CMS 7000

Procom

DIGITAL
INSTRUMENTATION
DEVICES

The ultimate in power network supervision

Digital three-phase instrumentation devices with communications capability CMS 7000

PROCOM

The optimum operation of an electrical network depends particularly on the reliability and the avaibility of the protection, measuring and automation devices, and the manner in which these devices can communicate the information in their possession.
PROCOM, CEE's new modular system, satisfies these criteria by providing the possibility of using either separately or in an integrated system all of the intelligent functions of an electrical cubicle:
Protection, Measurement, Automation, Communication.
CEE's exceptional experience in the field of network protection using static relays (more than 400,000 units in operation throughout the world) enabled our engineers to define, develop and manufacture PROCOM to the standards of quality and concepts of technical innovation which have been the foundation of CEE's reputation over the past 30 years...

Principles and applications of the CMS 7000

Devices in the CMS 7000 series perform the "measurement" functions of the PROCOM system. Installed in the control room or directly on an electrical cubicle, their task is to measure or calculate approximately 90 electrical quantities relevant to the rational operation of a three-phase energy network.
Two models are available in the range, depending on the number of VTs which are used:
. CMS 7004 when the three phase-to-neutral voltages are accessible.
. CMS 7003 when two of the three phase-to-phase voltages are accessible.
Using digital microprocessor technology, the CMS 7000 operate on the principle of sampling the input signals, voltage and current, in order to calculate their harmonic spectra up to the 7th harmonic, employing a Fast Fourier Transform (FFT).
These powerful measuring principles and methods can provide an appreciation of the "pollution" of an electrical network, and enable the true "rms" value of any quantity, whether fundamental, harmonic or global, to be calculated.
All of the electrical quantities measured or calculated by the CMS 7000 are defined in Table 1.
The cases of the CMS 7000 provide three main series of advantages as follows:

– Reliability and availability
The design and construction of equipment in the CMS 7000 series respects the same standards of reliability and safety used by CEE for the manufacture of conventional static protection devices:
. conforming to the recommendations and standards of IEC 255,
. mechanical, fool-proof fouling pins on cases and bases,
. debugging and individual testing of certain critical components,
. component selection as a function not only of the thermal withstand but also of the withstand to overvoltages, etc...
. withstand to severe environmental conditions: heat/humidity - 56 days, 40°C, 93% relative humidity.
In addition to these basic construction details, the CMS 7000 devices incorporate an automatic self-supervision system which, together with the plug-in case facility, optimises their availability.
The automatic self-supervision system intervenes at three different levels :
detection of loss of auxiliary supply,
. detection of a microprocessor failure using a "watchdog",
. detection of a breakdown of a microprocessor periferal (such as RAM, EEPROM, etc.) by executing microdiagnostic programs.
The user is warned of the operation of the automatic self-supervision system by the closure of a dry contact brought out to terminals and/or as required by the interruption of the digital communication channels.

– Adaptability and autonomy
As they are mounted in modular, plug-in, metallic cases type R, devices in the CMS 7000 series may be used either:
. as independent modules
. as modules integrated into a rack cradle incorporating conventional static relays in the 7000 series
. as modules integrated into a rack cradle as an element of the PROCOM structure.
This flexible presentation means that the CMS 7000 devices may be easily adapted to the user's real technical and economic requirements and can, for example, be inserted into existing schemes and installations.
The CMS 7000's autonomous and flexible nature is further reinforced by the fact that it can, without the use of special devices, be connected to a source of AC or DC auxiliary supply having a very wide range of tolerance (38 to 250V, or 20 to 66V).

– Power and flexibility of the communications
The CMS 7000 series communicates with the external world in four major ways:

. Local communication
Dialogue between the user and the equipment is ensured by means of a keyboard on the device itself, which may be used to set up and read back all of the quantities in memory, or those calculated or measured by the CMS 7000.
An easily readable LED display unit enables the user to have direct readout of the electrical quantities in true primary values.
Four programmable choices of readout are available to the user: 2 "fixed" modes for the readout of a parameter or an electrical quantity, and 2 "automatic rotation" modes for successive readout of 4 or 6 electrical quantities. Consulting the different data is performed using the CMS 7000 keyboard or remotely using a telecontrol which avoids the faceplate being removed by an operator not used to this procedure.

