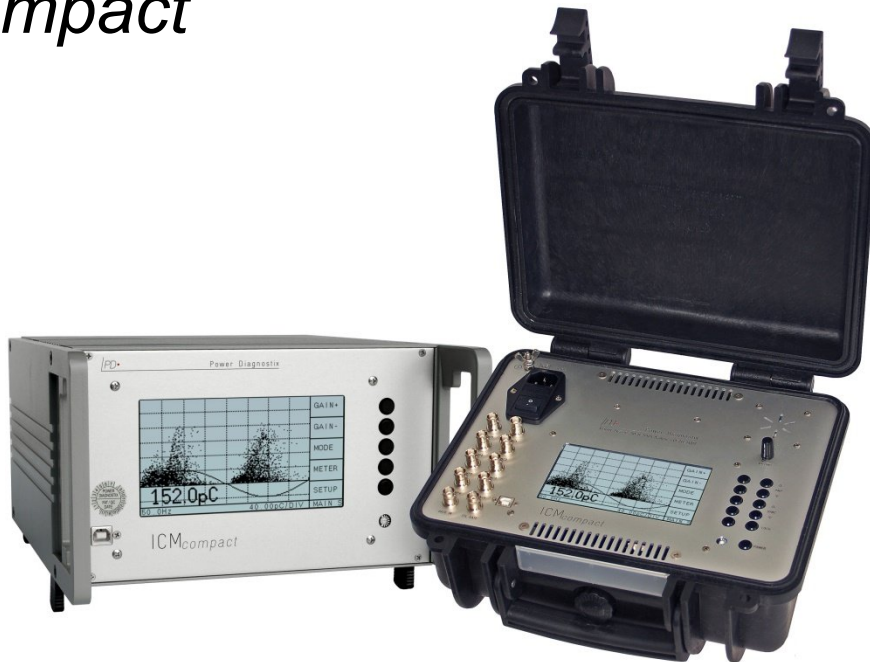# ICM*compact*

The ICM*compact* is part of the Power Diagnostix ICM*series* of digital partial discharge detectors. It is a compact, stand-alone instrument for evaluating the condition of medium and high voltage insulation. The ICM*compact* is often used in quality assurance and quality control tests in manufacturing, but the instrument may be adapted to non-conventional testing tasks such as field testing and diagnostics by use of various preamplifier and couplers.

Stand-alone Instrument

Partial discharge (PD) measurements are a proven method for effective, nondestructive evaluation of electrical insulation. The Power Diagnostix ICM*compact* provides a simple push-button interface and on-screen menus in an embedded LCD panel. The LC display modes include a simple PD charge meter with adjustable "needle" sensitivity, monochrome phase-resolved PD patterns for characterization of defects, and a scope-like display showing phase-summed charge pulses superimposed with a sine wave.

Although the ICM*compact* is an autonomous unit, it can be connected to a computer installed with Power Diagnostix software to capture screenshots or to implement remote control of the unit.

Applications

Instantly displaying information in an intuitive interface, the ICM*compact* is a good choice for applications such as quality control tests in the manufacture of electrical products and for quality assu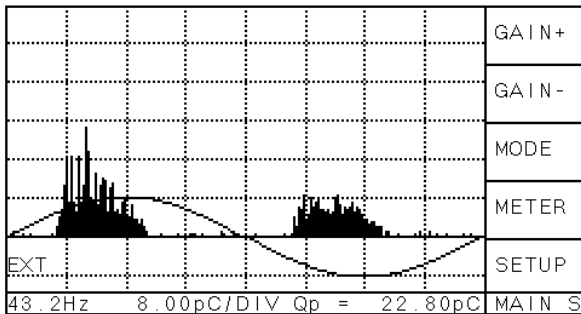rance of industrial and utility equipment; from capacitors and bushings to gas-insulated switchgear, voltage transformers, power plants, and others.

