

# R&S® TMU9 Transmitter System System Manual



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For information only!  
This manual, dated December 19,  
2012, reflects the technical status as of  
that date. There may have been  
technical changes since that time.

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The following abbreviations are used throughout this manual: R&S®XYZ1234 is abbreviated as R&S XYZ1234



# ROHDE & SCHWARZ

**KONFORMITÄTSERKLÄRUNG** gemäß dem Gesetz über Funkanlagen und Telekommunikationsendeinrichtungen (FTEG) und der Richtlinie 1999/5/EG (R&TTE) Anhang V, zertifiziert durch die Benannte Stelle CETECOM ICT Services GmbH, Kennnummer 0682.

**DECLARATION OF CONFORMITY** in accordance with the Radio and Telecommunications Terminal Equipment Act (FTEG) and Directive 1999/5/EC (R&TTE Directive) Annex V, certified by the Notified Body CETECOM ICT Services GmbH Germany, Identif. No. 0682.



Zertifikat-Nr.: / Certificate No.: 2012-55

Hiermit wird in alleiniger Verantwortung bescheinigt, dass die Funkanlage  
We herewith certify under our sole responsibility that the radio equipment

Gerätetyp  
Equipment Type

Benennung  
Designation

TMU9

Mittelleistungssender / Medium Power  
Transmitter

Geräteklasse: / Equipment class: 2.10 (Broadcast transmitter)

bei bestimmungsgemäßer Verwendung den grundlegenden Anforderungen des § 3 und den übrigen einschlägigen Bestimmungen des FTEG (Artikel 3 der R&TTE) entspricht.  
complies with the essential requirements of §3 and the other relevant provisions of the FTEG (Article 3 of the R&TTE Directive), when used for its intended purpose.

- Gesundheit und Sicherheit gemäß § 3 (1) 1, (Artikel 3 (1) a))  
• Health and safety requirements pursuant to § 3 (1) 1, (Article 3(1) a))
- Schutzanforderungen in Bezug auf die elektromagn. Verträglichkeit § 3 (1) 2, (Artikel 3 (1) b))  
• Protection requirements concerning electromagnetic compatibility § 3(1)(2), (Article 3(1)(b))
- Maßnahmen zur effizienten Nutzung des Funkfrequenzspektrums § 3 (2), (Artikel 3(2))  
• Measures for the efficient use of the radio frequency spectrum § 3 (2), (Article 3(2))
- Luftschnittstelle bei Funkanlagen gemäß § 3(3), (Artikel 3(3))  
• Air interface of the radio systems pursuant to § 3(3), (Article 3(3))

Angewendete harmonisierte Normen:  
Harmonized standards applied:

EN 60950-1: 2006  
ETSI EN 301489-1 V1.9.2 (2011-09)  
ETSI EN 301489-14 V1.2.1 (2003-05)  
ETSI EN 302296 V1.1.1 (2005-01)  
EN 61000-3-2: 2006 +A1 +A2  
EN 61000-3-3: 2008

Einhaltung der grundlegenden Anforderungen auf andere Art und Weise (hierzu verwendete Standards/Spezifikationen):  
Other means of proving conformity with the essential requirements (standards/specifications used):

Reg TP SSB RU 005  
Rec.1999/519/EG;  
26. BlmSchV

**ROHDE & SCHWARZ GmbH & Co. KG**  
**Mühlldorfstr. 15, D-81671 München**

München, den 26. Oktober 2012  
Munich, 2012-10-26

Zentrales Qualitätsmanagement GF-QP / Radde  
Central Quality Management GF-QP / Radde



# ROHDE & SCHWARZ

**KONFORMITÄTSERKLÄRUNG** gemäß dem Gesetz über Funkanlagen und Telekommunikationsendeinrichtungen (FTEG) und der Richtlinie 1999/5/EG (R&TTE) Anhang V, zertifiziert durch die Benannte Stelle CETECOM ICT Services GmbH, Kennnummer 0682.

**DÉCLARATION DE CONFORMITÉ** selon la loi sur les équipements radio et les équipements terminaux de télécommunications (FTEG) ainsi que selon la Directive 1999/5/CE (Directive R&TTE) Annexe V, certifié par l'Organisme Notifié CETECOM ICT Services GmbH Allemagne, numéro d'identification 0682.



Zertifikat-Nr.: / Certificat N° : 2012-55

Hiermit wird in alleiniger Verantwortung bescheinigt, dass die Funkanlage  
Par la présente, nous certifions sous notre responsabilité exclusive que l'équipement radio

Gerätetyp  
Equipment Type

Benennung  
Designation

TMU9

Mittelleistungssender / Émetteur moyenne  
puissance

Geräteklasse: / Classe d'équipement : 2.10

bei bestimmungsgemäßer Verwendung den grundlegenden Anforderungen des § 3 und den übrigen einschlägigen Bestimmungen des FTEG (Artikel 3 der R&TTE) entspricht.

est conforme aux prescriptions fondamentales du paragraphe 3 et aux autres prescriptions applicables de la loi susmentionnée (Article 3 de la Directive R&TTE), à condition qu'il soit utilisé dans les conditions stipulées.

- Gesundheit und Sicherheit gemäß § 3 (1) 1, (Artikel 3 (1) a))  
• Prescriptions en matière de sécurité et de santé selon le paragraphe 3 (1) 1, (Article 3 (1) a))
- Schutzanforderungen in Bezug auf die elektromagn. Verträglichkeit § 3 (1) 2, (Artikel 3 (1) b))  
• Prescriptions en matière de protection relative à la compatibilité électromagnétique selon le paragraphe 3 (1) (2) (Article 3 (1) b))
- Maßnahmen zur effizienten Nutzung des Funkfrequenzspektrums § 3 (2), (Artikel 3(2))  
• Mesures pour l'utilisation efficace du spectre radioélectrique le paragraphe 3 (2), (Article 3(2))
- Luftschnittstelle bei Funkanlagen gemäß § 3(3), (Artikel 3(3))  
• Interface radio des équipements radio selon le paragraphe 3 (3) (Article 3 (3))

Angewendete harmonisierte Normen:  
Normes harmonisées utilisées :

EN 60950-1: 2006  
ETSI EN 301489-1 V1.9.2 (2011-09)  
ETSI EN 301489-14 V1.2.1 (2003-05)  
ETSI EN 302296 V1.1.1 (2005-01)  
EN 61000-3-2: 2006 +A1 +A2  
EN 61000-3-3: 2008

Einhaltung der grundlegenden Anforderungen auf  
andere Art und Weise (hierzu verwendete  
Standards/Spezifikationen):

Reg TP SSB RU 005  
Rec.1999/519/EG;  
26. BlmSchV

Autres moyens servant à établir la conformité aux prescriptions  
fondamentales (normes/spécifications utilisées) :

**ROHDE & SCHWARZ GmbH & Co. KG**  
**Mühldorfstr. 15, D-81671 München**

München, den 26. Oktober 2012  
Munich, le 2012-10-26

Zentrales Qualitätsmanagement GF-QP / Radde  
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**Für Betrieb im Europäischen Wirtschaftsraum (EWR)  
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**Hinweis gemäß dem Gesetz über "Funkanlagen und Telekommunikationsend-  
einrichtungen" (FTEG) und der Europäischen Richtlinie 1999/5/EG:**

Dieses Produkt darf innerhalb des EWR nicht uneingeschränkt betrieben werden, da der verwendete Frequenzbereich auf nicht harmonisierten Bändern erfolgt. Nationale Vorschriften / Genehmigungen sind zu beachten.

Das Gerät ist 4 Wochen vor Inverkehrbringen bei der jeweils zuständigen nationalen Behörde für die Frequenzhoheit zu notifizieren. Informationen hierzu im Internet unter folgender Adresse: <http://europa.eu.int/comm/enterprise/rtte/spectr.htm>

**For operation in the European Economic Area (EEA)  
and civil use.**

**Note pursuant to the German Radio and Telecommunications Terminal Equip-  
ment Directive (FTEG) and the European R&TTE Directive 1999/5/EC:**

Operation of this product within the EEA is subject to restrictions since the frequency bands used are not harmonised. National provisions / authorizations shall be complied with.

The product shall be notified to the competent national frequency management authority four weeks before the product is put on the market.

For more information refer to: <http://europa.eu.int/comm/enterprise/rtte/spectr.htm>



# Quality management and environmental management

Certified Quality System  
**ISO 9001**

Certified Environmental System  
**ISO 14001**

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Sie haben sich für den Kauf eines Rohde&Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde&Schwarz ist unter anderem nach den Managementsystemen ISO9001 und ISO 14001 zertifiziert.

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- ISO 14001-zertifiziertes Umweltmanagementsystem

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- Amélioration continue de la durabilité environnementale
- Système de management environnemental certifié selon ISO 14001







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# Contents

<b>1</b>	<b>Information about this Manual.....</b>	<b>9</b>
<b>2</b>	<b>Safety Instructions.....</b>	<b>11</b>
<b>2.1</b>	<b>Safety Instructions for Transmitter Systems and Equipment.....</b>	<b>11</b>
<b>2.2</b>	<b>General Safety Instructions.....</b>	<b>12</b>
2.2.1	Safety Instructions.....	12
<b>2.3</b>	<b>Special Hazard Information.....</b>	<b>19</b>
2.3.1	Hazards from AC Supply Voltage.....	19
2.3.1.1	AC Power Supply.....	19
2.3.1.2	Changing Fuses.....	19
2.3.2	Hazards from High-Energy Electric Circuits.....	19
2.3.3	Hazards from RF Radiation.....	20
2.3.3.1	Obligation to Instruct Personnel.....	20
2.3.3.2	RF Shielding.....	20
2.3.3.3	Rules When Operating an Amplifier.....	20
2.3.3.4	Rules When Working on an Open Amplifier.....	21
<b>3</b>	<b>Transmitter System R&amp;S TMU9.....</b>	<b>23</b>
<b>3.1</b>	<b>Design and Function R&amp;S TMU9.....</b>	<b>23</b>
3.1.1	Rack Design.....	23
3.1.2	Arrangement of the R&S TCE900 Instruments and System Components.....	23
3.1.3	Redundancy Concepts.....	25
3.1.4	Applications.....	28
3.1.5	Overview of Modules and Devices.....	30
3.1.5.1	Mains Distribution Unit.....	30
3.1.5.2	Transmitter Control Unit.....	31
3.1.5.3	TSP900 (Transmitter Status Panel).....	32
3.1.5.4	Exciter and System Components.....	34
3.1.5.5	Output Stage Unit.....	34
3.1.5.6	OSKAR Coupler Module.....	35
3.1.5.7	External Directional Coupler (GD901/902).....	35
3.1.5.8	Bandpass Filter.....	35
3.1.5.9	RF Connector.....	36

3.1.5.10	Parallel Remote Control Interface.....	36
3.1.5.11	Exhaust Kit (optional).....	39
3.1.6	Performance Features.....	40
3.1.7	Power Display and Reflection Monitor.....	41
3.1.8	Specifications.....	42
3.1.8.1	Transmitter System, General – DTV.....	42
3.1.8.2	Requirements for the Output Bandpass Filter.....	46
3.1.8.3	Parallel Remote Control Interface.....	50
<b>3.2</b>	<b>Installation R&amp;S TMU9.....</b>	<b>50</b>
3.2.1	Equipment Supplied.....	50
3.2.1.1	Integrated Transmitter Components.....	50
3.2.1.2	Transmitter Components Supplied Separately.....	50
3.2.2	Overview of Transmitter Installation.....	51
3.2.2.1	Required Tools.....	51
3.2.3	Setting Up the Transmitter.....	52
3.2.3.1	Preparatory Work.....	52
3.2.3.2	Setting Up the Transmitter Rack.....	53
3.2.3.3	Aligning the Transmitter Rack.....	53
3.2.3.4	Bolting the Transmitter Rack to the Floor.....	53
3.2.3.5	Removing the Front Panels.....	53
3.2.3.6	Unpacking the Components.....	54
3.2.4	Installing the UHF Channel Bandpass Filter.....	54
3.2.5	Installing the Amplifier.....	55
3.2.6	Installing the Power Supply.....	56
3.2.6.1	General.....	56
3.2.6.2	Connecting the Transmitter Ground.....	57
3.2.6.3	Connecting the Power Cable.....	57
3.2.7	Installing the RF output.....	59
3.2.7.1	Connecting the Antenna.....	59
3.2.7.2	Connecting the Dummy Antenna.....	59
3.2.8	Installing R&S TCE900 Customer Interfaces.....	60
3.2.9	Installing the RF Loop.....	62
3.2.9.1	Single Drive (CAN Bus Adapter).....	62