. Communication by digital channels

The CMS 7000 contains two digital serial communication channels of the RS-232-C/DB 25 or current loop (0 - 20 mA). The choice is at the user's disgression, simply using a switch.

*The RS-232-C/DB 25 outlet can be used for direct connection (either by galvanomic connection or via fibre optics) to a PC (microcomputer).**

The current loop terminals (0 - 20mA) may be used to incorporate the unit into a communications network controlled by a PC or other device. All data available locally, whether measured or introduced as an input, may be transmitted to a remote location.*

. Communication by "all or nothing" channels

The CMS 7000 are fitted with electromagnetic output units to provide trip or load shedding, recording or alarm signals :

— trip or load shedding: an electromagnetic output unit with a dry contact can provide a trip or load-shedding signal if a set-level (programmed by the user) of mean "rms" current I or active power P is exceeded.

** Please consult us.*

— remote recording : active energy in MWh may be recorded remotely using a relay which produces pulses at a rhythm defined in the "GENERAL CHARACTERISTICS" section.

— local recording: by pressing on the "TRACE" key or by closing an external contact, it is possible to "freeze" all 6 usual electrical quantities (mean "rms" current and voltage I and V, active power P, reactive power Q, power factor cos ø, and frequency f, over a three second period around an event (2 seconds before and 1 second after). All of these quantities may subsequently be transferred to the digital communication channels.

— alarm: the closure of a dry contact available to the user gives an indication of the operation of the automatic self-supervision system.

. Communication by analogue channels

Two digital/analogue transducers (4 - 20mA current sources) with programmable outputs enable 2 of the 6 usual electrical quantities already mentioned above under "local recording" to be reproduced remotely in an analogue form.