A wide range of accessories adapts the ICM*compact* to specific testing applications and noise conditions.
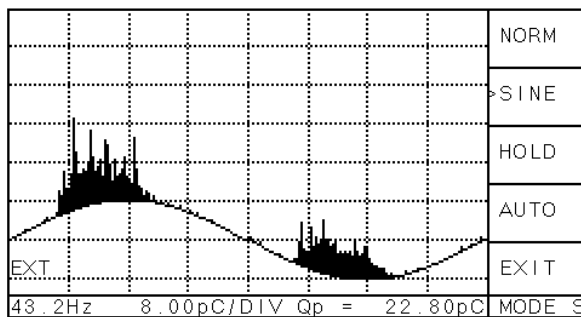
The PD measurement bandwidth of the ICM*compact* is limited to 800 kHz (AMP mode), 10 MHz (SPEC mode) or 20 MHz (AMP mode with preamplifier RPA2). Higher measurement frequencies are not useful because of the signal attenuation in the test object. For instance, with 100 MHz only PD sources very close to the coupling unit can be detected.

The ICM*compact* with DSO option can be used to locate partial discharge defects in power cable. Using time domain reflectometry, in which the PD and its "echoes" travel the length of the cable under test, the ICM*compact* provides the proportional distance of the PD fault along the cable.
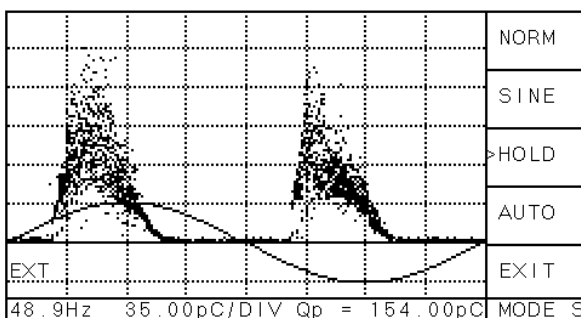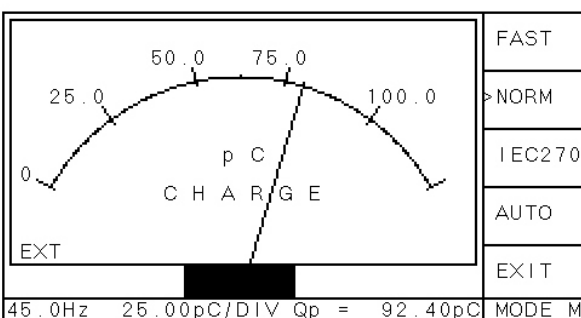
Standard Display Modes

```
                                    GAIN+
                                    GAIN-
                                    MODE
                                    METER
                                    SETUP
EXT
43.2Hz    8.00pC/DIV Qp =    22.80pC  MAIN S
```

In standard configuration the ICM*compact* comes with four main display modes. The scope display shows the maximum peak val-

```
                                    NORM
                                   >SINE
                                    HOLD
                                    AUTO
                                    EXIT
EXT
43.2Hz    8.00pC/DIV Qp =    22.80pC  MODE S
```

ues of discharges vs. phase. The refresh rate is about 5 pictures per second which gives a good view of increasing or decreasing PD activity. The PD pulses can also be put on top of the drawn sine wave as shown above.

```
                                    NORM
                                    SINE
                                   >HOLD
                                    AUTO
                                    EXIT
EXT
48.9Hz    35.00pC/DIV Qp =   154.00pC  MODE S
```

To get a phase resolved pattern a hold function is available. Each PD pulse is plotted related to its amplitude and phase position.
To visualize the PD activity like older analog

```
             50.0    75.0           FAST
       25.0            100.0        >NORM
                                    IEC270
          0    p C                  AUTO
            C H A R G E
EXT                                 EXIT
45.0Hz    25.00pC/DIV Qp =    92.40pC  MODE M
```

meters the next display can be chosen. Three different meter modes like e. g. IEC60270 mode are available.

Three Different Enclosure Models

The ICM*compact* is available with three different enclosures:

- ½ 19" or 19" desktop version
- 19" rack mountable version
- Robust outdoor Explorer case
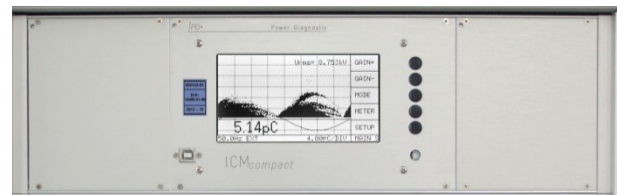
19" rack mountable version