3.2.9.2	Dual Drive (RF Switch).....	63
3.2.10	Installing the TM9-C1 Exhaust Kit.....	63
<b>3.3</b>	<b>Commissioning R&amp;S TMU9.....</b>	<b>65</b>
<b>4</b>	<b>Exciter/Transmitter Control R&amp;S TCE900.....</b>	<b>67</b>
<b>4.1</b>	<b>Design and Function R&amp;S TCE900.....</b>	<b>67</b>
4.1.1	R&S TCE900 General Design.....	67
4.1.2	R&S TCE900 Functions.....	71
<b>5</b>	<b>Amplifier R&amp;S PMU901.....</b>	<b>73</b>
<b>5.1</b>	<b>Design and Function R&amp;S PMU901.....</b>	<b>73</b>
5.1.1	Device Purpose and Overview.....	73
5.1.2	Mechanical Design.....	74
5.1.3	Display Elements and Interfaces.....	77
5.1.3.1	LEDs and Test Point – Front Panel.....	77
5.1.3.2	Connectors – Rear Panel.....	79
5.1.4	Circuit Descriptions.....	81
5.1.4.1	Block Diagram.....	81
5.1.4.2	Signal Gain in Preamplifier and Driver.....	81
5.1.4.3	Signal Gain in Doherty-Capable Output Stage.....	82
5.1.4.4	Power Control.....	83
5.1.4.5	Self-Protection Mechanisms.....	84
5.1.4.6	Emergency Shutdown.....	86
5.1.5	Specifications.....	86
5.1.5.1	General Data.....	86
5.1.5.2	Digital TV (DTV).....	87
5.1.5.3	Analog TV (ATV Combined).....	88
5.1.5.4	CW Mode.....	88
<b>A</b>	<b>R&amp;S TMU9 Interface Description.....</b>	<b>91</b>
<b>A.1</b>	<b>External Transmitter Interfaces.....</b>	<b>91</b>
A.1.1	Transmitter Input AC.....	91
A.1.2	Input Signals (TS, RF, Reference).....	91
A.1.3	Transmitter Output.....	94
A.1.4	Monitoring Signals (TS, RF, Reference).....	94

A.1.5	Remote interfaces.....	95
<b>A.2</b>	<b>Internal Transmitter Interfaces.....</b>	<b>95</b>
A.2.1	Internal RF Interfaces.....	95
A.2.2	Internal Ethernet Interfaces.....	97
A.2.3	Transmitter Control Bus (CAN bus).....	98
A.2.4	RF Loops.....	98
A.2.5	TSP900 – Display Interface.....	98
A.2.6	TDU900 – Display Interfaces (Optional).....	99
A.2.7	Air Cooling Interface (Optional).....	99
<b>B</b>	<b>R&amp;S TCE900 Interface Description.....</b>	<b>101</b>
<b>B.1</b>	<b>Interfaces of Base Unit .....</b>	<b>101</b>
B.1.1	X1: MAINS.....	101
B.1.2	Interfaces of Main Computer IPS1.....	101
B.1.2.1	X2 LAN REMOTE.....	101
B.1.2.2	X14 USB 1.....	101
B.1.2.3	X15 USB 2.....	102
B.1.2.4	X11 DVI.....	102
B.1.3	Interfaces of System Connection Boards (SCB).....	103
B.1.3.1	X3 LAN LOCAL FRONT.....	103
B.1.3.2	X7 LAN LOCAL REAR.....	103
B.1.3.3	X66 GPS ANTENNA.....	104
B.1.3.4	X12 TERMINAL SUPPLY.....	104
B.1.3.5	X6 TX.....	105
<b>B.2</b>	<b>Module Slots.....</b>	<b>105</b>
B.2.1	Coder Board.....	105
B.2.1.1	X30 TS LAN 1.....	105
B.2.1.2	X31 TS LAN 2.....	106
B.2.1.3	X23 1PPS IN.....	106
B.2.1.4	X24 REF MONITOR.....	106
B.2.1.5	X20 TS1 IN.....	107
B.2.1.6	X21 TS2 IN.....	107
B.2.1.7	X22 TS MONITOR OUT.....	107
B.2.2	RF Board.....	107

B.2.2.1	X64 REF IN.....	107
B.2.2.2	X60 RF OUT.....	108
B.2.2.3	X61 RF MONITOR OUT.....	108
B.2.2.4	X67 RF DOWNCONVERTER 1 IN.....	108
B.2.2.5	X68 RF DOWNCONVERTER 2 IN.....	108
B.2.3	Tx Interface.....	109
B.2.3.1	X40 LAN 1.....	109
B.2.3.2	X41 LAN 2.....	109
B.2.3.3	X42 LAN 3.....	110
B.2.3.4	X43 LAN 4.....	110
B.2.3.5	X44 Power Distributor.....	111
B.2.3.6	X45 Rf Switch PAR IO.....	112
B.2.4	Cooling Interface (CIF).....	113
B.2.4.1	X46 Pump.....	113
B.2.4.2	X47 HEX.....	114
B.2.5	Air Cooling Interface (Optional).....	116
B.2.5.1	Connection to Exhaust Fan, Differential Pressure Sensor, X46 FAN1.....	116
B.2.5.2	Connection to Exhaust Fan, Differential Pressure Sensor, X47 FAN2.....	116
<b>C</b>	<b>R&amp;S PMU901 Interface Description.....</b>	<b>119</b>
<b>C.1</b>	<b>X1: Supply Input; Schaltbau M3 connector.....</b>	<b>119</b>
<b>C.2</b>	<b>X2: RF Output 7/16 - Socket (Rear).....</b>	<b>120</b>
<b>C.3</b>	<b>X3: RF Test Socket; SMA Female (Front).....</b>	<b>120</b>
<b>C.4</b>	<b>X10: RF Input SMA Female (Rear).....</b>	<b>120</b>
<b>C.5</b>	<b>X13: Second RF Test Socket for ADE; SMA Female (Rear).....</b>	<b>121</b>
<b>C.6</b>	<b>X22: Fan Connection 1; 4-pin Molex Connector.....</b>	<b>121</b>
<b>C.7</b>	<b>X23: Fan Connection 2; 4-pin Molex Connector.....</b>	<b>121</b>
<b>C.8</b>	<b>X11: Amplifier Control Unit; 15-pin D-Sub connector (rear).....</b>	<b>122</b>





# 1 Information about this Manual

This manual is part of the documentation for the R&S TMU9 transmitter family from Rohde & Schwarz. The individual manuals for the transmitter family have a modular structure and complement each other.

## Structure

The system manual, which is the central and overarching part of the overall documentation, describes all the steps involved in installing a transmitter.

Operation of the transmitter system after installation and the steps required to put the system into operation are described in the operating manual.

The service manual describes all maintenance, troubleshooting and service tasks that customers can carry out themselves. At certain points in the transmitter manual, the reader is referred to the appropriate operating manual or service manual.

## Contents

The manuals for the transmitter family describe all activities required for installation, startup, operation, maintenance, troubleshooting and servicing of the transmitter and its component parts. The appendix contains the interface descriptions and the technical documentation.

## Safety

All skilled personnel working with a transmitter or its components have a duty to read the associated manuals and to follow the safety measures described in the section "Safety" and given at appropriate points in the manual. It must be ensured that the transmitter and the individual components of the transmitter are used only for their intended purpose. All activities connected with the transmitter or individual transmitter components must be carried out by skilled personnel. If activities require additional skills and qualifications, this is indicated at the appropriate points in the manual.

## Symbols and notation

The warning triangle symbol refers the reader to potential hazards. The degree of danger is indicated by different signal words next to the warning symbol.

Instructions are given in numbered steps. All other formatting options are intended to improve clarity and are self-explanatory.



## 2 Safety Instructions

### 2.1 Safety Instructions for Transmitter Systems and Equipment

#### **NOTICE**

##### **Compliance with safety regulations**

The safety regulations specified in this manual must always be complied with.

The following points require special attention:

- Only qualified technicians are allowed to install and wire the electrical equipment.
- National and international safety rules and regulations must be observed when equipping operating facilities and during the assembly and operation of electrical systems.  
These include, for example:
  - Protective measures to prevent accidents
  - Protection against overvoltage
  - Isolation of electrical systems
  - Grounding of electrical systems
  - Physical properties and laying of electrical lines and cables
  - Regulations that apply to factories, work areas and special systems
- When installing transmitter racks, it is important to observe national accident prevention regulations, for example, with regard to:
  - Crushing hazard when working beneath suspended loads
  - Fall hazards when working on ladders
  - Risk of injury when lifting heavy loads
- Personal protective equipment (PPE) must be used when installation or repair work is being carried out. Depending on the type of work, it may be necessary to wear protective clothing such as hard hats, safety gloves, eye protection, etc.
- Instruments and systems must not be operated unless their cabinets are closed. Observe the appropriate safety instructions when opening cabinets for maintenance or repair work.
- Isolate all poles when disconnecting instruments and systems from the AC supply. In addition, disconnect all external sources of power, i.e. all measuring cables, extension cables and multipoint connectors (except for special service connectors). Then wait approx. 5 minutes to ensure that the capacitors in the system are sufficiently discharged.
- Additional information on liquid-cooled transmitters: When installing the cooling system and filling it with coolant (pump and heat exchanger), the applicable regulations

on working with hazardous products (coolant) must be observed; see the section "Material Safety Data Sheets" under "EC Safety Data Sheet – Antifrogen".

## 2.2 General Safety Instructions

This section contains general safety instructions applying to all products manufactured or sold by Rohde & Schwarz.

In accordance with IEC215 or EN60215, transmitter systems and their add-on equipment must be operated under the responsibility of qualified technicians only. The minimum requirements for qualified electricians are also defined in the standard "Safety requirements for radio transmitting equipment".

Compliance with all legal and regulatory requirements is a precondition for operating radio equipment and systems. The operator or the operator's authorized representative is responsible for ensuring compliance with these requirements. They must additionally ensure that the training of the operating personnel satisfies the country-specific requirements. This includes any periodic training that is necessary.

### 2.2.1 Safety Instructions

**It is essential to read and observe the following instructions and safety information.**

All factories and sites of the Rohde & Schwarz company group continuously strive to ensure that our products meet the very latest safety standards and that our customers are provided with the highest possible degree of safety. Our products and any additional equipment that they require are manufactured and tested in accordance with the applicable safety regulations. Our quality assurance department regularly checks if these standards are met. This product has been manufactured and tested in accordance with the enclosed EC Certificate of Conformity and left the factory in a condition fully complying with the relevant safety standards. In order to keep the product in this condition and to ensure that it operates safely, the user must observe all information, warnings and instructions. Please do not hesitate to contact the Rohde & Schwarz company group if you have any queries regarding these safety instructions.

Additionally, it is the responsibility of the user to ensure that the product is operated in the appropriate manner. The product is intended for industrial and laboratory use only and, if expressly authorized, also for use in the field, and must never be used in such a way that may result in injury to personnel or damage to property. The user shall be held responsible if the product is used for purposes other than those specified or in such a way that disregards the instructions from the manufacturer. The manufacturer shall not be liable for any consequences resulting from the product being used for purposes other than those for which it is intended.

Use of the product for its intended purpose is assumed if the product is used in accordance with the specifications given in the associated product documentation and within its performance limits (see the data sheet, documentation and the following safety instruc-

tions). Use of the product requires specialist knowledge and, in part, knowledge of the English language. It is therefore important to ensure that the product is operated only by specialist personnel and persons with the appropriate skills who have received detailed instruction in how to operate the product. If personnel protective equipment is required for the operation of Rohde & Schwarz products, this is indicated at the appropriate point in the product documentation. Keep the basic safety instructions and product documentation in a safe place and pass them on to subsequent users of the product.

Observance of the safety instructions is intended to prevent injury or damage resulting from hazards of all types. It is therefore necessary that intended users carefully read and understand the following safety instructions before and during use of the product. It is also essential to observe all other safety instructions (e.g. relating to personnel protection) which are given at appropriate points in the product documentation. In these safety instructions, the term "product" refers to all articles sold and marketed by the Rohde & Schwarz company group; these include instruments, installations and all accessory items.

### Signal words and their meaning

The following signal words are used in the product documentation to warn of risks and hazards.

---

**⚠ DANGER**

indicates an immediate high-risk hazard which will result in death or serious injury if it is not avoided.

---

**⚠ WARNING**

indicates a potential medium-risk hazard which can result in death or (serious) injury if it is not avoided.

---

**⚠ CAUTION**

indicates a low-risk hazard which could result in minor or medium injury if it is not avoided.

---

**NOTICE**

indicates possible incorrect operation which could result in damage to the product.

---

These signal words correspond to the definitions customary in the European Economic Area for civil applications. In addition to this definition, there may also be varying definitions used in other economic areas or for military applications. It is therefore important to note that the signal words described here are used only in connection with the associated product documentation and the associated product. The use of signal words in connection

with non-associated products or non-associated documentation can lead to incorrect interpretation and thus result in injury and damage.

### **Operating conditions, positions and locations**

The product should only be operated in the operating conditions, positions and locations specified by the manufacturer such that ventilation is not obstructed. Non-observance of the manufacturer specifications can result in electric shock, fire and/or serious or (under certain circumstances) fatal injury. All work must be performed in compliance with the local or country-specific safety and accident prevention regulations.

1. Unless otherwise agreed, the following points apply for Rohde & Schwarz products:
  - a) Operating position: housing base at bottom
  - b) IP degree of protection: 2 x USB 2.0 for connecting an external mouse, keyboard, USB stick, etc.
  - c) Degree of soiling: 2
  - d) Overvoltage category: 2
  - e) For indoor use only
  - f) Operation up to 2000 m above sea level
  - g) Transport up to 4500 m above sea level
  - h) Tolerance for nominal voltage:  $\pm 10 \%$
  - i) Tolerance for nominal frequency:  $\pm 5 \%$
2. Do not stand the product on surfaces, vehicles, shelves or tables that are not suitable for weight or stability reasons. When mounting and securing the product on/to objects or structures (e.g. walls and shelves), always follow the installation instructions from the manufacturer. Persons can be injured or even killed if installation is not performed in the way described in the product documentation.
3. Do not place the product on appliances that generate heat (e.g. radiators and fan heaters). The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Overheating of the product can result in electric shock, fire and/or serious or (under certain circumstances) fatal injury.

### **Electrical safety**

Non-observance or inadequate observance of the instructions concerning electrical safety can result in electric shock, fire and/or serious or (under certain circumstances) fatal injury.

