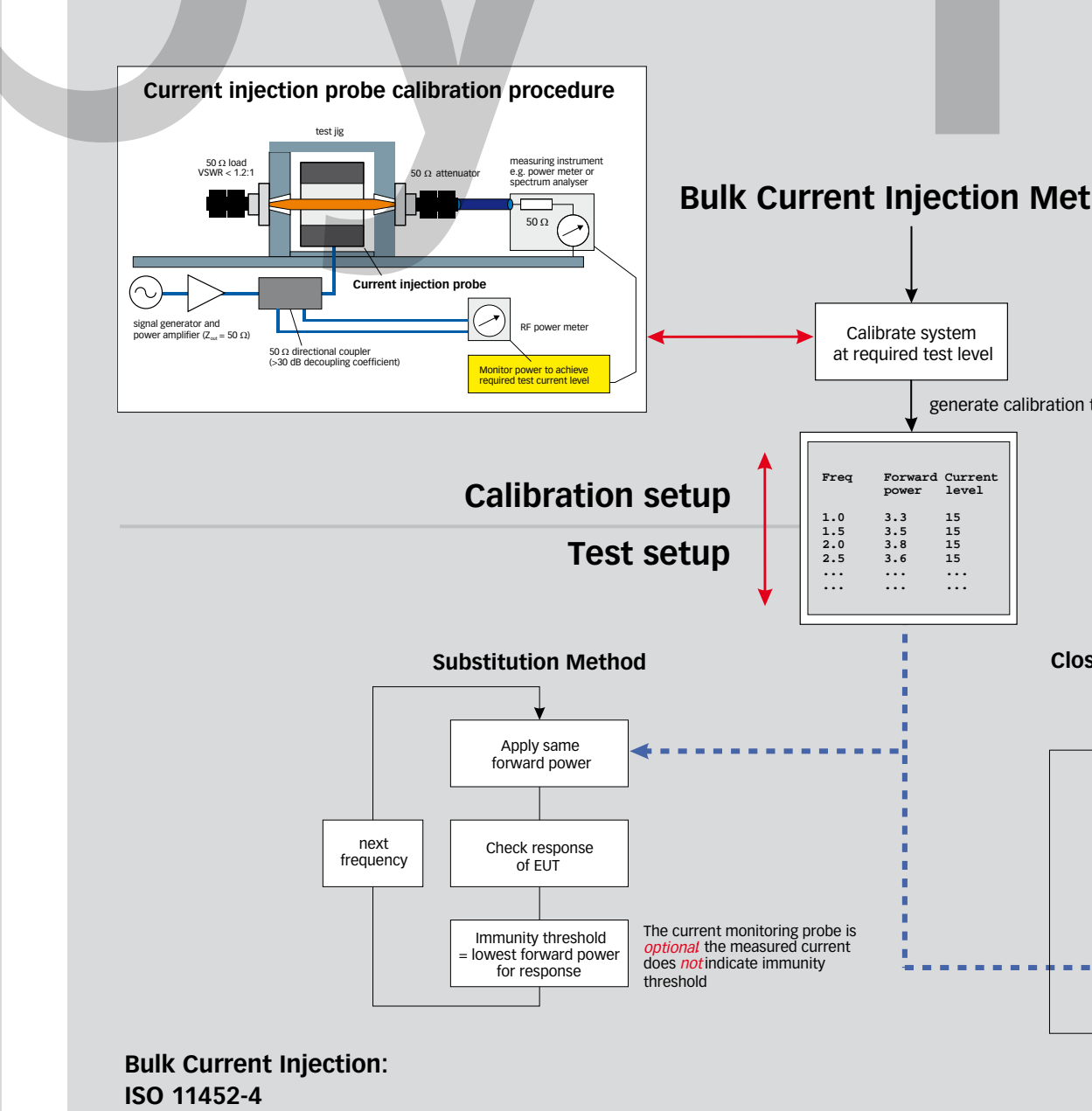
Direct RF Power Injection



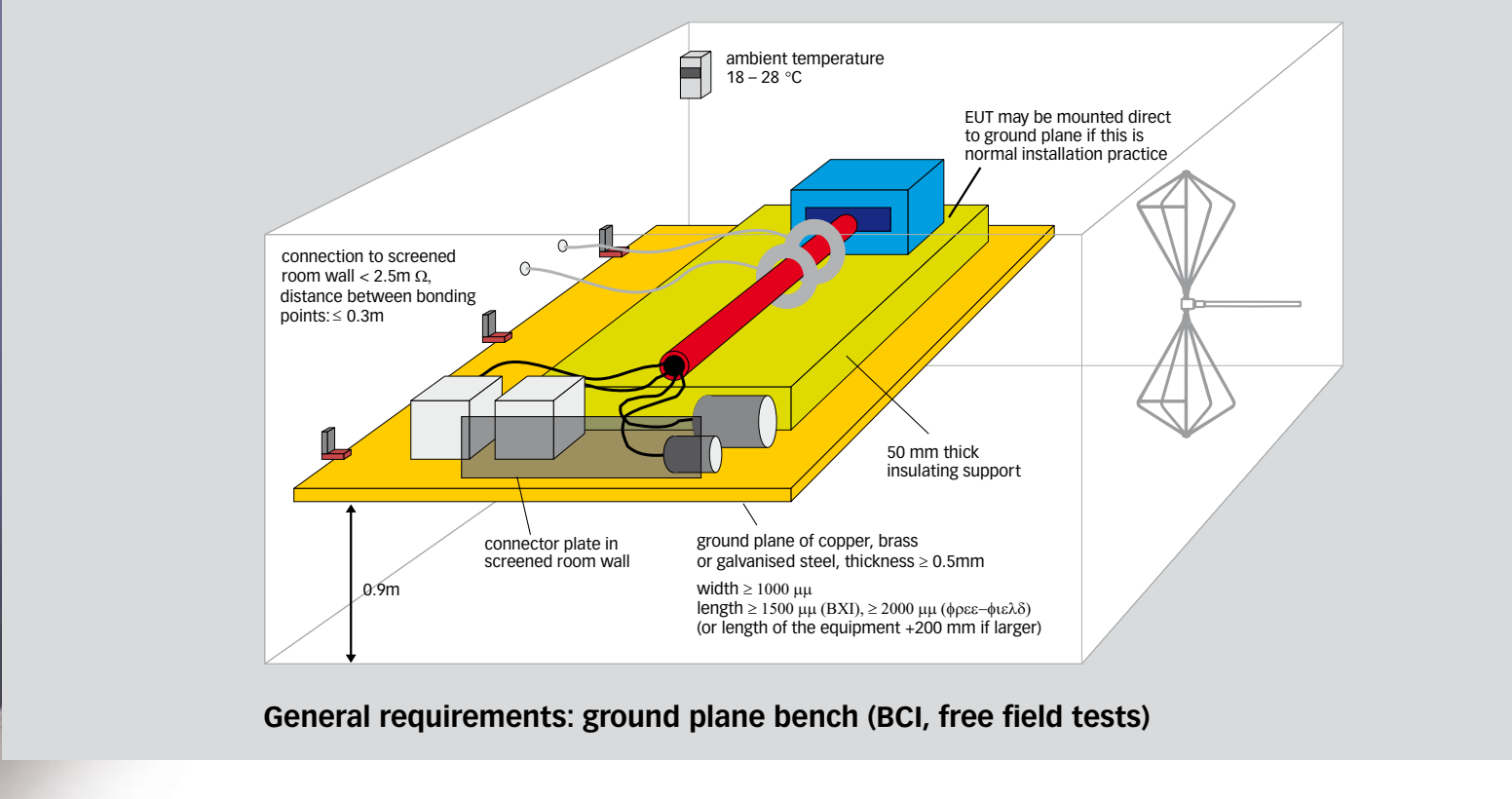
Immunity Standards

Test	Standard	ISO	SAE	2004/104/EC	Requirements
ESD	TR10695	J1113-13		None required	+4,6,7,8 kV - direct (contact discharge), +4,8,14,15 kV - air discharge (extra +25 kV required on vehicle test; test points accessible from outside vehicle)
Transients	ISO 7637-1, -2, -3	J1113-11		Annex X	Voltage pulses on supply and signal lines: inductive load supply disconnection and current interruptors, switching transients, supply voltage reduction, load dump ISO 7637-2 pulses 1, 2a, 2b, 3a, 3b, 4, 5a & 5b ISO 7637-2 pulses 1, 2a, 2b, 3a, 3b & 4
Conducted RF	Direct RF power injection	ISO 11452-7	J1113-3		250 kHz - 400 MHz, 0.1 - 0.2 - 0.3 - 0.4 - 0.5 W 250 kHz - 400 MHz, 0.05 - 0.1 - 0.2 - 0.3 - 0.4 - 0.5 W
	Bulk Current Injection	ISO 11452-4	J1113-4	Annex IX (ISO 11452-4)	1 MHz - 400 MHz, 25 - 50 - 75 - 100 mA 1 MHz - 400 MHz, 25 - 40 - 50 - 60 - 80 - 100 mA 20 MHz - 2 GHz, 60 mA over 90% of the 20 MHz to 2 GHz frequency band, with a minimum of 50 mA at any specific frequency point