Optional Features and Displays

a) PD Spectrum Analysis

Observing the frequency spectrum of a harshly disturbed PD signal allows selecting frequency bands with fewer disturbances. Using this selected frequency for a PD acquisition gives a largely improved signal-to-noise ratio resulting in a clear pattern acquisition. The combination of spectrum analyzer and PD detector within one instrument opens a broad field of new possibilities when analyzing isolation defects even with large noise.
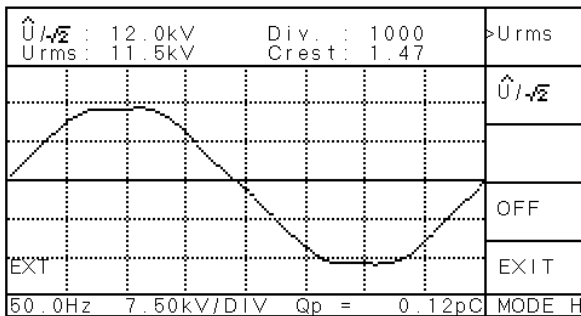
The SPEC mode shows the frequency spectrum of the input signal with a selectable span of up to 10 MHz. Three spectrum traces of the current input channel can be stored, compared, and analyzed. A variable cursor serves to set the center frequency for the PD pattern acquisition

b) Cable Fault Location

This option allows sampling PD pulses and its reflections running over HV cables for cable fault location. The sample rate of this DSO function is 100 MSamples and gives a resolution of 10 ns. An additional display with cursor settings and zoom functions helps to localize faults directly on-site. Advanced software gives more possibilities for evaluation and precise fault location using a PC or laptop.

c) Voltage Measurement

This enhanced board extension makes the acquisition of the voltage shape available. A 16-bit A/D converter samples about 200 values per cycle with polarity. An additional display shows this voltage shape and the calculated values for rms and peak. This feature allows to record PD and voltage values by software, i. e. for acceptance testing or quality tests.

```
Û/√2 : 12.0kV     Div. : 1000    >Urms
Urms : 11.5kV     Crest: 1.47
                                  Û/√2


                                  OFF
EXT
                                  EXIT
50.0Hz   7.50kV/DIV   Qp =   0.12pC  MODE H
```

d) Analog Gating

This is a optional function for noise cancellation. The firmware is extended by a new submenu to adjust the gating parameters.

e) 4-channel Multiplexer

For testing three-phase equipment, such as power transformers. The channel multiplexer allows a manual switching between four different PD sources. For each channel the unit maintains an individual setup and calibration.

f) 12-channel Multiplexer

This option offers a built-in 12-channel multiplexer or a remote 12-channel switching box for acceptance testing on large power transformers. For each channel the unit maintains an individual setup and calibration.

g) Auxiliary Inputs

For long-term testing four additional inputs can be used to record extra signals like power, temperature, pressure etc. Input levels of either 4–20 mA or 0–10 V are available.

h) RIV Measurement

This option adds a radio influence voltage measurement function to the instrument (needs the spectrum analysis option and includes the 4-channel multiplexer option).

i) LAN Module

To connect the ICM*compact* to the Intranet, the instrument is equipped with a RJ45 LAN connection for 10baseT twisted-pair cabling or a WLAN antenna, alternatively. The ICM*compact* comes with a preconfigured IP address.
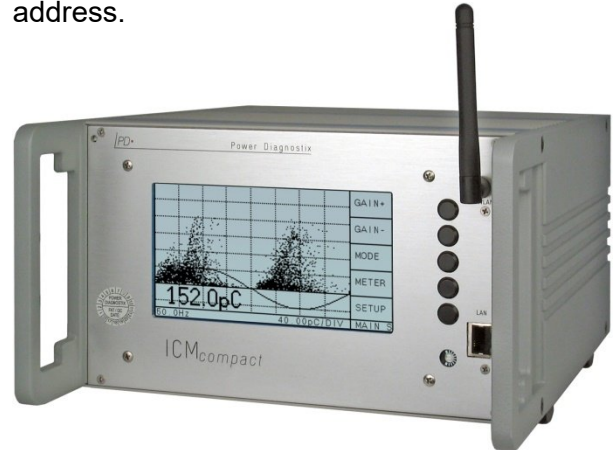
ICM*compact* with WLAN antenna