1. Before switching on the product, always make sure that the nominal voltage set at the product matches the nominal AC voltage of power supply network. If it is necessary to change the voltage setting, it may also be necessary to change the associated AC supply fuse of the product.
2. In the case of products of protection class I with movable power supply line and plug connector, operation is only permitted at sockets with protective contact and connected PE conductor.

3. Any deliberate interruption of the PE conductor (both along the feed line and at the product itself) is not permitted. This can result in a potential shock hazard at the product. If extension cables or multipoint connectors are used, it must be ensured that their safety is checked at regular intervals.
4. If the product is not equipped with a power switch to disconnect it from the power supply, the plug on the connecting cable must be used to disconnect the power supply. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Function switches or electronic switches are not suitable for disconnecting the product from the power supply. If products without power switch are integrated in racks or systems, the disconnecting device must be provided at system level.
5. Never use the product if the power cable is damaged. Check at regular intervals that the power cable is in perfect condition. Take suitable precautions and use suitable cable installation methods to ensure that the power cable cannot be damaged and personnel cannot be injured (e.g. as a result of electric shock or tripping over cables).
6. Operation is only permitted in TN/TT supply networks which are fuse-protected with max. 16 A (higher fuse ratings should only be used after consultation with the Rohde & Schwarz company group).
7. Do not insert the plug into dusty or dirty sockets. Insert the plug firmly and completely into the sockets provided. Disregard of these points can lead to sparks, fire and/or injury.
8. Do not overload the sockets, extension cables or multipoint connectors as this can cause fire or electric shocks.
9. In the case of measurements in electrical circuits with voltages  $U_{\text{rms}} > 30 \text{ V}$ , appropriate measures must be taken to avoid all hazards (e.g. suitable measuring equipment, fuse protection, current limiting, electrical separation, insulation, etc.).
10. In the case of connections to IT equipment (e.g. PCs or industrial computers), it must be ensured that such connections satisfy the applicable IEC60950-1/EN60950-1 or IEC61010-1/EN61010-1.
11. Unless explicitly permitted, never remove the cover or any part of the housing while the product is in operation. Electrical lines and components will otherwise be exposed, which can lead to injury, fire or damage to the product.
12. If the product is connected at a fixed location, the connection between the on-site PE conductor connection and the instrument PE conductor must be set up before any other connections are made. Installation and connection should only be performed by an electrician.
13. In the case of permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that personnel who have access to the product, as well as the product itself, are adequately protected.

14. Every product must be protected against overvoltage (e.g. as a result of a lightning strike) by means of appropriate overvoltage protection. The operating personnel are otherwise at risk of electric shock.
15. Foreign objects must not be inserted into the openings of the housing. This can cause short circuits in the product and/or electric shocks, fire or injury.
16. Unless otherwise specified, products are not protected against the penetration of fluids; see also the section "Operating conditions, positions and locations", point 1. The instruments must therefore be protected against the penetration of fluids. If this point is disregarded, there is a risk of electric shock for the user or of damage to the product, which in turn can also endanger personnel.
17. Do not use the product under conditions in which condensation could occur (or may already have occurred) in or on the product, e.g. if the product has been moved from a cold environment into a warm environment. Water penetration increases the risk of electric shock.
18. Before cleaning the product, fully disconnect it from the power supply (e.g. power supply network or battery). Clean instruments using a soft, lint-free dust cloth. Never use chemical cleaning agents such as alcohol, acetone or cellulose thinner.

### Operation

1. Use of the product requires special instruction and full concentration during use. It must be ensured that persons who operate the product are fit to do so from a physical, intellectual and mental viewpoint, otherwise there is a risk of injury or damage. It is the responsibility of the employer/operator to select suitable personnel to use the product.
2. Before moving or transporting the product, read and observe the information in the section "[Transport](#)" on page 18.
3. As with all industrially manufactured goods, it is not possible to completely rule out the use of materials which cause allergies, i.e. "allergens" (e.g. nickel). If, when using Rohde & Schwarz products, allergic reactions occur (e.g. skin rash, frequent sneezing, red eyes or respiratory problems), consult a doctor immediately in order to determine the cause and to prevent health problems.
4. Before mechanically and/or thermally processing or dismantling the product, it is essential to refer to the section "[Disposal](#)" on page 18, point 1.
5. Owing to the inherent functional design of certain products (e.g. RF radio systems), increased electromagnetic radiation may be produced. In order to protect unborn life, pregnant women must be protected by means of suitable measures. Electromagnetic radiation also poses a risk to persons with pacemakers. The employer/operator is obliged to assess and identify workplaces where there is a particular risk of exposure to radiation, and to take precautions to prevent potential hazards.



6. In the event of fire, toxic substances (gases, fluids, etc.) can be discharged from the product and damage the health of personnel. If a fire occurs, appropriate measures must therefore be taken (e.g. breathing masks and protective clothing).
7. If a laser product is integrated in an Rohde & Schwarz product (e.g. CD/DVD drive), no settings or functions other than those described in the product documentation should be used in order to prevent injury (e.g. from the laser beam).

### Repair and servicing

1. The product should be opened by authorized specialist personnel only. Before any work is performed on the product or before the product is opened, it must be disconnected from the supply voltage, otherwise there is a risk of electric shock.
2. Any adjustments, part replacements, maintenance or repairs should be carried out only by authorized Rohde & Schwarz electricians. If safety-relevant parts (e.g. power switches, power transformers or fuses) are to be changed, they must always be replaced with original parts. A safety check must be performed after safety-relevant parts have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leaking current measurement, functional check). This ensures that the product remains safe to use.

### Batteries and rechargeable batteries/cells

Non-observance or inadequate observance of the instructions concerning electrical safety can result in electric shock, fire and/or serious or (under certain circumstances) fatal injury. Batteries and rechargeable batteries with alkaline electrolyte (e.g. lithium cells) must be handled in line with EN62133.

1. Cells must not be disassembled, opened or crushed.
2. Lithium batteries must not be exposed to high temperatures or fire. Do not store or place batteries in direct sunlight. Keep cells and batteries clean and dry. Clean dirty terminals using a dry, clean cloth.
3. Cells and batteries must not be short-circuited. Cells and batteries must not be stored in a potentially hazardous manner in a box or drawer where they can short-circuit each other or can be short-circuited by other conductive materials. A cell or battery should only be taken out of its original packaging when it is to be used.
4. Keep cells and batteries out of the reach of children. If a cell or battery has been swallowed, seek medical assistance immediately.
5. Do not subject cells and batteries to severe mechanical jolts or impacts.
6. If a cell is leaking, do not allow the fluid to come into contact with the skin or eyes. If the fluid does come into contact with the skin or eyes, wash the affected area with plenty of water and seek medical assistance.
7. There is a risk of explosion if cells or batteries containing alkaline electrolyte (e.g. lithium cells) are replaced or charged incorrectly. To ensure that the product remains

safe to use, always replace cells or batteries with the appropriate R&S type (see the replacement parts list).

8. Cells or batteries must be recycled and must not be disposed of with residual waste. Rechargeable batteries or batteries containing lead, mercury or cadmium must be disposed of as special waste. Observe the country-specific disposal and recycling regulations.

### Transport

1. The product can be extremely heavy. It must therefore be moved and transported carefully and, if necessary, using suitable lifting gear (e.g. lift truck) in order to prevent injuries to the back and other parts of the body.
2. Handles on the products are handling aids which are only intended for persons transporting the product. The handles are not to be used for securing the product to or on transport equipment (e.g. cranes, forklift trucks, carts, etc.). It is your responsibility to ensure that the products are attached securely to or on suitable transport or lifting equipment. Observe the safety regulations from the manufacturer of the used transport or lifting equipment in order to prevent injury to personnel and damage to the product.
3. If you use the product in a vehicle, it is the responsibility of the driver to drive the vehicle in a safe and appropriate manner. The manufacturer shall not be liable for accidents or collisions. Never use the product in moving vehicle if there is a risk that this could distract the vehicle driver. Make sure that the product is adequately secured in order to prevent injury or further damage in the event of an accident.

### Disposal

1. If products or their components are processed mechanically and/or thermally beyond the scope of the operating conditions for which they were intended, hazardous materials (dust containing heavy metals such as lead, beryllium, nickel) can be released. The product should therefore be dismantled by specially trained personnel only. Incorrect dismantling can cause damage to health. The national regulations concerning disposal must be observed.
2. If, when handling the product, hazardous materials or operating fluids are encountered which must be disposed of separately (e.g. coolant or engine oils that have to be changed at regular intervals), the safety instructions from the manufacturer of these hazardous materials and operating fluids, and the applicable local disposal regulations must be observed. Also observe any additional relevant safety instructions in the product documentation. Incorrect disposal of hazardous materials or operating fluids can result in damage to health and the environment.

## 2.3 Special Hazard Information

### 2.3.1 Hazards from AC Supply Voltage

All voltages of  $U_{rms} > 30 \text{ V AC}$  or  $U > 60 \text{ V DC}$  must be regarded as constituting a shock hazard. When working with voltages that constitute a shock hazard, appropriate measures must be taken to prevent exposure to danger. Never work on live components. Work on live parts should only be performed in exceptional cases and only if special safety precautions are taken.

#### 2.3.1.1 AC Power Supply

- Before connecting the AC power supply, it is important to ensure that the power supply specifications given for the system or instruments match the nominal specifications for the local power supply network. The power supply circuit must be protected by means of fuses in order to prevent overloads and short circuits.
- Miniature modules have neutral conductor fuses. As a result, the power supply may still be connected even after interruption of the circuit by a fuse.

#### 2.3.1.2 Changing Fuses

- Fuses which are accessible to the operator should only be changed after the instruments have been disconnected from the power supply. They must always be replaced with fuses that have the same electrical rating, tripping characteristics and breaking capacity.
- Motor protection switches and automatic line fuses in those parts of a transmitter system that can be accessed by users must be tripped. If their response range is adjustable, the ex-factory setting must not be altered. If settings are changed inadvertently, the correct values specified in this documentation must be set.

### 2.3.2 Hazards from High-Energy Electric Circuits

The instruments contain low-voltage circuits that can be fed from a voltage source with an extremely low impedance (e.g. amplifier operating voltage). These circuits carry dangerously high levels of energy. At Rohde & Schwarz, we treat these circuits in the same way as circuits with hazardous contact voltages. Normally, these circuits are protected by covers to prevent unintentional contact. The cover has a warning label.

In practice it has been repeatedly shown that short circuits caused by small metallic tools result in severe burns. For safety reasons, any high-energy electric circuits in areas of the equipment that can be accessed by users are concealed by protective covers.

- Exercise the same amount of caution for measurements on low-impedance voltages (e.g. for repair purposes) that you would when performing measurements on operating voltages which constitute a shock hazard.  
Wear suitable protective gear when necessary.

- Before opening any equipment or removing a particular cover, turn off the power supply and wait 5 minutes to ensure that capacitors have discharged sufficiently.
- Do not discharge capacitors by short-circuiting them.

### 2.3.3 Hazards from RF Radiation

#### 2.3.3.1 Obligation to Instruct Personnel

- The operator must train all personnel in the operation of this transmitter or instrument in line with EN60215 and/or IEC215. It is essential that these regular training sessions emphasize the dangers related to high frequency that exist at the respective transmitter or instrument. Operating personnel are only authorized to adjust and operate the equipment after they have completed the respective training sessions and their participation has been documented.

High-energy RF circuits inside the transmitter or instrument are routed via conventional removable RF connectors (e.g. type N). Depending on the output power, the output ports of the transmitter and instrument are equipped with screw-type or plug-in RF lines or ducts.

If RF lines or modules carry high power, the connection point or the entire module is tagged with the general danger warning label (yellow triangle with a black exclamation mark).

#### 2.3.3.2 RF Shielding

Transmitters and instruments from Rohde & Schwarz are shielded so that even in the immediate vicinity there is no danger from RF radiation when all RF lines are connected. This applies to statutory provisions in Germany, i.e. the regulation concerning electromagnetic fields:

Limits for electrical and magnetic field strengths of high-frequency installations are defined in the 26th ordinance of the German Federal Government's Emission Control Act of December 16, 1996 (26. BImSchV).

#### 2.3.3.3 Rules When Operating an Amplifier

Disconnecting RF lines that are in operation can result in arcs. These can cause burns and eye injuries.

- Operation of the amplifier is only permitted if a main or dummy antenna is connected
- Never disconnect RF lines when the amplifier is in operation
- Never open the amplifier or modules when the amplifier is in operation
- Never operate the amplifier if RF lines are exposed

#### 2.3.3.4 Rules When Working on an Open Amplifier

Operation with RF power is not permitted if the instrument has been opened or covers have been removed.



## 3 Transmitter System R&S TMU9

### 3.1 Design and Function R&S TMU9

The TV transmitters of the R&S TMU9 transmitter family support the following standards.

With DTV operation:

- DVB-T/H
- DVB-T2
- ATSC/ATSC Mobile
- ISDBT<sub>B</sub>

This manual describes the TV transmitters of the R&S TMU9 transmitter family, which support the DVB-T/H, DVB-T2, ATSC and ISDBT<sub>B</sub> standards.

#### 3.1.1 Rack Design

The air-cooled transmitters of the R&S TMU9 series are designed as rack transmitters.

The exciters (TCE900 exciter) and the transmitter control units (TCE900 SystemControl for MultiTx, N+1, and dual drive) are each installed horizontally above their associated output stages.

When partially and fully equipped, the power distribution with main switches is on the bottom of the front.

Installing customer instruments in the upper part of the rack is an option, depending on the transmitter configuration.

A maximum of 6 power amplifiers (3.5 RU) can be installed in a rack, depending on the configuration. The output stage of a single transmitter can contain up to 5 power amplifiers.