Operation

Example of simplified operation and connection diagram

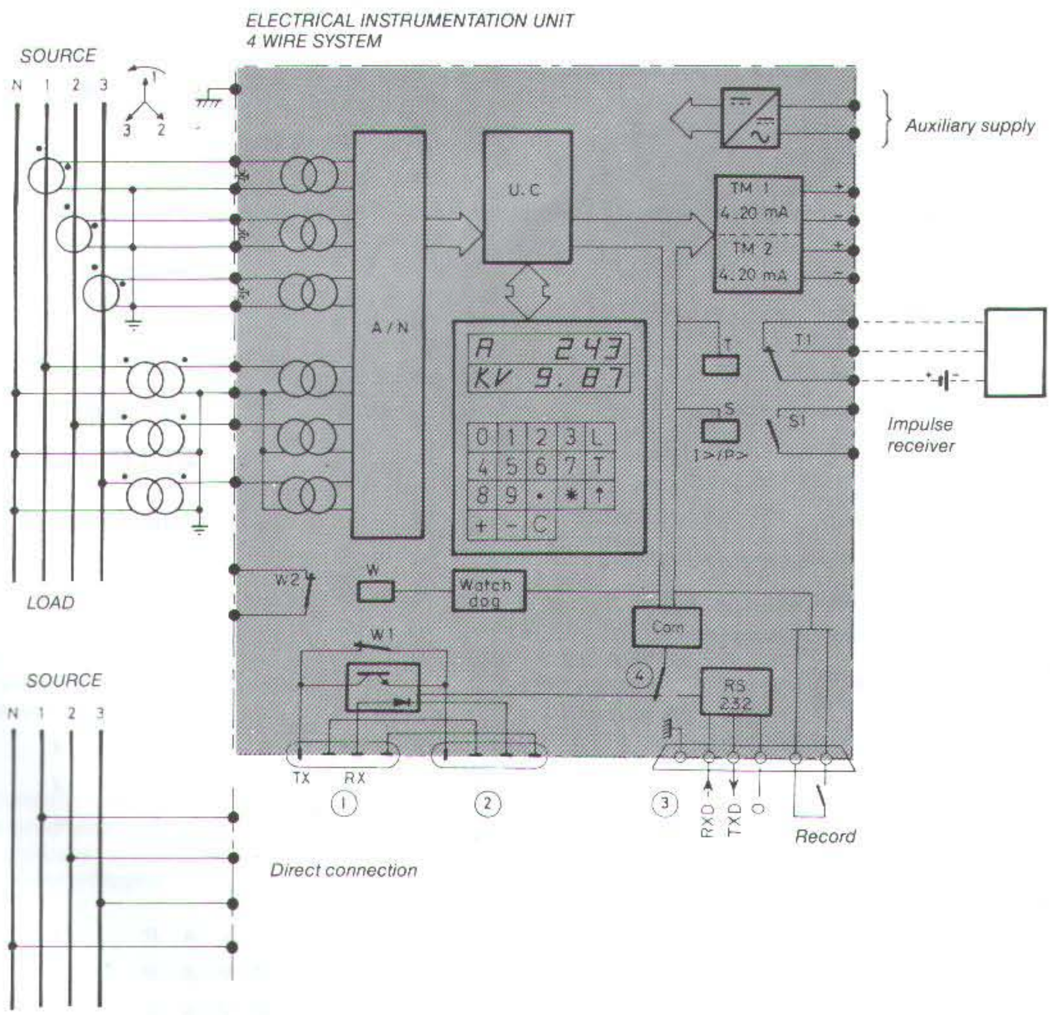


Fig. 1 - CMS 7004

Calculated electrical quantities - Chart 1

		Display symbols	CMS 7003	CMS 7004
1. Voltages : key U				
– Mean : $\frac{\lvert\vec{U}_{12}\rvert+\lvert\vec{U}_{23}\rvert+\lvert\vec{U}_{31}\rvert}{3}$		U M E A N k V	X	X
– Ph-N "rms" V_1, V_2, V_3		V – k V	X	X
– Ph-Ph "rms" U_{13}, U_{23}, U_{31}		U – – k V	X	X
– Harmonics from H1 (fundamental) to H7 :		V – H – k V	on Ph-Ph	on Ph-N
on each phase	ou	U – – H – k V	voltages	voltages
– Symmetrical components:				
positive		V P O S k V	X	X
negative		V N E G k V	X	X
zero		V Z E R k V	NO	X
2. Currents : key I				
– Mean : $\frac{\lvert\vec{I}_1\rvert+\lvert\vec{I}_2\rvert+\lvert\vec{I}_3\rvert}{3}$		I M E A N A	X	X
– Integrated demand on mean "rms" current (note 2)		< I > A	X	X
– Maximum integrated demand		< I > A	X	X
(permanently registered every 12 hours)		M X		
– "rms" line currents I1, I2, I3		I – A	X	X
– Harmonics from H1 (fundamental) to H7 on each phase		I – H – A	X	X
– Symmetrical components				
positive		I P O S A	X	X
negative		I N E G A	X	X
zero		I Z E R A	optional	X
3. Power factor : key cos ø				
– of the fundamental per phase		C O S P H –	NO	X
– of the harmonics per phase (balanced)		K –	NO	X
– of the fundamental three-phase (unbalanced)		C O S P H I	X	X
4. Active power : key P				
– total "rms" three-phase		P M W	X	X
– integrated demand of total three-phase power (note 2)		< P > M W	X	X
– Maximum integrated demand		< P > M W	X	X
(permanently registered every 12 hours)		M X		
– of the fundamental three-phase		P H 1 M W	X	X
– symmetrical components				
positive		P P O S M W	X	X
negative		P N E G M W	X	X
zero		P Z E R M W	NO	X
5. Reactive power : key Q				
– total "rms" three-phase		Q M V A R	X	X
– integrated demand of total three-phase power (note 2)		< Q > M V A R	X	X
– maximum integrated demand		< Q > M V A R	X	X
(permanently registered every 12 hours)		M X		

Calculated electrical quantities continued)