j) Additional Setups

If the instrument is frequently used at different places, the optional function STP12 can store up to 12 different setups. Three extra buttons are added to the front panel to swap between the different setups.
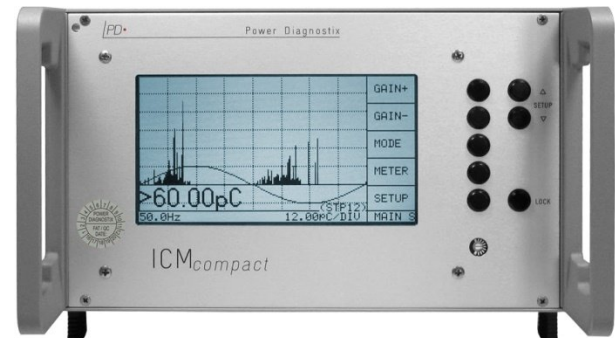
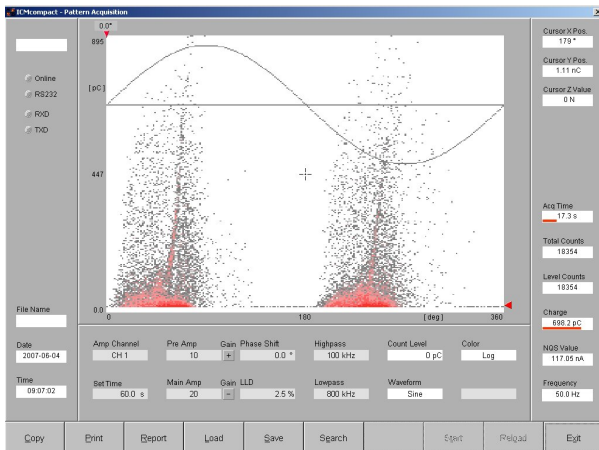
ICM*compact* with additional setups

k) Modem

A built-in modem allows communication with the instrument via analog telephone line.

l) Battery Operation

A built-in battery pack offers three hours of cordless operation. The battery will be charged, when the instrument is powered by electricity,

Available Software

The instrument can be connected to a PC or laptop by serial interface. The upper picture shows the standard software to read out the display contents and to record data like PD peak values or voltage. The next picture shows the advanced software panel for cable fault location.
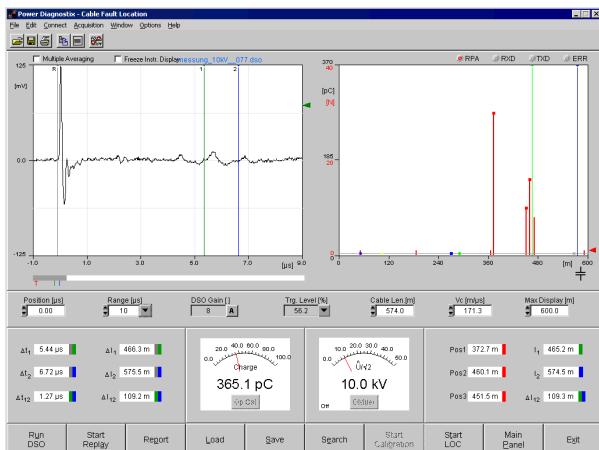
To integrate the ICM*compact* into a full test environment it is possible to use the HV*pilot* software. This software reads out data from different instruments and runs high voltage step tests automatically.
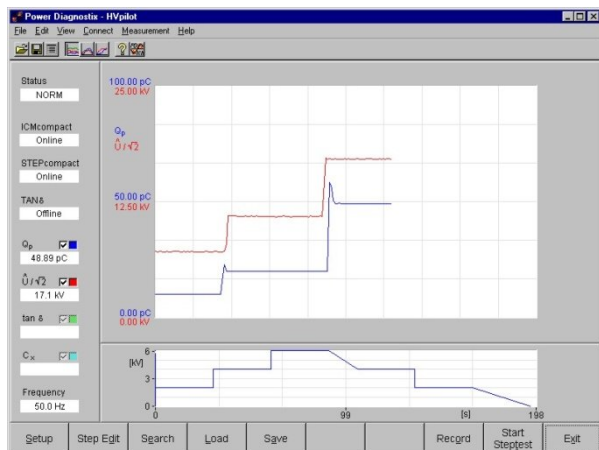
Technical Data