#### 3.1.2 Arrangement of the R&S TCE900 Instruments and System Components

The R&S TCE900 instruments are always arranged according to the same rules for all applications.

- On top of the rack there are 1 to 3 optional customer rackmounts (depending on the configuration), followed by the TCE900-SystemControl or the TDU900 display unit..
- The rackmounts for the TCE900 units and the amplifiers of a transmitter are under the TDU900 display unit (required for MultiTx and N+1 transmitter systems, otherwise optional). One to three TCE900 units per transmitter are required, depending on the system (single drive, dual drive, backup drive).

In the following, different examples of transmitters with maximum configuration are displayed.

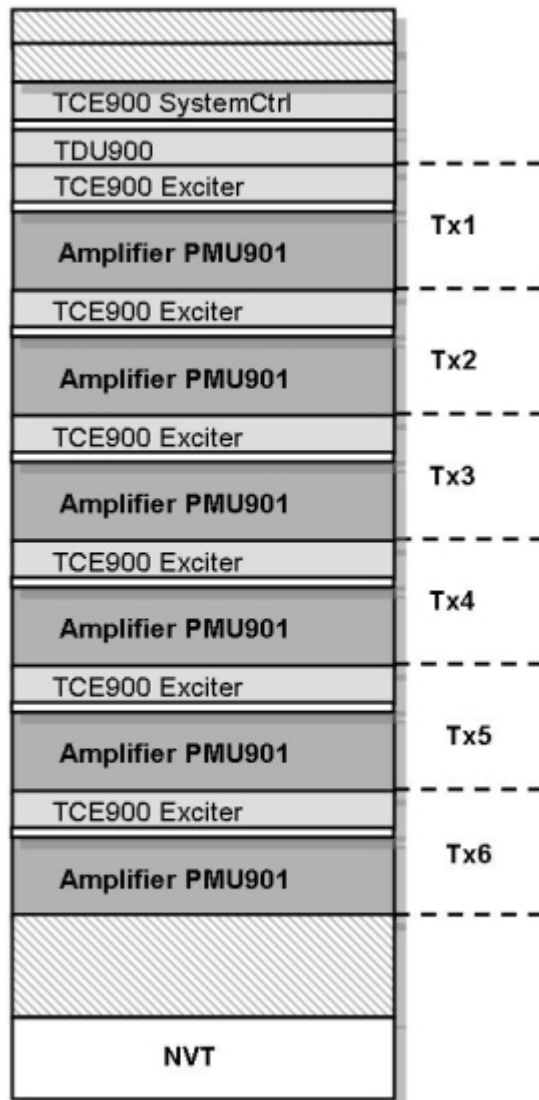


Fig. 3-1: TMU 9 – Multi Tx single drive with six transmitters.



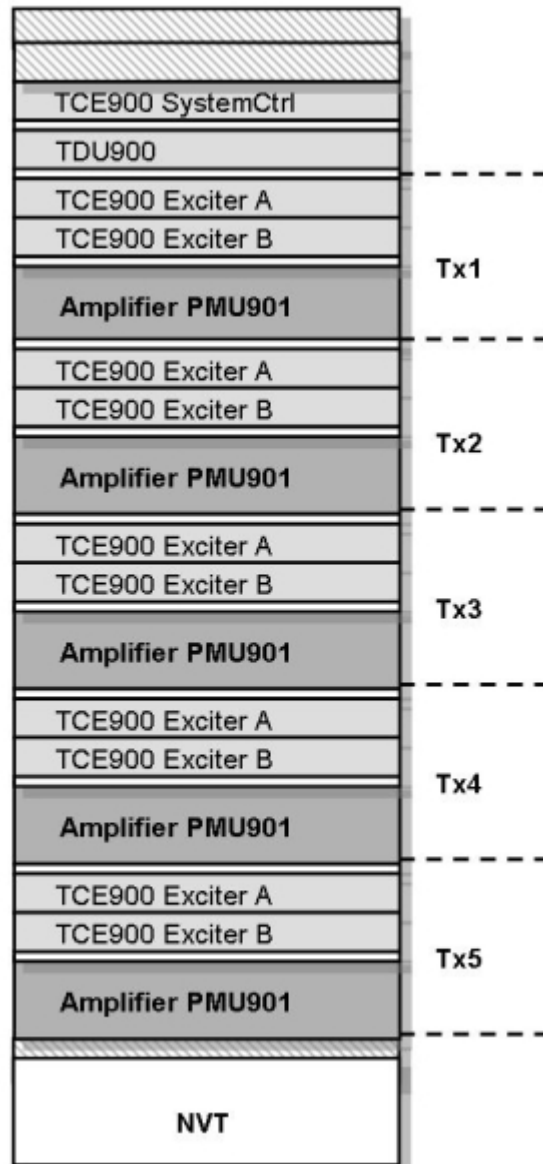


Fig. 3-2: TMU9 – Multi Tx dual drive with five transmitters.

### 3.1.3 Redundancy Concepts

#### Single transmitter (single drive)

This simplest variant for medium-power transmitters consists of an exciter (R&S TCE900-Exciter) and an output stage. The redundancy in this transmitter type is exclusively in the output stage, which can consist of  $n$  amplifiers ( $n = \text{max. of } 5 \text{ per rack}$ ).

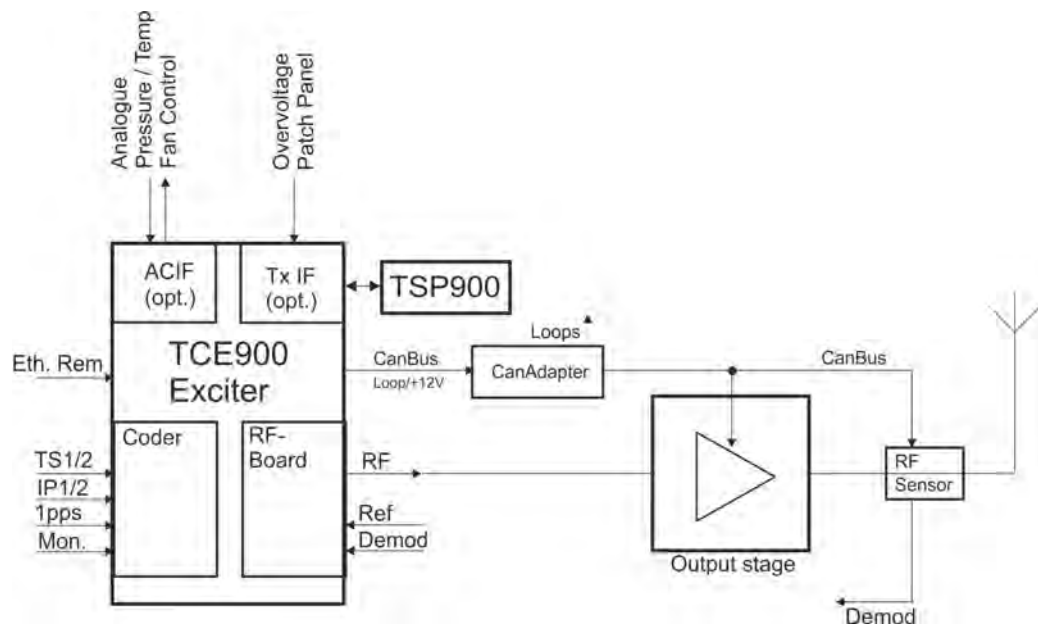


Fig. 3-3: Single Drive - block diagram.

### Dual drive

This variant of a dual-drive transmitter consists of a transmitter control unit (R&S TCE900-SystemControl), two exciter (R&S TCE900 exciter), an exciter switch, and an output stage. If one of the exciter fails, the transmitter control unit uses the exciter switch automatic to switch to the second exciter via moving the exciter switch.

The redundancy properties of the output stage correspond to those of a single transmitter.

One rack from the R&S TMU9 series offers space for a maximum of five transmitters as a dual-drive solution.

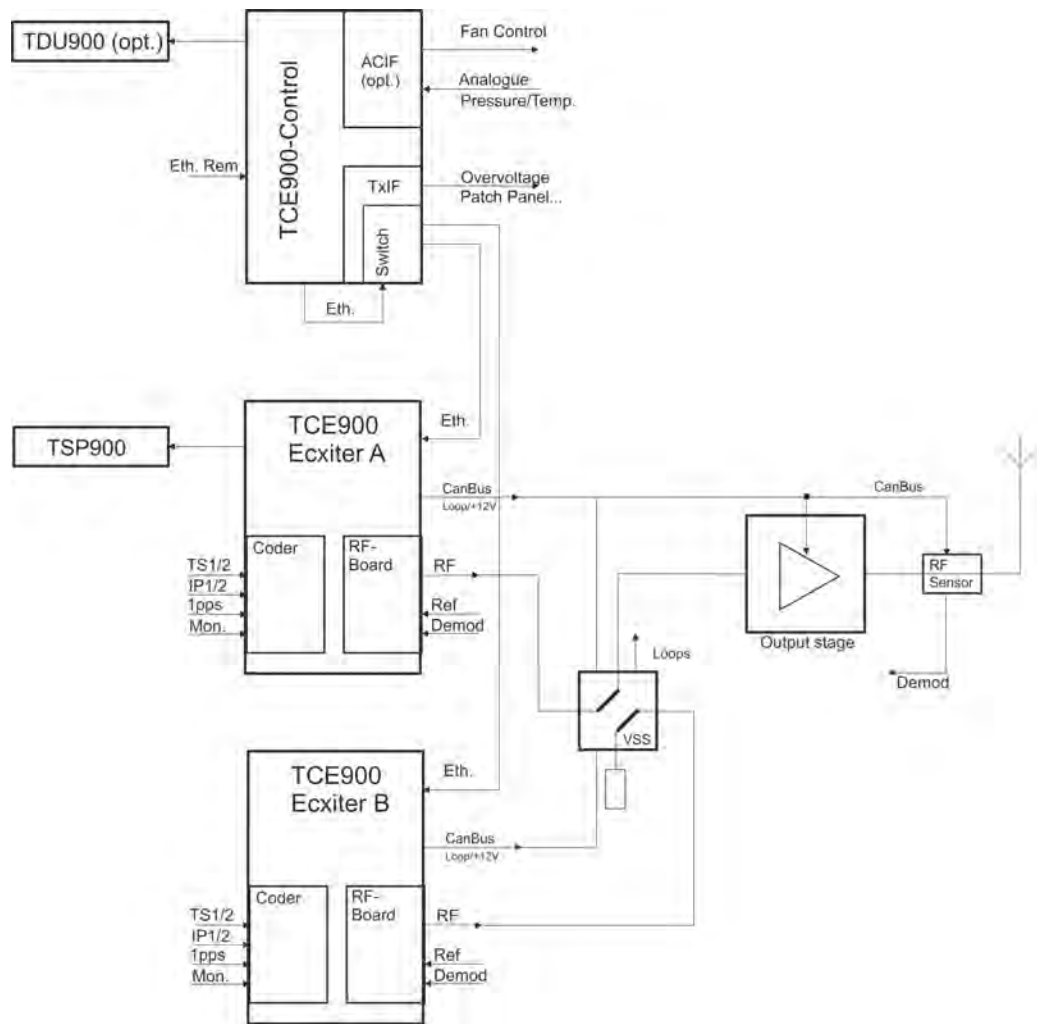


Fig. 3-4: Dual Drive - block diagram

### Backup drive

This variant of a dual-drive transmitter consists of 2 exciters (R&S TCE900 exciter) with various functions, an exciter switch, and an output stage. In contrast to the dual-drive solution, with the backup drive a TCE900-System Control is not necessary. By default, the program exciter (R&S TCE900 program exciter) is connected to the output stage and supplies the modulation signal. The control exciter (R&S TCE900 control exciter) monitors the program exciter and switches to the output stage if the program exciter fails. A rack of the R&S TMU9 series offers space for a maximum of 5 transmitters as a backup drive solution.

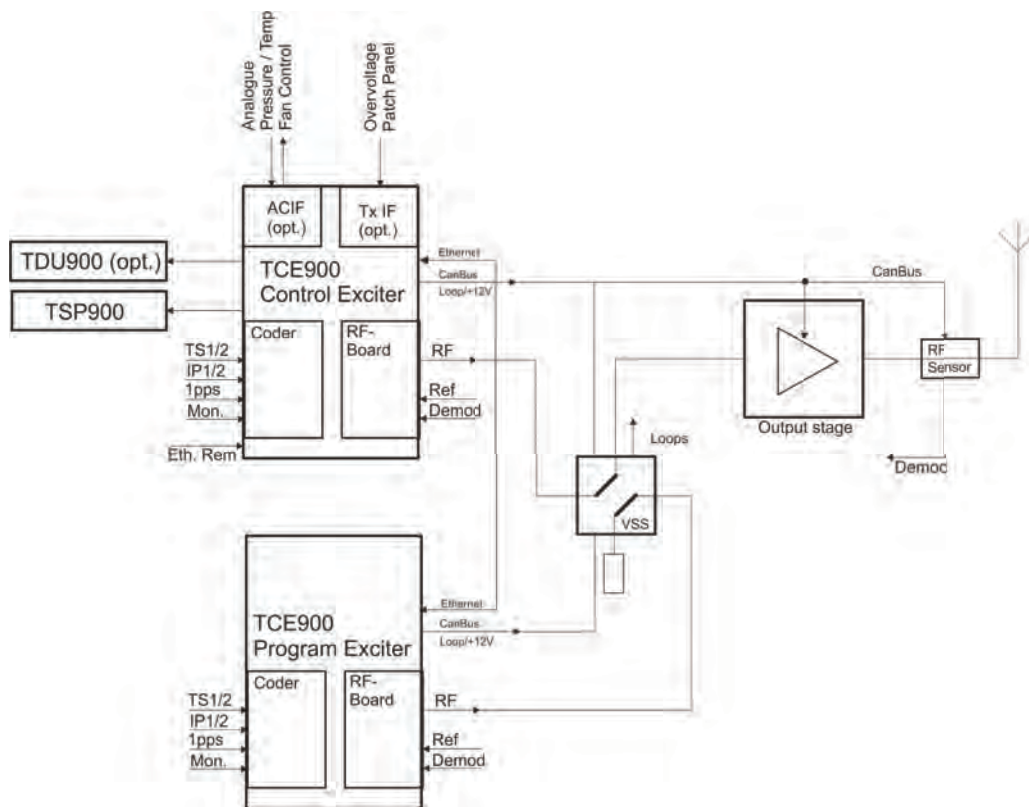


Fig. 3-5: Backup drive – block diagram.