Radiated RF	Free field / absorber lined chamber	ISO 11452-2	J1113-21	Annex IX (ISO 11452-2)	80 MHz - 18 GHz, 25 - 50 - 75 - 100 W/m 10 kHz - 18 GHz, 20 - 40 - 60 - 80 - 100 - 150 W/m 20 MHz - 2 GHz, 30 W/m over 90% of the 20 MHz to 2 GHz frequency band, with a minimum of 25 W/m at any specific frequency point
	TEM Cell	ISO 11452-3	J1113-24	Annex IX (ISO 11452-3)	10 kHz - 200 MHz, 50 - 100 - 150 - 200 W/m 10 kHz - 200 MHz, 20 - 70 - 100 - 150 - 200 W/m (TEM Cell is allowable) 20 MHz - 2 GHz, 75 W/m over 90% of the 20 MHz to 2 GHz frequency band, with a minimum of 62.5 W/m at any specific frequency point
	Stripline	ISO 11452-5		Annex IX (ISO 11452-5)	10 kHz - 200 MHz, 50 - 100 - 150 - 200 W/m 20 MHz - 2 GHz* 150 mm stripline - 60 W/m over 90% of the 20 MHz to 2 GHz frequency band, with a minimum of 50 W/m at any specific frequency point 800 mm stripline - 15 W/m over 90% of the 20 MHz to 2 GHz frequency band, with a minimum of 12.5 W/m at any specific frequency point
	Reverberation Chamber	ISO 11452-11 (under development)	J1113-27	J1113-28	J1113-27 (Mode Stir method) - 500 MHz - 2 GHz (200 MHz - 10 GHz Optional), 25 - 40 - 60 - 80 - 100 W/m J1113-28 (Mode Tuning method) - 400 MHz - 18 GHz, 25 - 40 - 60 - 80 - 100 W/m
	Magnetic Field	ISO 11452-8	J1113-22		15 Hz - 150 kHz, 0.3 - 1000 A/m 15 Hz - 30 kHz, 20 - 30 - 40 - 50 - 80 - 100 µT

