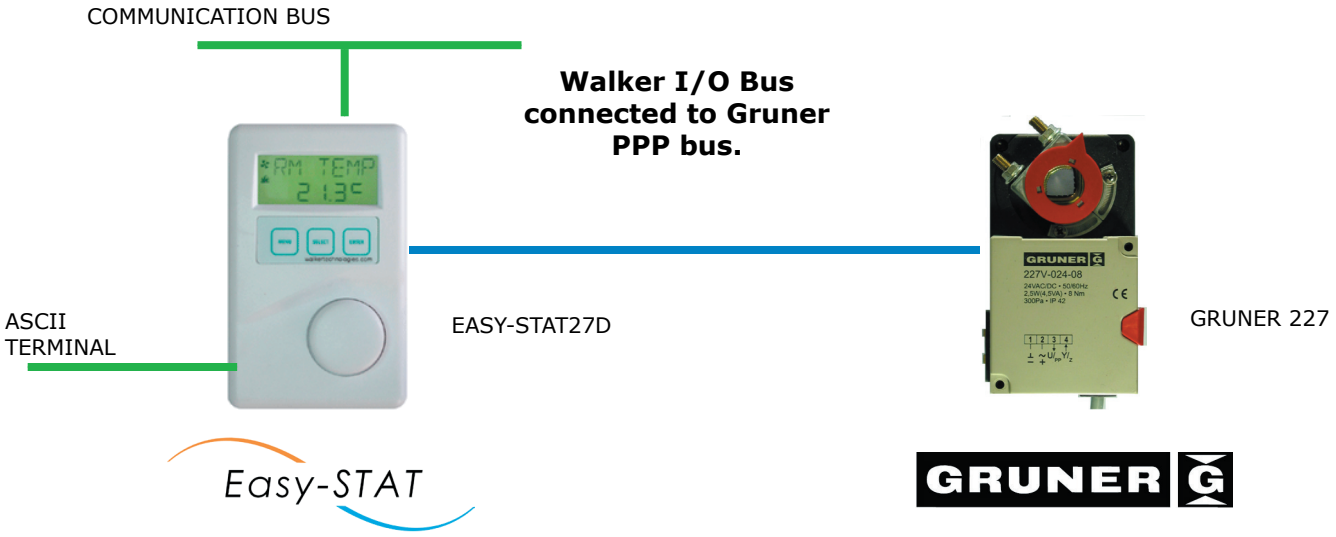
Easy-VAV
Operator's Manual

EASY-STAT
and
GRUNER FLOW CONTROLLER
for
VAV CONTROL

Intelligent Stand Alone/
Communicating VAV Controller



OPERATING VOLTAGE
- 24Vac (18Vac to 30Vac).
- Digital outputs – 20ma contact closure to ground.
- Analog outputs – 0 or 2 to 10Vdc @ 20ma.
- Output drive for 24/120/240 Volts through external relay board.

SIGNAL INPUTS
- 0 to 5Vdc with 3.0K 1% pull up.
- PP Bus from 227V.

INTERNAL SENSOR
- 3K thermistor (+/- 0.2C, +/- 0.36F).

COMMUNICATION
- Jumper selectable Walker I/O BUS or RS232
- MS/TP BACnet
- RS485 and I/O BUS available on the back of connector
- RS232 connector on the bottom of stat
- Connector at the bottom of stat allows for calibration of the Gruner 227V.

SETUP & CALCULATIONS

PREAMBLE

This discussion focuses on the setup and operation of Easy-STAT when tied to a Gruner flow controller. A prior knowledge of Easy-STAT operation is required.
Once the flow controller is connected to the Easy-STAT, the terminal display looks like figure 1. The items marked in BLUE are user Eprom presets that can be made via the download, or keypad, or terminal entry. It should be noted that the information available in this discussion is for initial product setup and evaluation and is more than would normally be presented or required by a vendor. Reference documents and specifications on the Gruner motor and sensor are available from Walker.