### 3.1.4 Applications

MultiTx transmitters can be combined with any kind of redundancy. Consequently, however, the possible maximum number of transmitters in a rack decreases.

Theoretically possible structure in the rack:

Transmitter type	per rack
Single transmitter	6 single transmitters (with one amplifier for each transmitter)
Dual drive	5 transmitters with dual drive (with one amplifier for each transmitter)
N+1	4 + 1 system (with one amplifier for each transmitter)

A rack of the R&S TMU9 series offers space for a maximum of 6 single transmitters, each with one amplifier.

#### Transmitter constellation with MultiTx systems

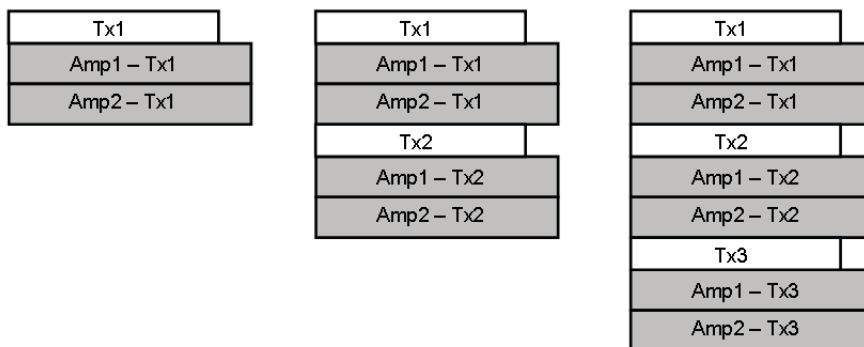
The MultiTx application presupposes a combination of similar transmitters. In this case, there are different options:

*MultiTx transmitter with 1 amplifier / Tx*

Up to 6 single transmitters can be integrated for each rack. Up to 5 dual drives can be installed for each rack.

*MultiTx transmitters each with 2 amplifiers / Tx*

Up to 3 single transmitters can be integrated for each rack. Up to 3 dual drives can be installed for each rack.

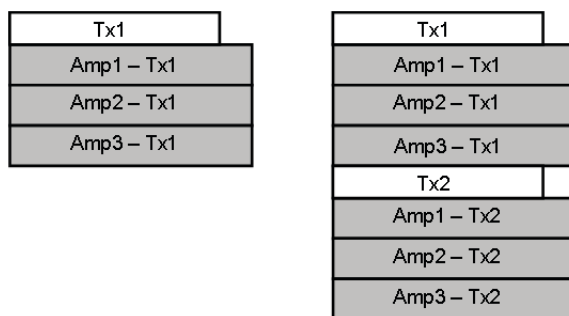


**Fig. 3-6: MultiTx transmitters, each with 2 amplifiers per transmitter.**

Tx = Transmitters 1 to 3  
 Amp x = Amplifiers 1 to 2 per transmitter

*MultiTx transmitters each with 3 amplifiers / Tx*

Up to 2 single transmitters can be integrated for each rack. Up to 2 dual drives can be installed for each rack.

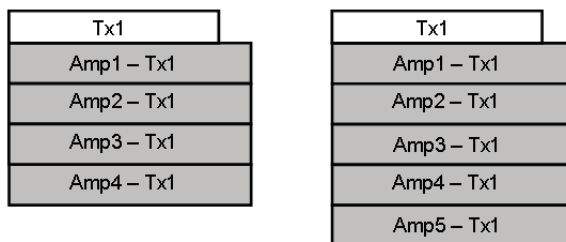


**Fig. 3-7: MultiTx transmitters, each with 3 amplifiers per transmitter.**

Tx = Transmitters 1 to 2  
 Amp x = Amplifiers 1 to 3 per transmitter

*MultiTx transmitters each with 4 or 5 amplifiers / Tx*

A single drive transmitter, dual drive transmitter system, or backup drive transmitter system can be installed.



**Fig. 3-8: MultiTx transmitters each with 4 or 5 amplifiers per transmitter.**

Tx = Transmitter 1

Amp x = Amplifiers 1 to 4 or 5 per transmitter

### 3.1.5 Overview of Modules and Devices

#### 3.1.5.1 Mains Distribution Unit

##### Design

The R&S ZR900Z10 mains distribution unit is designed as a 19" rackmount and serves to provide power and safeguard various devices such as amplifiers, transmitter control units, etc.

The mains distribution unit consists of the following modules or components:

- Main switch Q1
- Circuit breakers F1 to F20
- Overvoltage protection A101
- Network access terminal X1
- 4 terminals for auxiliary contacts (optional)
- Network output terminal X2

##### Characteristics

The variant of the ZR900Z10 mains distribution unit implemented until now is Var. 21.

Characteristics	Var. 21 (2600.1370.21)
Supply voltage	230 V: L1, L2, or L3 to N
Main switch Q1 designed for	max. 63 A
Protective contacts (optional) designed for	max. 10 A
Protection	Single-pole circuit breakers F1 to F6: 20 A Single-pole circuit breakers F7 to F20: 6 A

<b>Characteristics</b>	<b>Var. 21 (2600.1370.21)</b>
Overvoltage protection A101	One overvoltage arrester for each of L1, L2, L3, and N
Connectors for	max. 20 devices

### Function



See circuit diagram 2600.1370.01 S.

The supply voltage is routed to network access terminal X1 with three phases (L1, L2, L3, N). As an option, the two-pin switches can also be connected with the auxiliary contacts (each 1 phase and N). The individual phases are routed from X1 to main switch Q1 via cable W1E. Q1 enables the total load to be switched on and off at all poles.

The voltage is routed with three phases from Q1 to overvoltage protection A101, which contains one overvoltage arrester for each phase. Any overvoltage is diverted via W1T and X1.PE to PE.

Via W1T, the individual phases L1, L2, and L3 are each routed to circuit breakers F1 to F20, so that 230 V are present there with respect to N. The outputs of the circuit breakers are connected to output terminal strip X2 via cables W2A, W3A, and W3B. A max. of 20 loads are connected to X2.

Thus each load is protected against overcurrent by a circuit breaker. Circuit breakers F1 to F6 trigger at 20 A and serve to protect the amplifiers. Circuit breakers F7 to F20 trigger at 6 A and serve to protect the TCEs, the fans of an exhaust kit (optional), or any customer instruments.

#### Standby power supply (with amplifiers)

If an optional standby power supply is installed for an amplifier, the main and standby power supplies operate in parallel, each at half power. If one of the two power supplies drops out, the functional one operates as the power supply at full power.

Amplifiers not including a standby power supply are connected to L, N, and PE (network output terminal X2) using a 3-wire cable. When using a standby power supply, a 5-wire cable is used to connect to L1, L2, N1, N2, and PL1, since now the main and standby power supplies are protected by a separate circuit breaker.

#### 3.1.5.2 Transmitter Control Unit

The transmitter control unit contains the following components:

- R&S TCE900 SysCtrl

The transmitter control unit is responsible for both internal and external communications, including all control functions.

The current status of the transmitter system can optionally be shown on a straightforward color display via the R&S TDU900.

### 3.1.5.3 TSP900 (Transmitter Status Panel)

The TSP900 allows local operation of a transmitter. One TSP900 is allocated to each transmitter (single drive, dual drive, backup drive) and is fastened to the front panel of the respective transmitter.

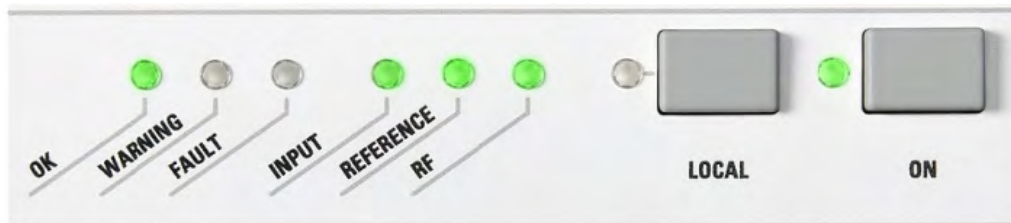


Fig. 3-9: TSP900 (Transmitter Status Panel)

For single drive, dual drive, and backup drive transmitters with optional TDU900, the TSP900 (keys and LEDs) are active in parallel with the TDU900.

For N+1 and MultiTx transmitters, each individual transmitter has a separate TSP900, which enables local operation of the single transmitter.

#### Meaning of the LEDs

		Single drive	Backup drive	Dual drive
OK (green)		Transmitter all OK	Transmitter all OK	Transmitter all OK
Warning (orange)		Warning for transmitter	Warning for transmitter	Warning for transmitter
Fault (red)		Fault for transmitter	Fault for transmitter	Fault for transmitter
Input	OK	Sum input status of the exciter is <b>OK</b>	Sum input status of the active exciter is <b>OK</b> <sup>[2]</sup>	Sum input status of the active exciter is <b>OK</b> <sup>[2]</sup>
	W	Sum input status of the exciter has a <b>Warning</b>	Sum input status of the active exciter has a <b>Warning</b> <sup>[2]</sup>	Sum input status of the active exciter has a <b>Warning</b> <sup>[2]</sup>
	F	Sum input status of the exciter has a <b>Fail</b>	Sum input status of the active exciter has a <b>Fail</b> <sup>[2]</sup>	Sum input status of the active exciter has a <b>Fail</b> <sup>[2]</sup>



Reference	OK	Sum reference of the exciter is <b>OK</b>	Sum reference of the active exciter is <b>OK</b> <sup>[3]</sup>	Sum reference of the active exciter is <b>OK</b> <sup>[3]</sup>
	W	Sum reference of the exciter has a <b>Warning</b>	Sum reference of the active exciter has a <b>Warning</b> <sup>[3]</sup>	Sum reference of the active exciter has a <b>Warning</b> <sup>[3]</sup>
	F	Sum reference of the exciter has a <b>Fail</b>	Sum reference of the active exciter has a <b>Fail</b> <sup>[3]</sup>	Sum reference of the active exciter has a <b>Fail</b> <sup>[3]</sup>
	Off	Reference signal (10 MHz/ PPS/ GPS...) is not present and is not required, since frequency regulation source is set to "Manual"	Reference signal (10 MHz/ PPS/ GPS...) for the active exciter is not present and is not required, since frequency regulation source is set to "Manual"	Reference signal (10 MHz/ PPS/ GPS...) for the active exciter is not present and is not required, since frequency regulation source is set to "Manual"
RF	OK	Transmitter RF <b>OK</b>	Transmitter RF <b>OK</b>	Transmitter RF <b>OK</b>
	W	Transmitter RF <b>Warning</b>	Transmitter RF <b>Warning</b>	Transmitter RF <b>Warning</b>
	F	Transmitter RF <b>Fail</b> <sup>[1]</sup>	Transmitter RF <b>Fail</b> <sup>[1]</sup>	Transmitter RF <b>Fail</b> <sup>[1]</sup>
	Off	Transmitter program <b>off</b>	Transmitter program <b>off</b>	Transmitter program <b>off</b>
Local	Transmitter Local/Remote LED shows the Local status (yellow)	Transmitter Local/Remote (applies for program and control exciter) LED shows the Local status (yellow)	Transmitter Local/Remote (applies for Tx control, exciter A and exciter B) LED shows the Local status (yellow)	Transmitter Local/Remote (applies for Tx control, exciter A and exciter B) LED shows the Local status (yellow)
On	Transmitter On (ON/OFF command accepted by the transmitter)	Transmitter On (ON/OFF command accepted by the transmitter)	Transmitter On (ON/OFF command accepted by the transmitter)	Transmitter On (ON/OFF command accepted by the transmitter)

<sup>[1]</sup> Special case: Saved RF Fail for (switched over and) switched off transmitter

<sup>[2]</sup> If an exciter switchover – called up by an incorrect input feed – already took place, the faulty input feed to the switched-over exciter cannot be identified by the input LED. Instead, only a transmitter sum warning is displayed for the exciter automatic switchover function.

<sup>[3]</sup> If an exciter switchover – called up by an incorrect reference feed – already took place, the faulty reference feed to the switched-over exciter cannot be identified by the REF-

ERENCE LED. Instead, only a transmitter sum warning is displayed for the exciter automatic switchover function.

#### 3.1.5.4 Exciter and System Components

The exciter consists of the following components:

- Exciter
- Exciter switch (for exciter standby only)
- CAN bus adapter (for single drive only)
- TS distributor (optional)

##### Exciter

The R&S TCE900 exciter performs all signal processing from the audio/video input signal or transport stream signal up to an RF output signal that complies with the relevant standards.

For additional information, refer to the TCE900 instrument manual.