Mains supply:	90–264 V_{AC}, 47–440 Hz (automatic)
Line fuse:	1.6 A (time-lag)
Power requirements:	Approx. 40 VA
Battery (optional):	3 hours continuous operations
Display:	Backlit LCD
Display size:	120 mm x 64 mm
Display resolution:	128 x 240 pixels b/w
Operation:	5 menu supported pushbuttons
	5 fix function pushbuttons with multi-channel version
	or remote controlled via software
Recorder output:	0–10 V with R_O=100 Ω (re-converted analog value of the meter reading)
Operation temperature:	10–40 °C (non-condensing)
Input impedance:	50 Ω ‖ 50 pF (AMP IN)
A/D converter (PD):	8 bit (unipolar) / ±7 bit (bipolar)
Size: (W x H x D)	236 x 133 x 300 mm³ (desktop model, exclusive BNC-connectors)
	305 x 144 x 270 mm³ (Explorer case, closed)
	305 x 360 x 270 mm³ (Explorer case, open)
	482.5 x 133 x 345/310 mm³ (19" rack mountable version)
Weight:	~ 4 kg (½ 19" model)
	~ 4.4 kg (Explorer case)

Standard PD Mode

Lower cut-off (-6 dB):	40, 80, or 100 kHz (software controlled)
Upper cut-off (-6 dB):	250, 600, or 800 kHz (software controlled)
Input sensitivity:	< 500 µV$_{rms}$ / 5 pC (without preamplifier)
Gain range:	1, 2, 4, 8, 10, 20 …, 200, 400, 800

Preamplifier

Input impedance:

RPA1/RPA1D:	10 kΩ ‖ 50 pF
RPA1L/RPA1H:	1 kΩ ‖ 50 pF
RPA2 / RPA3:	50 Ω ‖ 50 pF

Input sensitivity:

RPA1/RPA1D:	< 50 μV_{rms}/0.03 pC
RPA1L:	< 15 μV_{rms} /0.02 pC
RPA1H:	< 40 μV_{rms}/0.05 pC
RPA2:	< 800 μV_{rms}/1 pC
RPA3:	< 2 μV_{rms}

Bandwidth:

RPA1/RPA1D:	40–800 kHz
RPA1L/RPA1H:	40 kHz–20 MHz
RPA2:	2–20 MHz
RPA3:	200 MHz–1 GHz

Synchronization / HVM

Sync. Frequency:	6–505 Hz / VLF (0.02/0.05/0.1 Hz)
Maximum voltage:	200 V_{peak} (140 V_{rms}), 100 V_{rms} nom.
Input impedance:	10 MΩ
A/D converter:	$\pm$15 bit
Precision:	Typ. < 1.5 %

Spectrum Function

Input sensitivity:	< 5 μV_{rms} / 0.5 pC (270 kHz bandwidth) < 1 μV_{rms} / 2 pC (9 kHz bandwidth)
Max. input voltage:	120 mV_{rms} (270 kHz bandwidth) 5 mV_{rms} (9 kHz bandwidth) 2.5 mV_{rms} (RIV)
Frequency range:	10 kHz–10 MHz (in steps of 10 kHz)
Bandwidth:	9 kHz or 270 kHz
Precision:	Typ. < 5%

Cable Fault Location (CFL)

Trigger:	0 to 100 % of input signal step width in 3.125 %
A/D Converter:	$\pm$ 7 bit
Samples:	100 MSamples/s (T_{sample} = 10 ns)
Reduced sample rates:	50 MS, 25 MS
Displayed time window:	200 ... 8000 Samples (2 ... 80 μs @ 100 MS / 8 … 320 μs @ 25 MS)
Specimen cable length:	10 to 5000 m, for 80 µs & v_c=140 m/µs

(CFL at cables > 5000 m not possible because of pulse attenuation)

Localization precision:	1 m + 0.1 % of cable length

Available Communication Interfaces

USB 2.0
Bluetooth
Fiber optic serial link
LAN
RS232 (57.6 kBit/s)

Back of ICM*compact* with MUX4 option, RS232, and RIV measurement

Product information and design are subject to changes without notice.

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