FLOW MEASUREMENT AND "BOX FACTOR"

The Gruner flow sensor measures flow automatically and returns it to the Easy-STAT as a number 0 to 4063 in proportion of the flow that would result in 300pa or 1.204 inWC pressure differential at its flow pickup. By entering this maximum flow value in the Easy-STAT, the flow pickup is calibrated for the flow units used. The value of 300pa is a fairly common maximum pressure for a flow pickup device. For the Gruner sensor, returned values higher that 4063, indicate out of range pressures at the sensor pickup and are not accurate. For the flow equation,
$V_{(flow)} = C_{(factor)} * (\Delta P_{(sensor\ pressure)}/p_{(air\ density)})^{1/2}$, the Gruner motor does the square root extraction internally so that the output is proportional to the square root of the pressure change.
For the example shown on page 3, a Velocity Wing Air flow sensor made by Anemostat was used. It was determined from the flow sensor data that for a 6" duct, a flow of 832.5m^3/hr or 490cfm relates to this maximum pressure of 300pa.

USER DATA

To properly set up the Easy-STAT and Gruner flow controller, the user must enter the following 4 items (usually specified by the engineer).

These objects are defined as follows:

FSENSOR Sensor flow. This is the flow value equivalent of the maximum sensor pressure of 300pa or 1.204 in WC. It is used to correctly scale the flow data returned from the sensor.

FLOWMIN Minimum flow. This is the minimum flow required in the zone specified by the engineer.

FLOWMA Maximum flow. This is the maximum flow required in the zone specified by the engineer.

FDESIGN Design flow. This is the zone design flow and is used by Easy-Stat to normalize the motor operation over the intended range. It equals to 120% of **FLOWMAX**

The Easy-STAT uses the design flow **"FDESIGN"** to tell the Gruner controller where the normal operating range of the flow control will be. The Easy-STAT then supplies the flow set point to the flow controller as a value proportional to this. The Easy-STAT converts the 0 to 100% controller output to a range between the **"FLOWMIN"** and **"FLOWMAX"** flow values and passes them to the motor as a flow set point.
(Note: The Easy-STAT treats all values as dimensionless so that any flow units can be used.)

CALCULATIONS AND MOTOR COMMUNICATIONS

To normalize the operation of the flow controller over the range desired, the Easy-STAT passes it a value corresponding to the ratio of the design flow **"FDESIGN"** to the maximum sensor flow (**"FSENSOR"+"FADJUST"**).
Here **"FADJUST"** is the correction factor calculated as a result of balancing. The Easy-STAT shows this value, **"FNOMINL"** = **"FDESIGN"/("FSENSOR"+"FADJUST")** X 100% .
For the Gruner motor, inputs must be normalized to 255, so this value is input to the motor by Easy-STAT as **"NOM_VAL"** = (**"FNOMINL"**/100) X 255**.**

BALANCING PROCEDURE

To balance the VAV box where required (as in North America), the balancer sets up a flow of interest to him. For example, he can use the **"MSTATUS"** object to set the flow output to **"FLOWMAX"**. Once this is done he sets the **"BALANCE"** variable to "ON" which puts the Easy-STAT in balance mode, then changes the value of **"FBALNCE"** to get the actual flow reading desired. During balance mode, the Easy-STAT back-calculates the flow reading to get an adjustment value **"FADJUST"** as follows:

"FADJUST" = **"FBALNCE"** * 4063/**"RAWFLOW"** - **"FSENSOR"**

This value us then added to **"FSENSOR"** during normal operation

CONTROLLER OPERATION

The controller operates using a Proportional/Integral strategy that has a controller output **"CTLR"** that goes from 50% to 100% for cooling, and 50% to 0% for heating. Many options are available for driving additional outputs and this is described in the Easy-STAT controller manual.

CONTROLLER OUTPUT AND "FSETPNT"

The output of the controller is converted so that the 50% to 100% output for cooling is converted to flow between **"FLOWMIN"** and **"FLOWMAX"**. This value must be presented to the motor in terms of **"NOM_VAL"** so:
SETPOINT(cfm) = (**"CTLR"** - 50.0)*2/100*(**"FLOWMAX"**-**"FLOWMIN"**)+**"FLOWMIN"**
"FSETPNT" =SETPOINT(cfm)/**FDESIGN** * 255

FLOW READING

For the flow output **"RAWFLOW"**, the flow controller returns a number between 0 and 4063 for the flow between 0 and "FSENSOR". To convert this to cfm flow **"FLOWVAL"**, the following calculation is used:
"FLOWVAL" = (**"FSENSOR"**+**"FADJUST"**) * **"RAWFLOW"** / 4063.