##### Exciter Switch

With dual-drive transmitters (dual drive), the exciter switch switches to the standby exciter in the following cases:

- If the main exciter malfunctions
- If there is a manual switchover via the R&S TCE900 SysCtrl

The exciter switch is controlled by the exciter switch automatic, which is operating on both TCE900-Exciters redundant,

##### CAN Bus Adapter

The CAN adapter is required for communication between the individual system components (output stage and CAN bus-capable test point) and the transmitter control unit (for single drive only).

##### TS Distributor

The transport stream (TS) distributor distributes the input signal to the respective exciter (for dual drive only).

#### 3.1.5.5 Output Stage Unit

The air-cooled R&S PMU901 amplifier is a broadband unit that operates as a power amplifier in the frequency range from 470 MHz to 862 MHz with the following TV standards:

- Digital (DTV) standards: DVB-T/H, DVB-T2, ATSC, ATSC Mobile, ISDBT<sub>B</sub>
- Analog (ATV) standards: ATVc (combined) B/G, D/K, K1, I, I1

For additional information, refer to [chapter 5.1, "Design and Function R&S PMU901"](#), on page 73.

### 3.1.5.6 OSKAR Coupler Module



The acronym OSKAR stands for harmonics filter, splitter, coupler, absorber, and directional coupler (**O**berwellenfilter, **S**plitter, **K**oppler, **A**bsorber, **R**ichtkoppler).

The OSKAR coupler module is a complete functional unit with the following functions:

- RF signal distribution (splitter)
- RF signal combination (coupler)
- Cooling system of the coupler and the load compensation resistors by arranging the coupler in the exhaust air flow of the amplifier
- Integrated harmonics filter for either band IV or band V
- Three directional coupler test points as separate sensors:
  - CAN bus-capable test point (forward/reflected power), frequency response-compensated
  - ADE test point (forward/reflected power)
  - Free test point (forward/reflected power, optional)The directivity of the test points is at  $\approx 34$  dB.

Depending on how many amplifier output signals are to be combined, the following four different coupler versions can be used.

- 2-way coupler/splitter for an output stage with 2 power amplifiers
- 3-way coupler/splitter for an output stage with 3 power amplifiers
- 4-way coupler/splitter for an output stage with 4 power amplifiers
- 5-way coupler/splitter for an output stage with 5 power amplifiers

### 3.1.5.7 External Directional Coupler (GD901/902)

An external directional coupler can be used to measure the transmitter output power for transmitters with an amplifier.

You can select either the GD901 or the GD902 with one or two measurement connections for the forward and reflected power (connection to main line 7-16).

### 3.1.5.8 Bandpass Filter

A UHF channel bandpass filter is provided downstream of the amplifiers to reduce out-of-band interference. In the signal path, the bandpass filter is located before the harmonics filter.

### 3.1.5.9 RF Connector

The RF connector (EIA flange) is on the transmitter roof (alternatively, it can also be located at the base of the transmitter). The size (diameter) of the RF connector is 1 5/8".

### 3.1.5.10 Parallel Remote Control Interface

The parallel remote control interface is used to operate the transmitter from a remote location via parallel wire connections (not a computer interface). You can use a remote operator position to issue commands (ON, OFF, etc.) or to receive messages from the transmitter, such as status messages (TRANSMITTER ON).

#### Custom Interfaces

No.	Designation	Type	Connection	Remarks
X101A X101B	Commands to transmitter	25-pin D-Sub socket	Command line	The module has optocoupler inputs floating with respect to 0 V. 0 V floating is applied to pin 24 and 25. (as per command line)  Commands 1 to 16 to X101A pin 1 to 16  Commands 17 to 32 to X101B pin 1 to 16
X201A X201B	Messages from transmitter	25-pin D-Sub plug	Relay outputs	The module has normally-open (NO) contacts or double-throw (DT) contacts for messages.  Messages 1 to 9 and 76 are applied to X201A.  Messages 10 to 18 and 77 are applied to X201B.  NO contacts are available for message 1 to 6 and 10 to 15; all others have DT contacts.

No.	Designation	Type	Connection	Remarks
X203A X203B	Messages from transmitter	25-pin D-Sub plug	Relay outputs	<p>The module has normally-open (NO) contacts or double-throw (DT) contacts for messages.</p> <p>Messages 19 to 24 and 78 are applied to X203A.</p> <p>Messages 28 to 33 and 79 are applied to X203B.</p> <p>NO contacts are available for message 19 to 24 and 28 to 33; all others have DT contacts.</p>
X205A X205B	Messages	25-pin D-Sub plug	Relay outputs	<p>The module has normally-open (NO) contacts or double-throw (DT) contacts for messages.</p> <p>Messages 37 to 46 are applied to X205A.</p> <p>Messages 47 to 56 are applied to X205B.</p> <p>NO contacts are available for message 37 to 42 and 47 to 52; all others have DT contacts.</p>
X207A X207B	Messages	25-pin D-Sub plug	Relay outputs	<p>The module has normally-open (NO) contacts or double-throw (DT) contacts for messages.</p> <p>Messages 57 to 66 are applied to X207A.</p> <p>Messages 67 to 80 are applied to X205B.</p> <p>NO contacts are available for message 57 to 66 and 67 to 72; all others have DT contacts.</p>

### Connectors for Connecting Remote Control Equipment

Special "D-Sub tandem connectors" are used. Possible designations for an **X201** connector are **X201A** and **X201B**.

The designation of the connector pin indicates the respective half of the tandem connector.

Example: Command 1 is applied to connector **X101**, pin 1A. The command can be input at connector pin 1 of connector **101A**.

### Command Inputs

All command inputs are operated via optocouplers with a floating supply voltage that is generated on the module. A command input becomes active by means of a connection to the common command line. Both continuous signals and pulse signals are permitted. With pulse signals, a minimum pulse length of 100 ms must be ensured. With continuous operation, the signal which became active last is rejected in the case of mutually exclusive signals.

Example: The TRANSMITTER ON command is valid and the TRANSMITTER OFF command is issued. The TRANSMITTER OFF command stays invalid for as long as the first ON command is active. The command inputs are distributed between two 25-pin D-Sub sockets (**X101A**, **X101B**).

### Message Outputs

All message outputs are implemented by means of floating relay contacts. A message is valid when the contact is in its closed state. Normally-open (NO) contacts and, to a limited extent, normally-closed (NC) contacts are available for this purpose. Relays with bistable switching characteristics are reserved for the local/remote messages of the corresponding function groups.

The module can be used universally for FM, DAB, and TV transmitters. It contains the consecutively numbered commands COMMAND□1 to COMMAND□32 and the consecutively numbered message outputs MESSAGE□1 to MESSAGE□80.

### Assignment to Transmitter Functions

The messages or commands are assigned to the transmitter functions according to the used configuration via a routing program stored in the higher-level control unit. During the configuration phase, this program assigns the command inputs and message outputs their logical meaning according to the functional use of the module.

### Communication between Remote Control Interface and Transmitter

Data is exchanged with the R&S TCE900 SysCtrl unit via an internal CAN bus. The transmitter control unit also provides the operating voltage for the remote control interface.

### CAN Bus

The remote control interface has an internal 9-pin CAN bus D-Sub plug X1 and a 9-pin CAN bus D-Sub socket X11. The module receives its power supply (+12V) via the CAN bus plug X1.

### Single Transmitter and Standby System

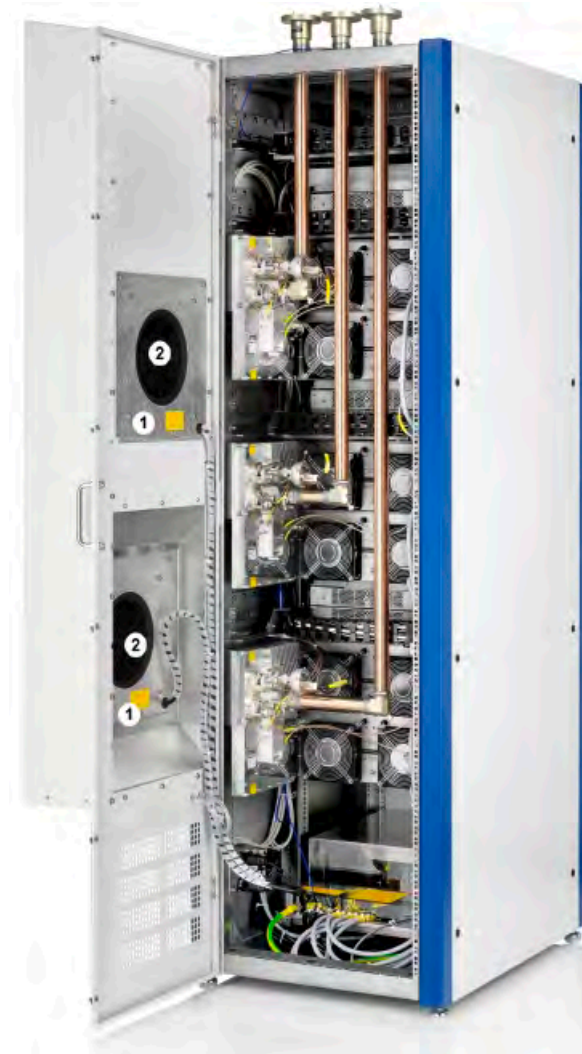
In a single transmitter, the remote control interface is directly connected to the TCE900 SysCtrl via the CAN bus plug **X1**. The **X11** socket remains free.

In standby systems, the CAN bus is connected to further n+1 modules via **X11**.

#### 3.1.5.11 Exhaust Kit (optional)

The exhaust kit allows the transmitter to be connected to a central ventilation system at the transmitter station or for the hot air from the transmitter to be vented directly outside.

Two differential pressure sensors (1) are used to measure the pressure inside the frame enclosure with reference to the outside air pressure. Through the ACIF of the TCF, the RPM of the two fans (2) are regulated with the aim of maintaining normal air pressure within the enclosed frame.



**Fig. 3-10: Mutli Tx transmitter with exhaust kit**

1 = Differential pressure sensors  
2 = Fans

This option cannot be ordered separately and subsequently installed in the transmitter system, since some modules or components have to be preassembled at the factory.

The cooling system consists of the following modules or components:

- Exhaust kit TM9-C1
  - Fans E1, E2
  - Differential pressure sensors S1, S2
  - Temperature sensor B2
  - Exhaust air transfer duct
- Air cooling interface (ACIF) (option to the TCE900 TxControl transmitter control unit)

The air cooling interface (ACIF) is used to establish the connection from the TM9-C1 exhaust kit to the TCE900 SysCtrl unit. The ACIF serves in part to control speed and monitor the fans and, where appropriate, to send error messages to the TCE900 SysCtrl. Pressure sensors S1 and S2 measure the pressure inside and outside of the rack. Thus, a pressure-neutral environment can be configured in the rack. Temperature sensor B2 measures the exhaust air temperature in the vicinity of the exhaust air transfer duct.

Mains distribution unit ZR900Z10 protects fan E1 via circuit breaker F7 and fan E2 via circuit breaker F8.

### 3.1.6 Performance Features

#### Efficiency

The efficiency of a transmitter is correctable. This readjustment of the transmitter efficiency is done by modifying the DC supply of the power amplifier.

To get an idea for transmitters that are not operated at the nominal power, the following estimation is permitted.

$$U_{\text{new}} = \sqrt{(P_{\text{new}}/P_{\text{nom}})} * U_{\text{nom}}$$

Here, a linearity precorrection found at nominal power does not yet have to be adapted.

#### Uninterruptible power supply

To bridge extended power supply faults, the control and signal processing components present in the transmitter are equipped with a separate supply. The following options are available for an uninterruptible power supply:

- The "external UPS feed" option
 

The external supply can be switched off via the main switch and supplies the transmitter control unit components and the exciters. Alternatively, one or more UPS devices can be installed in the option section of the rack. The UPS devices are 19" rack-mounts with 1 HU.
- The "internal UPS" option
 

The "internal UPS" option uses a UPS (additional purchase part) as a 19" instrument rackmount with 1 HU. The 3 free rack units (option section) are intended as the



defined installation location. This means it is not possible to equip all exciters and the transmitter control unit with an independent UPS for MultiTx in the full configuration.

- The "redundant voltage supply for the transmitter control unit (TCE900 CTRL)" option  
The transmitter control unit (TCE900 CTRL) has an optional "external supply" rack-mount for an "+12 V external" supply.

### Emergency mode

If the transmitter control unit has failed or communication with the transmitter components has been interrupted, the system is in emergency mode.

This means the last operating states in all system components are saved to nonvolatile memory, with exception of the power amplifiers, for which the operation settings are saved only until the next restart. When restarted, the amplifiers are re-commanded by the active exciter.

The system components maintain this operating state until other states are commanded by a new/repaired/replaced transmitter control unit.

## 3.1.7 Power Display and Reflection Monitor

### Displays

The displays of the transmitter show the forward and reflected power of the transmitter output. The forward and reflected power is displayed with an accuracy better than  $\pm 5\%$  of the nominal value.

### RF forward monitoring and messages

For nominal power up until the warning level, the transmitter sends the messages RF ON and RF OK.

If the configurable warning threshold (0 dB to -20 dB) is undershot, the transmitter sends the RF ON message and an additional warning message (RF WARNING). The RF OK message is canceled.

If the configurable fault threshold (0 dB to -20 dB) is undershot, the transmitter cancels the RF ON message right away and issues an RF fault (RF FAIL) after a configurable waiting period (1 s to 20 s).

### Reflection warning

A warning threshold is set to generate a reflection warning.

The warning threshold lies between -18 dB and -28 dB and is the return loss in dB.

### Reflection fault

The transmitter is switched off when the return loss is -17 dB to -14 dB (configurable) (corresponds to 1/50 to 1/20 of the forward power). It can be switched off by blocking the RF (RF carrier loop).