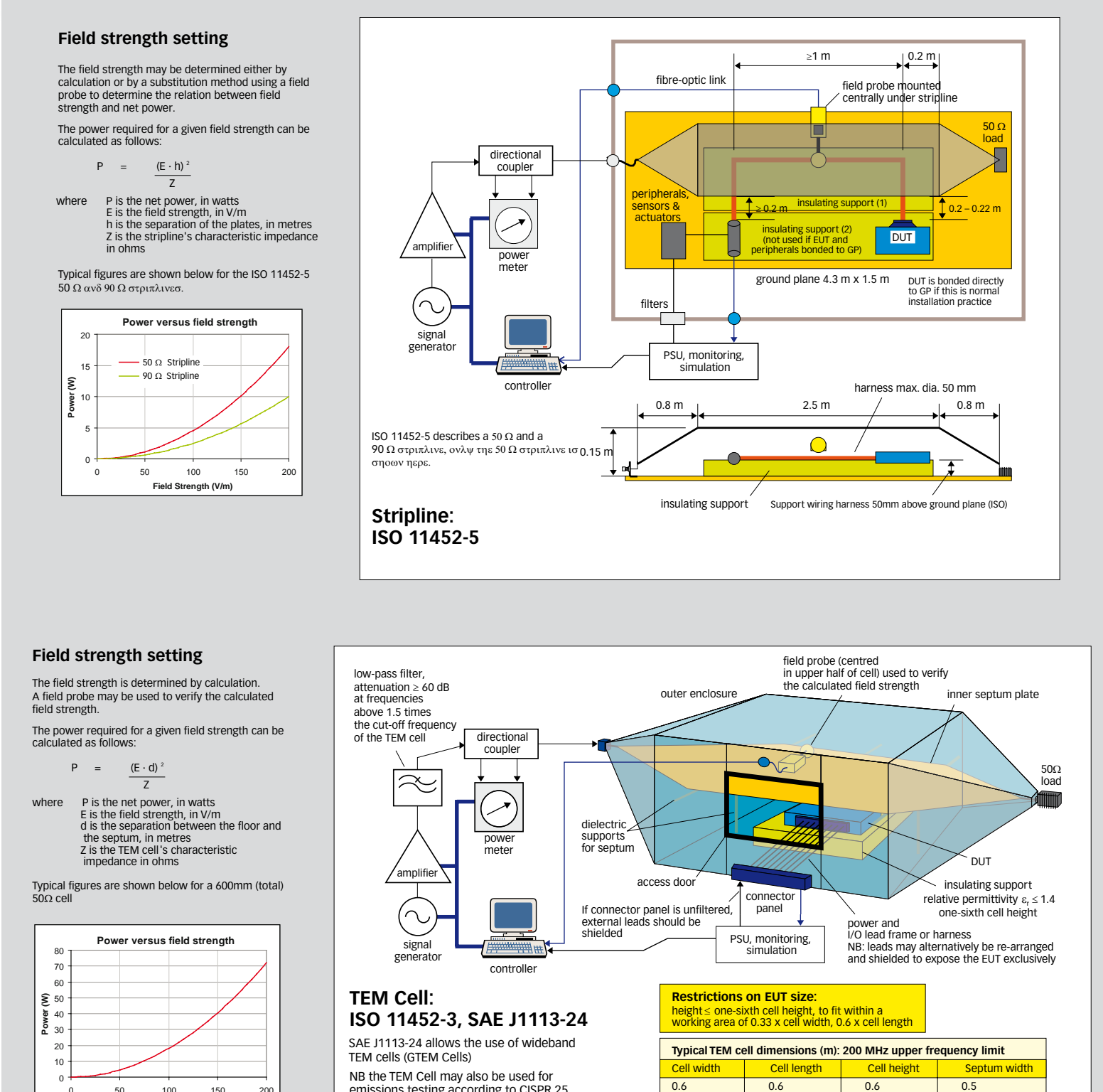
Bulk Current Injection (BCI)



Ground Plane Bench



TEM Cell and Stripline



www.teseq.com