	Display symbols	CMS 7003	CMS 7004
– of the fundamental three-phase	Q H 1 M V A R	X	X
– symmetrical components			
positive	Q P M V A R	X	X
negative	Q N M V A R	X	X
zero	Q Z M V A R	NO	X
6. Apparent power : key S			
– total "rms" three-phase	S M V A	X	X
– integrated demand of total three-phase power (note 2)	< S > M V A	X	X
– maximum integrated demand	< S > M V A	X	X
(permanently registered every 12 hours)	M X		
– "deforming" power per phase	P D - M V A	NO	X
7. Energy : key Energ.			
– flow of active power in normal direction *	M W H +	X	X
– flow of active power in reverse direction *	M W H –	X	X
– flow of reactive power in normal direction *	M V A R H +	X	X
– flow of reactive power in reverse direction *	M V A R H –	X	X
* permanently registered every 12 hours.			
8. Frequency : key F	F H z	X	X

Note 1 : X = available on the device

Note 2 : the period of integration, common to all of the electrical quantities, is adjustable from 5 to 60 min in steps of 1 min.

General characteristics

1. Input quantities

• Frequency		
– nominal frequency FN	50 / 60 Hz	
– operating range	40 - 70 Hz	
• Voltages		
– nominal Ph-N voltage VN	$100/\sqrt{3}$ - $110/\sqrt{3}$ - 220VAC	CMS 7004
– nominal Ph-Ph voltage UN	100 - 110 - 380 VAC	CMS 7003
– nominal operating range	0.5 to 1.5 VN/UN	
– permanent withstand	1.5 VN/UN	
– short-time thermal withstand	2 VN/UN for 10s	
– burden	< 0.3 VA per phase at VN/UN	
• Currents		
– nominal current IN	1 A or 5 A	
– nominal operating range	0 to 1.5 IN	
– permanent withstand	2 IN	
– short-time thermal withstand	80 IN for 1s - 20 IN for 3s	
– burden	< 0.3 VA per phase at IN	
• Auxiliary supply		
– ranges	20 to 66 Vdc 38 to 250 Vdc or Vac 50/60 Hz	
– burden	~ 11 W DC ~ 18 VA AC	

General characteristics (continued)

2. Output quantities

• Analogue outputs TM1 and TM2

– output current Is	4 to 20 mA
– output load	0 to 1 kΩ
– influence of load resistance	< 0.1 %
– maximum output voltage	~ 27 V
– peak-to-peak ripple at 20 mA / 1 kΩ	< 0.25 %
– quantities which may be transmitted via TM1 and TM2	I MEAN, U MEAN, P, Q, COS Ø, F and S
– correspondance between quantities and output current Is	

Is		+ 4 mA	+ 12 mA	+ 20 mA	Precision class index
I MEAN		0	0.75 IN	1.5 IN	0.5
V MEAN		0	0.75 IN	1.5 IN	0.5
P		– 1.25 PN	0	+ 1.25 PN	1
Q		– 1.25 QN	0	+ 1.25 QN	1
S		0	0.75 SN	1.5 SN	1
COS PHI		0 —— CAP +	—— 1 ——	IND + —— 0	0.5
F	FN = 50 Hz	40 Hz	50 Hz	60 Hz	0.5
F	FN = 60 Hz	50 Hz	60 Hz	70 Hz	0.5

• Tripping or load-shedding level

– quantities which may be used for this level	I MEAN, P+, P–
– operating time	500 to 800 ms
– adjustment range	1 to 120 % of nominal
– drop-out level	97% of pick-up
– precision class index	0.5% of nominal. or 10% of setting
contact characteristic	1 NO (see watchdog alarm relay)

• Watchdog alarm relay

– relay is normally picked up in a quiescent state, dropping off for an anbnormal condition.

– contact characteristics	1 NC
maximum voltage	600 V
max permanent current	5 A
closing current (0.2 s)	10 A
breaking current	
. dc (L/R = 40 ms)	50 W (1A/48VDC - 0.5A/110 VDC)
. ac (cos φ = 0.4)	1250 VA; I < 3 A

• Pulse relay: MWh transmission

– output contacts	1 changeover
– contact operating capacity	100V/0.1 A DC max.
– pulse width	120 ms
– correspondance between nominal apparent power and KWh / pulse	

SN	KWh / pulse
100 KVA to 1 MVA	1
1 MVA to 10 MVA	10
10 MVA to 100 MVA	100

3. Digital communication

– Support	2 switchable channels, each with its own outputs: – current loop 0-20 mA – DB 25 / RS 232 C
– Information exchange protocol	Master / slave, as required J.BUS or other standard.
– Operating speed	1200-2400-4800 baud (programmable)