Within one minute after it has been switched off the first time, three attempts at switching it back on will be made. If there is still reflection after the last attempt to switch it on, the transmitter is permanently switched off (Output Stage will be switched off) and a "Reflection" fault message is generated.

### 3.1.8 Specifications

#### 3.1.8.1 Transmitter System, General – DTV

##### General

	DVB-T/H	DVB-T2	ISDB-T	ATSC
Frequency range	470 MHz to 862 MHz UHF band IV/V:(step size 1 Hz)			
Frequency range Doherty	470 MHz to 790 MHz			
Channel bandwidth	5/6/7/8 MHz	1.7/5/6/7/8 MHz	6/7/8MHz	6 MHz
Standards	EN 300744 EN 302304 (opt.)	EN 302755	ARIB STD-B31 ABNT NBR 15601	FCC Doc. A/53
SFN / DTx function	TS 101191		ARIB STD-B31 ABNT NBR 15601	
EMC	EN 302296 EN 301489-1 / -14 With channel bandpass filter		ARIB STD-B31 ABNT NBR 15601 Part 1	
Max. installation altitude	2000 m (sea level); up to 3000 m on request			
Operating temperature (operation room)	+1 °C to +45 °C			
Maximum relative humidity	95 % non-condensing (interior)			
Environmental class	ETSI EN 300-019-1-3 Interior, in acc. with 3.2, with limited temperature range, non-condensing			
Voltage supply	3W+N+PE (Y) 230 V AC/400 V AC ±15 %			
AC supply frequency	47 Hz to 63 Hz			
Power factor per phase	≥ 0.95			
Circuit feedback	EN 61000-3-2 fulfilled for transmitters with ≤ 3 amplifiers EN 61000-3-12 fulfilled for transmitters with ≥ 4 amplifiers			

	DVB-T/H	DVB-T2	ISDB-T	ATSC
Immunity --> to fast transients and bursts (in acc. with EN 61000-4-4)	< 2kV (mains) < 1 kV (signals)			
Immunity to surges --> (in accordance with EN 61000-4-5)	< 1kV (symmetric) < 2kV (non-symmetric)			
Noise level	Interior: < 60 dBA			
Permitted VSWR	s ≤ 1.33 at the transmitter level optionally at s > 1:1.33 shutoff (standard) or s > 1:1.45 (configurable)			
RF connector	EIA 1 5/8"			

### Inputs

	DVB-T/H	DVB-T2	ISDB-T	ATSC
Input signals	ASI	ASI TS over IP	ASI	ASI SMTPE310M
Data rate	3 Mbps to 30 Mbps	3 Mbps to 50 Mbps	32,507937 Mbps	19.39 Mbps
inputs	2 x ASI (HP/LP) BNC 75 Ω	2 x ASI BNC 75 Ω	2 x ASI BNC 75 Ω	2 x SMPTE310 or 2 x ASI BNC 75 Ω
	RJ-45, TCP/IP			
Modulator interface	---	T2-MI ETSI TS 102773		---
Reference frequency	10 MHz; 0.1 to 5 Vpp or TTL, BNC 50 Ω			
Reference pulse	1 pps, TTL, BNC 50 Ω			
Monitoring	Current data rate, input signal present, TS synchronization present,			
Packet length	204 byte/188 byte	Fixed packet length (188 byte) Generic cont. stream > 64 kbit Generic fixed packe- tized streams (< 64 kbit) Generic encapsulated streams (TS 102606) High efficiency mode	204/188 Byte	207 byte/187 byte
Modulation modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, 256QAM	DQPSK QPSK 16 QAM 64 QAM	8 VSB

	DVB-T/H	DVB-T2	ISDB-T	ATSC
IFFT modes (bandwidth specifications for 8 MHz channel)	2k, 8k opt. 4k for DVB-H bandwidth 7.61 MHz	1k, 2k, 4k, 8k, 16k, 32k bandwidth 7.61 MHz	Mode 1 2k Mode 2 4k Mode 3 8k	---
Extended carrier mode	---	8k, 16k, 32k bandwidth 7.77 MHz		---
Symbol period	224 $\mu$ s (2k) 448 $\mu$ s (4k) 896 $\mu$ s (8k)	112 $\mu$ s (1k) 224 $\mu$ s (2k) 448 $\mu$ s (4k) 896 $\mu$ s (8k) 1792 $\mu$ s (16k) 3584 $\mu$ s (32k)	252 $\mu$ s (2k) 504 $\mu$ s (4k) 1008 $\mu$ s (8k)	---
Guard interval	1/4, 1/8, 1/16, 1/32	1/4, 1/8, 1/16, 1/32, 19/128, 19/256, 1/128	1/4, 1/8, 1/16, 1/32	---
Code rate	1/2, 2/3, 3/4, 5/6, 7/8	1/2, 3/5, 2/3, 3/4, 4/5, 5/6	1/2, 2/3, 3/4, 5/6, 7/8	---
Trellis coding	---	---	---	2/3
Hierarchical coding	supported	---	---	---
PAPR	---	Yes	---	---
Rot. constellation	---	Yes	---	---
DVB-T2 modes	---	Single PLP Multi PLP	---	---
Delay correction	Max. 1000 ms, automatic and manual setting			
Pre-correction	ADE (adaptive digital equalization)	ADE (adaptive digital equalization)	ADE (adaptive digital equalization)	adaptive digital equalization (ADE) ext. group delay (opt.)

### Quality

	DVB-T/H	DVB-T2	ISDB-T	ATSC
MER	$\geq 33$ dB at $P_{nom}$	$\geq 33$ dB at $P_{nom}$	$\geq 33$ dB at $P_{nom}$	$\geq 35$ dB at $P_{nom}$
Frequency response	$< \pm 0.5$ dB	$< \pm 0.5$ dB	$< \pm 0.5$ dB	$< \pm 0.25$ dB
Intermodulation suppression	$\geq 37$ dB ( $\pm 12$ MHz)	$\geq 37$ dB ( $\pm 12$ MHz)	$\geq 37$ dB ( $\pm 12$ MHz)	$\geq 47$ dB ref. to mean power
BW 8 MHz: $\pm 4.2$ MHz				
BW 7 MHz: $\pm 3.7$ MHz				
BW 6 MHz: $\pm 3.2$ MHz			BW 6MHz: $\pm 3,15$ MHz	
Spectrum mask	in line with ETSI EN 302296 with channel bandpass filter		ABNT NBR 15601 Part 1 with channel bandpass	FCC DTV emission mask, with channel bandpass filter

	DVB-T/H	DVB-T2	ISDB-T	ATSC
Nonharmonics	≤ -60 dBc Without channel band-pass filter	≤ -60 dBc Without channel band-pass filter		≤ -60 dBc Without channel band-pass filter
Harmonics	≤ -70 dBc Without channel band-pass filter	≤ -60 dBc Without channel band-pass filter		≤ -60 dBc Without channel band-pass filter
Noise power density	dBc / Hz			
10 Hz	> 70			
100 Hz	> 90			
1 kHz	> 93			
10 kHz	> 103			
100 kHz	> 112			
1 MHz	> 130			
Frequency stability	$10^{-7}$ / year			

### Operation

RJ-45	Operation via PC using standard web browser (opt. network management interface for SNMP)
Parallel interface	Contacts / optocoupler (opt.)

### Safeguarding and monitoring

Transmitter	Mains Reflection Temperature RF out
Amplifier	Mains Reflection Temperature Overvoltage Transistor Fail RF Input Level RF output level Transistor currents DC voltages

## Standards

ETSI EN62015	Safety requirements for radio transmission equipment (VDE0866 / IEC 215)
ETSI EN60950	Safety of information technology equipment incl. electrical business equipment (VDE0805 / IEC 950)
ETSI EN 301489-14	Electromagnetic compatibility for radio spectrum matters (ERM) Electromagnetic compatibility for radio equipment and service (EMC); Part 14: Specific conditions for analog and digital terrestrial TV broadcasting service transmitters
ETSI EN302296	Electromagnetic compatibility and radio spectrum matters (ERM); Transmitting equipment for the digital television broadcast service, terrestrial (DVB-T)

### 3.1.8.2 Requirements for the Output Bandpass Filter

A channel bandpass filter is required for maintaining the brand and nonharmonics requirements, which depend on standards.

#### DVB-T

The shoulder distance on the transmitter side, without filter, is presupposed to be at least 37 dB.

**Table 3-1: Specification of DVB-T Channel Bandpass Filter for Non-Critical Mask**

Frequency	Default filter attenuation
$f_0$	0.3 dB to 0.4 dB
$\pm 3.805$ MHz	0.8 dB to 1.0 dB
$\pm 4.2$ MHz	$\geq 5.0$ dB
$\pm 6.0$ MHz	$\geq 20.0$ dB
$\pm 12$ MHz	$\geq 40.0$ dB

**Table 3-2: Specification of DVB-T Channel Bandpass Filter for Critical Mask**

Frequency	Default filter attenuation
$f_0$	0.45 dB to 0.6 dB
$\pm 3.805$ MHz	1.0 dB to 1.5 dB
$\pm 4.2$ MHz	$\geq 15.0$ dB
$\pm 6.0$ MHz	$\geq 27.0$ dB
$\pm 12$ MHz	$\geq 50.0$ dB

#### General specifications

- VSWR:  $\leq 1.22$  min in the range  $\pm 3.805$  MHz

- Drift:  $\leq 2$  kHz/K
- RF connector: 3 1/8" pipe connection

### DVB-T2

The shoulder distance on the transmitter side, without filter, is presupposed to be at least 37 dB.

For DVB-T2, a new operating mode, "Extended carrier mode," was introduced in the standard. This mode can be activated at FFT sizes of 8k, 16k, and 32k and leads to a bandwidth extension of  $\pm 80$  kHz.

The throughput range with DVB-T2 is at  $\pm 3.885$  MHz, the max. impedance matching has to be ensured in this range.

The attenuation requirements in the stopband are identical as with DVB-T.

### ATSC

The shoulder distance on the transmitter side, without filter, is presupposed to be at least 37 dB.

**Table 3-3: Specification of Channel Bandpass Filter for "Full Power FCC Mask"**

Frequency	Default filter attenuation
$f_0 \pm 2.69$ MHz	0.3 dB to 0.4 dB
$\pm 3.00$ MHz	$\geq 0.5$ dB
$\pm 3.50$ MHz	$\geq 3.0$ dB
$\pm 4.00$ MHz	$\geq 8.0$ dB
$\pm 6.00$ MHz	$\geq 30.0$ dB
$\pm 9.00$ MHz	$\geq 65.0$ dB

**Table 3-4: Specification of Channel Bandpass Filter for "Stringent Mask"**

Frequency	Default filter attenuation
$f_0 \pm 2.69$ MHz	0.3 dB to 0.4 dB
$\pm 3.00$ MHz	$\geq 0.5$ dB
$\pm 3.50$ MHz	$\geq 3.0$ dB
$\pm 4.00$ MHz	$\geq 8.0$ dB
$\pm 6.00$ MHz	$\geq 30.0$ dB
$\pm 9.00$ MHz	$\geq 30.0$ dB

### General specifications

- VSWR:  $\leq 1.12$  to 1.15
- Drift:  $\leq 2$  kHz/K

**ATSC (Canada)**

The shoulder distance on the transmitter side, without filter, is presupposed to be at least 37 dB.

*Table 3-5: Specification of Channel Bandpass Filter for "Canadian Tight Mask"*

Frequency	Default filter attenuation
$f_0 \pm 2.69$ MHz	0.3 dB to 0.4 dB
$\pm 3.00$ MHz	$\geq 0.5$ dB
$\pm 3.50$ MHz	$\geq 1$ dB
$\pm 4.00$ MHz	$\geq 6$ dB
$\pm 6.00$ MHz	$\geq 20$ dB
$\pm 9.00$ MHz	$\geq 30$ dB

## General specifications

- VSWR:  $\leq 1.12$  to 1.15
- Drift:  $\leq 2$  kHz/K

**ISDB-T (Japan)**

The shoulder distance on the transmitter side, without filter, is presupposed to be at least 37 dB.

*Table 3-6: Specification of Channel Bandpass Filter for "Non-Critical Mask"*

Frequency	Default filter attenuation
$f_0 \pm 2.79$ MHz	0.3 dB to 0.4 dB
$\pm 3.15$ MHz	$\geq 2$ dB
$\pm 4.50$ MHz	$\geq 20$ dB
$\pm 9.00$ MHz	$\geq 40$ dB

## General specifications

- VSWR:  $\leq 1.12$  to 1.22 min. in the throughput range
- Drift:  $\leq 2$  kHz/K

**ISDB-T<sub>B</sub>**

The shoulder distance on the transmitter side, without filter, is presupposed with at least 37 dB or 42 dB.