SUPERVISORY CONTROL

All points shown in the example can be set for display or control by a supervisory system. Information on this is in the Easy-STAT and Walker product manuals.

MOTOR BACKUP

Both the Easy-STAT and the flow controller are set to store the relevant control parameters such as factor, design flow and min and max. When either device is replaced, it can be set to pick up the values from the other device.

SCREEN CAPTURE & OBJECT LIST

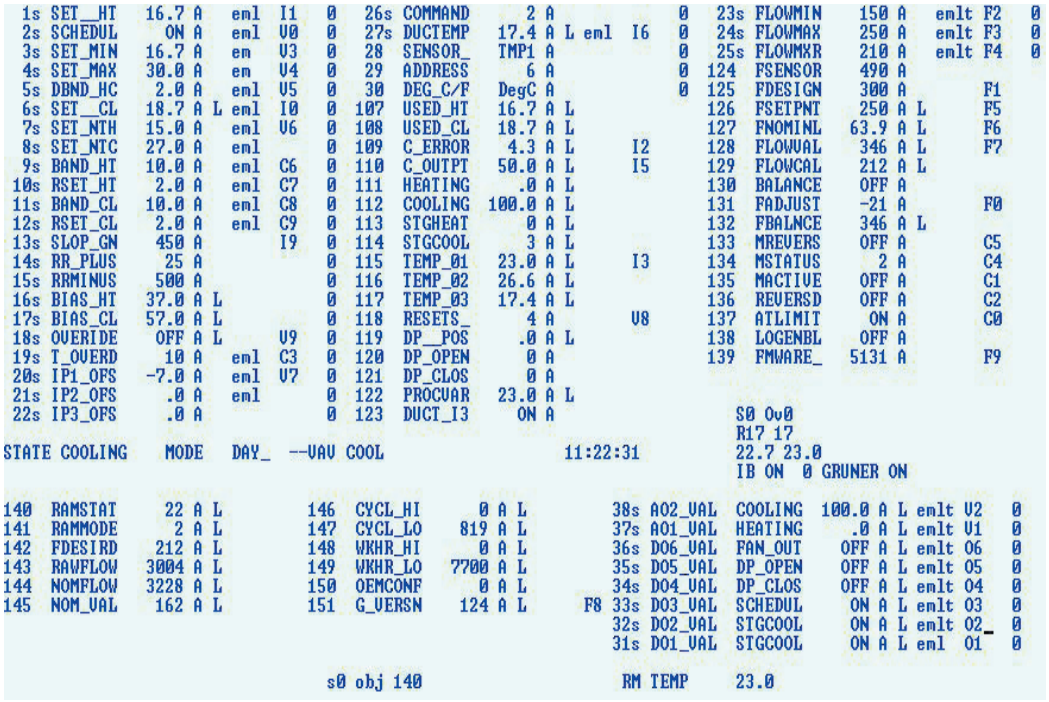


FIGURE 1. Terminal capture from Version 3131

EASY-STAT CONTROLLER VARIABLES

SET__HT Heating set point
SCHEDUL Current value of Schedule (On or Off)
SET_MIN Minimum heating setpoint
SET_MAX Maximum heating setpoint
DBND_HC Dead band between heat/cool setpoint
SET__CL Cooling set point
SET_NTH Night set point
SET_NTC Night cooling set point
BAND_HT Proportional band for heating
RSET_HT Reset for heating (integral) in mins/repeat
BAND_CL Proportional band for cooling
RSET_CL Reset for cooling (minutes/respeat)
SLOP_GN A temperature filter parameter
RR_PLUS A temperature filter parameter
RRMINUS A temperature filter parameter
BIAS_HT Bias for heating
BIAS_CL Bias for cooling
OVERIDE Override state
T_OVERD Override timer
IP1_OFS Scaling Factor for TEMP_01
IP2_OFS Scaling Factor for TEMP_02
IP3_OFS Scaling Factor for TEMP_03
COMMAND Determines VAV is doing HEAT or COOL. 0 TO 2, NON, HEAT, COOL
DUCTEMP Duct temperature, can be TEMP_03 or a preset value depending on DUCT_IP3
SENSOR_ Sensor used for PROCVAR -- 0-TEMP_01, 1-TEMP_02, or 2-AVGE
ADDRESS Address of Stat on IOBus
DEG_C/F 0-Deg.C, 1-Deg.F
USED_HT Used heating sepoint
USED_CL Used cooling setpoint
C_ERROR Error between PROCVAR and setpoint used
C_OUTPT Control value from -50 to 50 for heating and cooling
HEATING Heating control output
COOLING Cooling control output
STGHEAT Heating stage 0 to 3
STGCOOL Cooling stage 0 to 3
TEMP_01 Temperature converted from IP1 the internal sensor
TEMP_02 Temperature converted from IP2 the internal sensor