4. Nominal ranges of incluencing factors

– temperature	– 10°C to + 55°C
– auxiliary supply	20 to 66 VDC 38 to 250 VDC or AC 50/60 Hz

5. Measurement

• Voltages

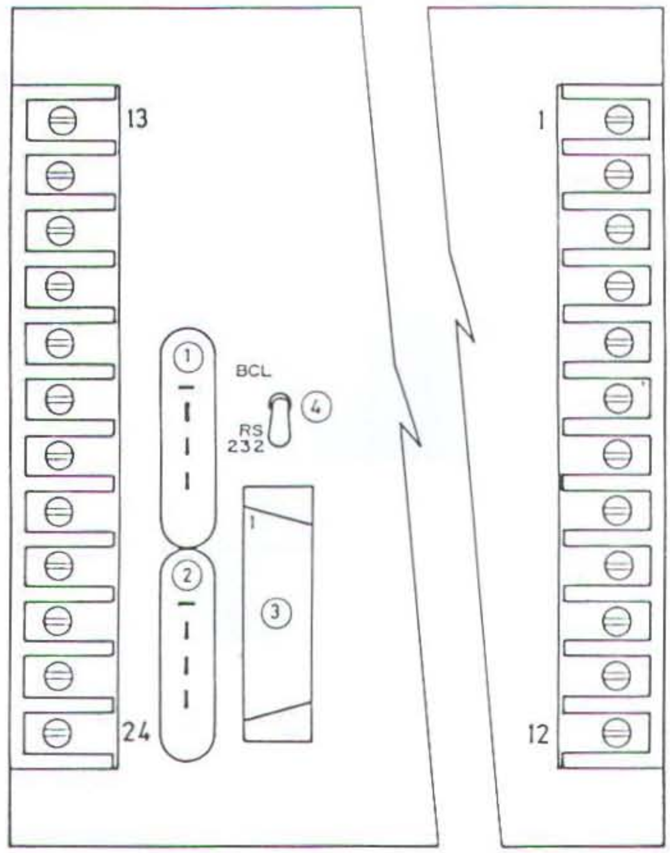
– nominal primary value	VN/UN: adjustable 0.100 kV to 1000 kV
– resolution (of adjustments and settings)	1 V from 0.100 kV to 10 kV 10 V from 10 kV to 100 kV 100 V from 100 kV to 1000 kV
–precision class index	0.5 (on measured voltages)

• Currents

– nominal primary value	IN = adjustable from 10A to 100 KA
– resolution (of adjustments and settings)	1A from 10A to 10 KA 10A from 10 KA to 100 KA
– precision class index	0.5
– permanent register of max	every 12 hours

General characteristics (continued)

• **Power factors**	
– measured range	4 quadrants (2 quadrants for analogue transducers)
– resolution	0.01
– precision class index	1
• **Power** P - Q - S	
– measured range	100 K * to 100 M *
– resolution	0.1 k* from 100 K* to 1 M* 1 k* from 1 M* to 10 M* 10 k* de 10 M* à 100 M* * W or VAR or VA
– extent of measurement	0 to (1.5 UN) × (1.5 IN) × 3
– precision class index	1
– permanent register of max	every 12 hours
• **Energy**	
– maximum values stored	1 KWh/pulse: 10^8 KWh 10 KWh/pulse: 10^9 KWh 100 KWh/pulse: 10^{10} KWh
– precision class index	1
– permanent register	every 12 hours
• **Frequency**	
– measured range	40 to 70 Hz for 0.6 UN $<$ U $<$ 1.5 UN
– resolution	0.01 Hz
– precision class index	0.3
6. Relative variations within the following ranges:	
• temperature	−10°C to + 55°C
• auxiliary supply	within guaranteed range
– on readings	<0.5 %
– on analogue transducers	< 0.02 % per 1°C
– on telemetering	< 0.5 %
– on operating level	< 0.5 % of nominal
7. Insulation (to CEI 255-5)	
– dielectric withstand	2 KV for 1 min. DB 25/RS 232 C output: 500 V for 1 min.
– impulse voltage withstand (except DB 25 / RS-232-C output)	
. common mode	5 Kv peak, 1.2/50 µs
. differential mode	5 Kv peak, 1.2/50 µs
– insulation resistance at 500 V	> 10.000 MΩ
8. High frequency disturbance withstand (to CEI 255-22-1) except the DB 25/RS-232-C socket	
. common mode	2.5 Kv 1 MHz class III
. differential mode	1 Kv, 1 MHz class III
9. Recommended transformers	
– measuring CT	5 or 10 VA precision class 0.5 %
– measuring VT	5 or 10 VA precision class 0.5 %
Note : the CMS 7003 and 7004 may be used on protection class CTs (withstand is 80In, 1 sec), and the measuring accuracy will be dependent upon the precision class index of the CTs.	
10. Case	
– type	R4
11. Identifying drawings	
– CMS 7003	05 A2
– CMS 7004	03 A7
12. Weight	approx. 4.2 kg
13. Associated remote control unit TLC 7000 (in option)	05A6