**Table 3-7: Specification of Channel Bandpass Filter for "Non-Critical Mask"**

Frequency	Default filter attenuation (SH 37 dB)	Default filter attenuation (SH 42 dB)
$f_0 \pm 2.79$ MHz	0.3 dB to 0.4 dB	0.2 dB to 0.4 dB
$\pm 3.15$ MHz	$\geq 2$ dB	0 dB
$\pm 4.50$ MHz	$\geq 20$ dB	$\geq 12$ dB
$\pm 9.00$ MHz	$\geq 40$ dB	$\geq 35$ dB

**Table 3-8: Specification of Channel Bandpass Filter for "Sub-Critical Mask"**

Frequency	Default filter attenuation (SH 37 dB)	Default filter attenuation (SH 42 dB)
$f_0 \pm 2.79$ MHz	0.3 dB to 0.5 dB	0.3 dB to 0.4 dB
$\pm 3.15$ MHz	$\geq 8$ dB	$\geq 3$ dB
$\pm 4.50$ MHz	$\geq 23$ dB	$\geq 18$ dB
$\pm 9.00$ MHz	$\geq 48$ dB	$\geq 40$ dB

**Table 3-9: Specification of Channel Bandpass Filter for "Critical Mask"**

Frequency	Default filter attenuation (SH 37 dB)	Default filter attenuation (SH 42 dB)
$f_0 \pm 2.79$ MHz	0.4 dB to 0.6 dB	0.4 dB to 0.6 dB
$\pm 3.15$ MHz	$\geq 15$ dB	$\geq 10$ dB
$\pm 4.50$ MHz	$\geq 30$ dB	$\geq 25$ dB
$\pm 9.00$ MHz	$\geq 55$ dB	$\geq 50$ dB

#### General specifications

- VSWR:  $\leq 1.12$  to  $1.22$  min. in the throughput range
- Drift:  $\leq 2$  kHz/K

#### ATV

With analog-only operation of the transmitter, a 4-circuit bandpass filter is sufficient for achieving the standards requirements.

**Table 3-10: Specification of Channel Bandpass Filter (Analog-Only Operation)**

Frequency	Filter attenuation
Passband	$< 0.2$ dB (better $0.15$ dB)
$f_B - f_T$	$> 30$ dB
$f_B + 2^* f_T$	$> 30$ dB

Frequency	Filter attenuation
$f_B - 2 * f_T$	$\geq 24$ dB
$f_B + 3 * f_T$	$\geq 24$ dB

#### General specifications

- VSWR:  $\leq 1.06$  to  $1.10$
- Drift:  $\leq 2$  kHz/K

#### 3.1.8.3 Parallel Remote Control Interface

Operating voltage	12 V DC
Current drain	1 A maximum
CAN interface	CAN V2.0B at 1 Mbps
Number of command inputs	32
Insulation voltage	3000 V <sub>eff</sub>
Maximum external line resistance	50 $\Omega$ (referenced to common command line)
Number of message outputs	80 (of which 5 have bistable character)
Dielectric strength of contact/coil	1000 V <sub>eff</sub>

## 3.2 Installation R&S TMU9

### 3.2.1 Equipment Supplied

#### 3.2.1.1 Integrated Transmitter Components

- TCE900 units
- System components

#### 3.2.1.2 Transmitter Components Supplied Separately

- Amplifier
- Bandpass filter (optional, depending on transmitter configuration)
- Transmitter accessories

### 3.2.2 Overview of Transmitter Installation

The transmitter can be installed by following the basic sequence given below:

- Setting up the transmitter
  - Checking the floor suitability
  - Preparing openings required in the floor (only with inlets and outlets from below)
  - Arranging the connections on the transmitter roof
  - Setting up the transmitter rack
  - Aligning the transmitter rack
  - Removing the front panels
  - Unpacking the components
- Installing UHF channel bandpass filter
- AC power supply
  - Connecting the transmitter ground
  - Connecting the power cable
  - Connecting external units
- Amplifier
  - Making preparations for installing the amplifiers
  - Installing the amplifiers
- RF output
  - Connecting the antenna
  - Connecting the dummy antenna
- Connecting the modulation/reference signals
- Connecting the remote control system to the transmitter system

#### 3.2.2.1 Required Tools

You will need the following tools to install the transmitter:

Tool	Type	Size
Screwdriver	Torx	No. 8
Screwdriver	Torx	No. 20
Screwdriver	Phillips	No. 1
Screwdriver	Slotted	No. 1
Screwdriver	Slotted	No. 3
Hexagon socket		No. 5
Hexagon socket		No. 6
Open-end wrench		Width across flats 13□mm (2□pcs)
Open-end wrench		Width across flats 10□mm
Spirit level		



The table lists the basic tools required for installation of the transmitter rack (not for floor openings, base frame, and so on).

### 3.2.3 Setting Up the Transmitter

#### 3.2.3.1 Preparatory Work

Before setting up and installing the transmitter, you must make the following preparations:

- Checking the floor suitability
- Prepare openings required in the floor and set the screw holes in the floor for fixing the rack (optional)
- Arranging the connections on the transmitter roof

#### Checking the floor suitability

Before installing the transmitter, you must check whether the floor of the building in which the transmitter is to be operated has an adequate weight to floor area ratio.

Depending on the type of system, a transmitter rack of the THU9/TMU9 family can have a total weight of up to 720 kg with the maximum number of rackmounts installed. A weight to floor-area ratio of at least 1200 kg / m<sup>2</sup> is therefore required.



The exact weight of your transmitter is given in the specifications.

The installation surface should be flat (i.e. horizontal along all axes) and measure at least 600 mm x 1100 mm to accommodate the transmitter rack.



During installation, the transmitter must be easily accessible from the front and rear. A clearance space of at least 1.2 m is necessary in order to install all components without difficulty.

#### Preparing openings required in the floor (only with inlets and outlets from below)

If cables (RF cables, control lines, etc.) are to be connected to the transmitter from below, you must make appropriate floor openings in the building in which the transmitter is to be operated.



Further details and dimensions can be found in the corresponding drawing in the appendix "Basic documentation":

### 3.2.3.2 Setting Up the Transmitter Rack

The transmitter rack can be set up using lifting equipment (crane). Lifting lugs are attached to the top of the rack for this purpose.

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**⚠ CAUTION****Crushing Hazard**

Do not stand under suspended racks.

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**⚠ CAUTION****Risk of Falling**

Take the relevant safety precautions when climbing ladders (not wobbly, suitable footwear)

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### 3.2.3.3 Aligning the Transmitter Rack

The rack must be aligned vertically and horizontally in order to prevent distortion caused by shearing forces.

- ▶ Using the height-adjustable rack feet, align the rack such that it is vertical and horizontal along all axes.  
Use a water level to align the rack.

### 3.2.3.4 Bolting the Transmitter Rack to the Floor

If required, the transmitter rack can be screwed to the floor or a floor frame. Two 12 mm boreholes are provided in the lower crossbeam of the transmitter rack for this purpose.

### 3.2.3.5 Removing the Front Panels

Before you start installing the individual units, make sure that you have easy access to all units, connectors, and interfaces needed.

1. Using a Torx screwdriver No. □20, remove all front panels from the rack.
2. Open the rear door of the transmitter rack.



Take care not to damage the ground connections when removing and fitting the front panels.

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### 3.2.3.6 Unpacking the Components

Each transmitter component is packaged separately.

- ▶ Remove the packaging and have all equipment ready for the installation.

## 3.2.4 Installing the UHF Channel Bandpass Filter



An integrated bandpass filter is optionally available.

---

### **DANGER**

#### High voltage

Risk of fatal injury from touching voltages constituting a shock hazard. The transmitter rack must be completely de-energized before the following service work is performed, otherwise there is a risk of injury and death caused by electric shock.

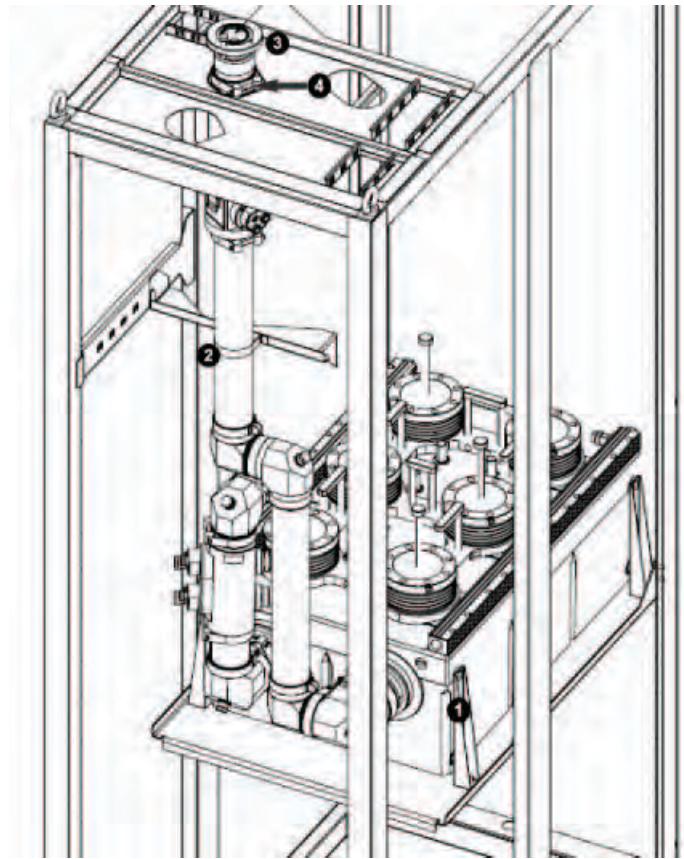
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Plug in the RF components up to the respective markings.

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1. Unscrew the lower front panel on the transmitter (Torx screwdriver No. 20).
2. Insert the filter into the filter trough from the front of the transmitter.
3. Align the filter brackets with the fastening holes in the filter trough and screw the filter brackets to the filter trough (hexagon socket No. 6).
4. Install the directional coupler in the correct installation direction with the connector bracket at the filter inlet/coupler output and fasten the directional coupler by tightening the clamps (hexagon socket No. 5).



- 1 = RF bracket on the channel bandpass filter outlet
- 2 = Retaining clamp of the harmonics filter
- 3 = EIA pipeline junction
- 4 = Roof mount of the directional coupler

5. Install the RF connecting pipe at the upper bracket/filter outlet and fasten the RF connecting pipe with clamps (hexagon socket No. 5).

### 3.2.5 Installing the Amplifier

1. With the aid of a second person, carefully slide the amplifier into the free slot until the automatic connectors engage. The front panel of the amplifier must be flush with the rack uprights.



*Fig. 3-11: Slide the amplifier into the rack*

2. Tighten the amplifier to the rack using the two screws on the front panel (Torx screwdriver T25).
3. Switch on the amplifier via the power distribution unit in the transmitter rack (turn the appropriate protective switch to the "I/ON" position).

If the installation was successful, the LINK LED flashes until the amplifier has been detected by the system and is illuminated continuously if the amplifier is logged on to the system.

## 3.2.6 Installing the Power Supply

### 3.2.6.1 General

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#### **⚠ DANGER**

##### **High Voltage**

Risk of fatal injury from touching dangerous voltages. To prevent injury and death from electric shock, always make sure that the power supply is disconnected before commencing any work.

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The ZR900Z10 mains distribution unit is installed in the transmitter rack at the factory. The mains distribution unit is connected to the power supply network of the transmitter station.

### 3.2.6.2 Connecting the Transmitter Ground

#### **NOTICE**

##### **Transmitter Ground**

The rack must be connected to the station's main ground terminal.

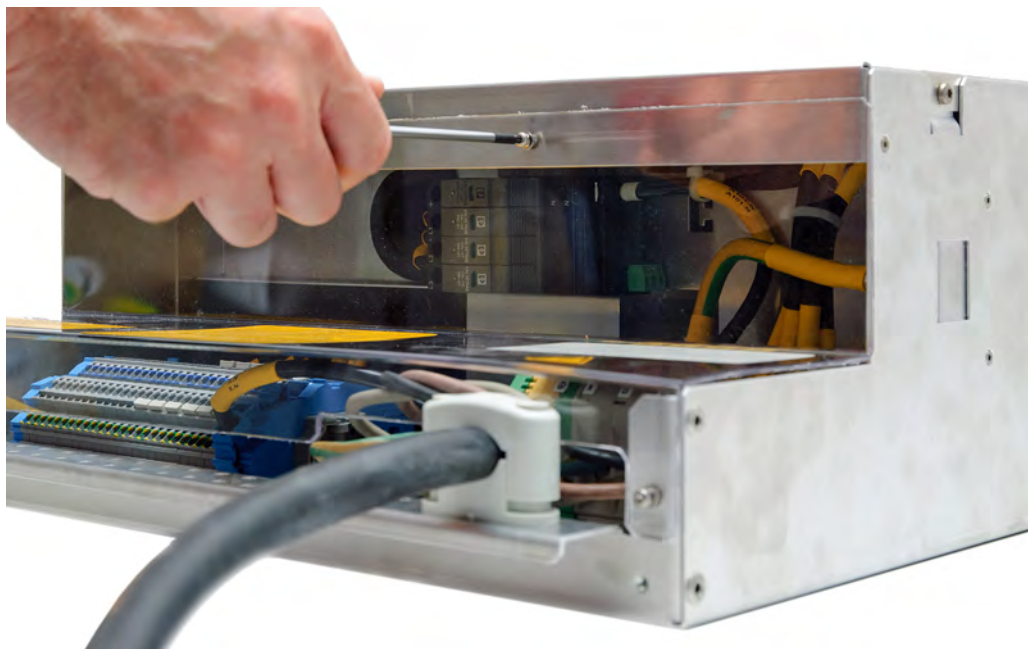
The transmitter rack has two grounding bolts near the floor which are easily accessible from the rear.

Connect a system ground conductor to the free grounding bolt.

### 3.2.6.3 Connecting the Power Cable

Before connecting the power cable, remove the transparent protective cover of the ZR900Z10 mains distribution unit.

Loosen the transparent protective cover at the rear of the mains distribution unit using a Torx screwdriver No. 10, as shown in the following figure, and remove the cover.



*Fig. 3-12: ZR900Z1 mains distribution unit, protective cover on the rear side*

Furthermore, determine which series fuses and cable cross-sections are required. The recommended values refer to a cable length of 20 m when routing in perforated cable