TEMP_03 Temperature converted from IP3 the internal sensor
RESETS_ Number of resets of the Stat
DP__POS Reheat actuator position
DP_OPEN Open command for reheat valve
DP_CLOS Close command for reheat valve
PROCVAR space temperature
DUCT_I3 1--duct temp is TEMP_03 ; 0--duct temp is preset value
FLOWMIN Minimum flow entered by operator (cfm)
FLOWMAX Maximum flow entered by operator (cfm)
FLOWMXR Reheat flow setpoint
FSENSOR Maximum sensor flow entered by operator (cfm)
FDESIGN Design flow as specified by design-- equals to 120% of FLOWMAX
FSETPNT Flow set point from Easy-STAT
FNOMINL Percentage FDESIGN/(FSENSOR+FADJUST)
FLOWVAL Measured flow calculated from RAWFLOW
FLOWCAL Flow setpoint normalized for motor command
BALANCE Off = normal mode, On = balancing mode
FADJUST Flow adjustment to FSENSOR from balancing
FBALNCE Flow setup value entered by balancer
MREVERS 0 = Motor normal, 1 = Motor reverse action
MSTATUS Motor control for balancing CLOSED, OPEN, AUTO, MAX and MIN.
MACTIVE 1-motor is runing
REVERSD read motor action. 1-- reversed
ATLIMIT On -- Motor is at limit stop
LOGENBL 1- terminal screen shows temperature filter log
FMWARE_ Walker Easy-STAT firmware version

FLOW CONTROLLER VARIABLES

RAMSTAT Motor status byte --- see Gruner documents.
RAMMODE Mode byte
FDESIRD Control value 0 to 255 for 0 to 100% flow setpoint command
RAWFLOW Flow output as a ratio of NOM_VAL
NOM_VAL Nominal or design flow as a ratio of FSENSOR
CYCL_HI number of control cycles high 16 bit
CYCL_LO number of control cycles low 16 bit
WKHR_HI working hours counter HIGH16 bit
WKHR_LO working hours counter LOW 16 bit
OEMCONF OEM konfig byte
G_VERSN Gruner motor firmware version

WALKER

STAND ALONE SYSTEM

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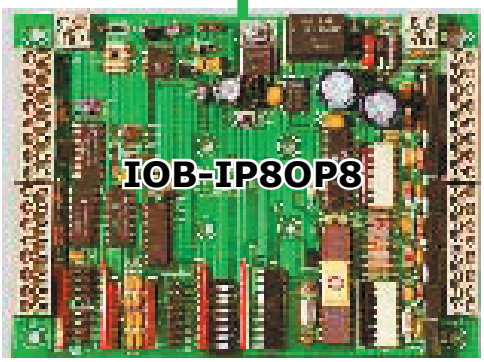
Direct or terminal access for control

PC, or LAPTOP or PALM PILOT

RS232

WALKER I/O BUS



Proportional control of fan system and economizer

Easy-VAV full setup and control for Gruner Flow Controller/Motors

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