Rear view

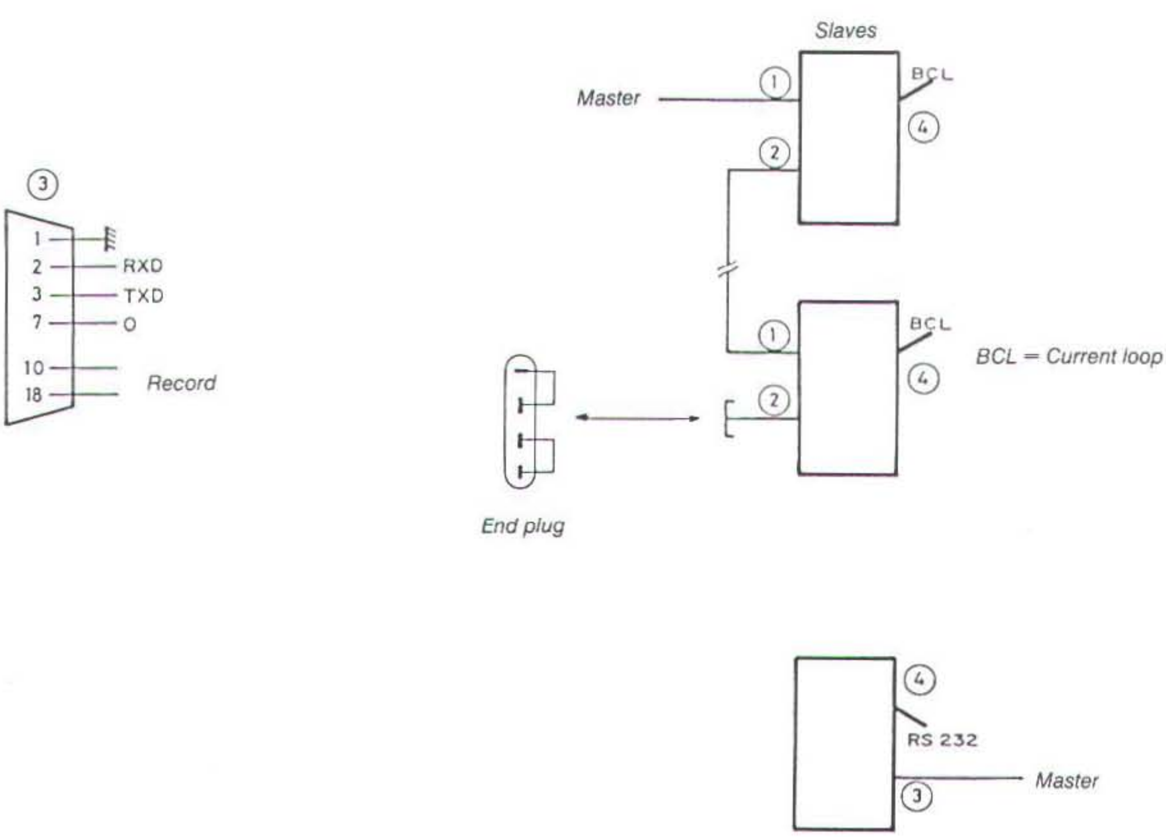
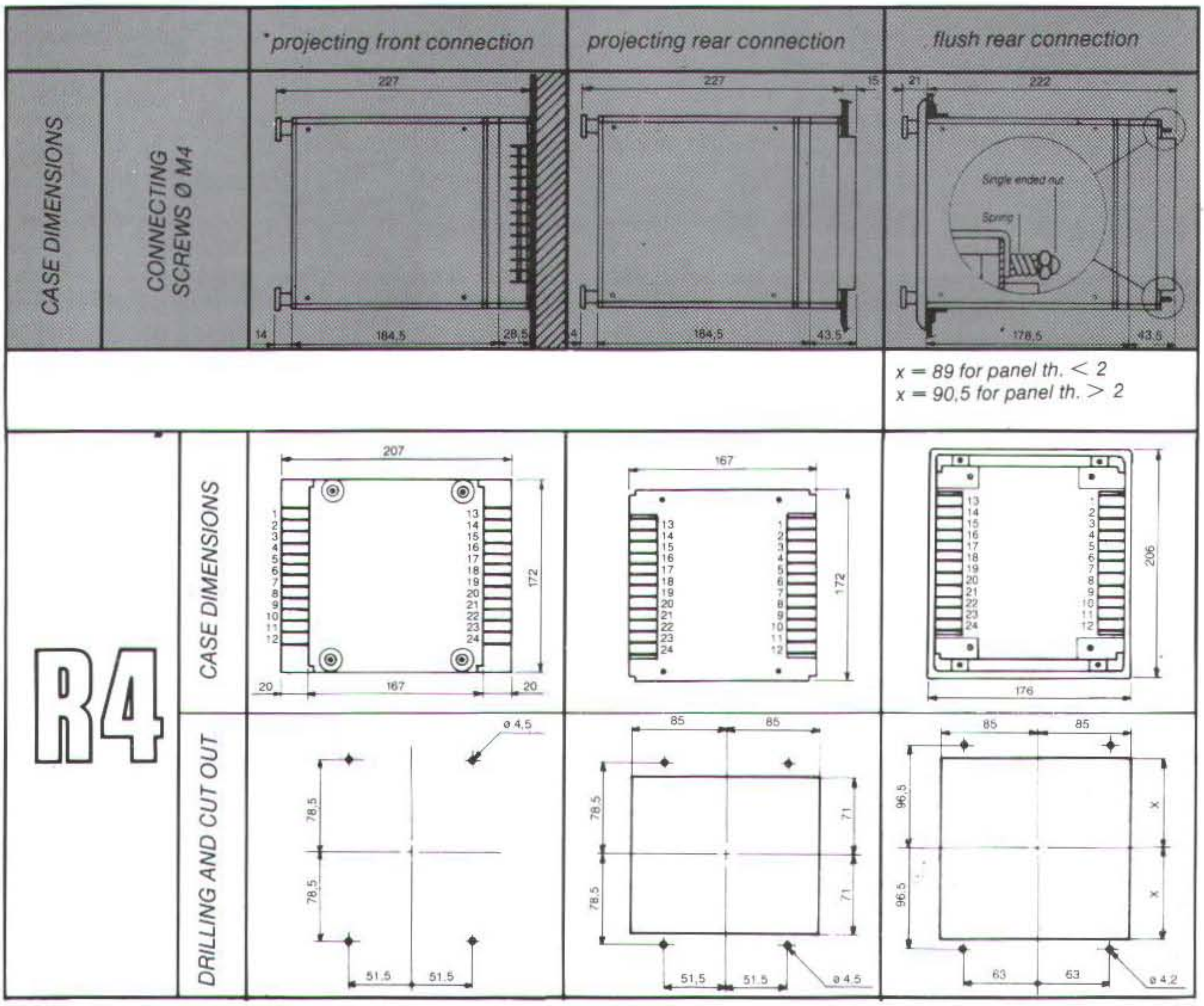


Fig. 2 - Communication network wiring diagram

Case type R4



* Only without communication

Set of 3 PROCOM cases mounted in 19" RACK with microcomputer connection.

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